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Part 1 of 5

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BEFORE THE ARIZONA CORPORATION COMMISSION

<u>COMMISSIONERS</u>

DOUG LITTLE – CHAIRMAN
BOB STUMP
BOB BURNS
ANDY TOBIN
TOM FORESE

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF THE VALUE AND COST OF DISTRIBUTED GENERATION.	))))	**DOCKET NO. E-00000J-14-0023**

Direct Testimony and Exhibits of

Michael T. O'Sheasy

on Behalf of

Arizona Investment Council

February 25, 2016

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I. INTRODUCTION AND PURPOSE

Q. Please state your name, business address, and occupation.

A. My name is Michael T. O'Sheasy. My business address is 5001 Kingswood Drive, Roswell, Georgia 30075. I am a Vice President with Laurits R. Christensen Associates, Inc.

Q. Briefly state your education, background, and experience.

A. I received a Bachelor of Industrial Engineering degree from the Georgia Institute of Technology in 1970. In 1974, I earned a Master's degree in Business Administration from Georgia State University. From 1971 to 1975, I was employed by the John W. Eshelman Company—Division of the Carnation Company as a plant superintendent in their Chamblee, Georgia operation. From 1975 to 1980, I worked for the John Harland Corporation, initially as an assistant plant manager and then as a plant manager in their Jacksonville, Florida plant, and finally as their plant manager in Miami, Florida. I joined Southern Company Services in 1980 as an engineering cost analyst and progressed through various positions to the position of supervisor, during which time I began serving as an expert witness in costing. In 1990, I became Manager of Product Design for Georgia Power Company and testified as an expert witness on rate design and pricing. I retired from Georgia Power Company on May 1, 2001 and became a consultant with Christensen Associates. In my current role, I serve as an expert witness and consultant on electric industry costing and pricing, and I manage related analytical work conducted by Christensen Associates Energy Consulting, an affiliate of Christensen Associates that focuses on the energy industry.

Q. On whose behalf are you testifying?

A. I am testifying on behalf of the Arizona Investment Council ("AIC").

Q. Have you testified previously before the Arizona Corporation Commission?

A. No, I have not. Exhibit MTO-1 identifies a number of dockets in various jurisdictions where I have testified regarding ratemaking, cost-of-service, and rate design.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to describe the appropriate costing and pricing methods for customers with renewable distributed generation ("DG"), specifically solar DG. I recommend against the use of a two-part rate design for solar DG customers. A two-part design includes a basic service charge to recover customer-related costs and energy charges to recover both energy-related and demand-related costs. Demand-related costs are caused by demand measured in kilowatts (kW). If demand-related costs are recovered through energy rates, the rate design will create prices that do not correspond to the way utility costs are incurred. Additionally, this can allow solar DG customers to shift their demand-related costs to other customers. I then explain why it is not appropriate to include "external" costs (i.e., costs that are not directly incurred by the utility in serving its customer, such as environmental costs associated with carbon dioxide emissions) or value-based pricing in regulated utility rates. Basing rates on the value of the service rather than its cost can lead to inappropriate customer incentives and cross-subsidies.

Q. How is your testimony organized?

A. Section II describes the established cost of service and rate design principles. Section III describes the ratemaking issues relevant for solar DG customers. Section IV describes rate design issues for solar DG customers.
Section V describes issues related to the Value of Solar ("VOS").
Section VI provides a summary of my recommendations.

II. ESTABLISHED COST OF SERVICE AND RATE DESIGN PRINCIPLES

Q. What is the purpose of this section of your testimony?

A. In this section I describe the ratemaking process for a regulated electric utility. It will serve as the foundation for the pricing of solar DG customers.

Q. What is the fundamental basis for ratemaking in the regulated electricity industry?

A. For more than 100 years, cost-of-service regulation has been the fundamental basis for setting rates for regulated electric utilities. In the late 19th Century, the United States Supreme Court held that certain economic activities were so important to modern society that the government must assert the right to oversee the prices charged to ensure that those services were provided to the public in a reasonable manner. The provision of electricity was considered one such activity, and, with some exceptions, power companies became subject to the oversight of public utility commissions. In attempt to ensure that the price of electricity appropriately balanced both customer and investor interests, a cost-of-service regulatory regime emerged – a system that allows customer rates to be based upon cost to serve and provides the utility the opportunity to recover its prudently incurred costs, including an opportunity to earn a reasonable, government-approved return. I shall refer in my testimony to this system as "ratemaking," comprised of two major activities: cost of service and rate design.

Q. Please describe generally how a "cost of service" analysis is performed.

A. Cost of service is, by nature, an objective, mathematical exercise. The "revenue requirement" is a key component of the cost of service, and is determined by the following formula:

(Rate Base x Allowed Rate of Return) + Expenses

The rate base is the net amount of investment, funded by investors, in utility plant and other assets devoted to the rendering of utility service. The rate of return is the percentage rate that the regulatory commission determines should be allowed on the rate base in order to cover the utility's cost of capital. Expenses include operation and maintenance costs, depreciation, and taxes. For any of these costs to be included in the revenue requirement, the regulator must deem them to be just and reasonable and prudently incurred.

Once the utility's revenue requirement is determined, a cost of service study is performed. A cost of service study apportions the total utility costs among the various customer rate classes in a fair and equitable manner, using <u>established cost of service principles</u>. There are several common steps: (a) functionalization of costs (assigning costs to generation, transmission, distribution, etc.), (b) levelization of these functional costs into service levels, (c) classification into cost components (customer-related costs, energy-related costs, and demand-related costs), and (d) assignment or allocation of these costs to rate classes. In a cost of service study, similar customers are grouped into rate classes and costs are assigned or allocated to those classes on the basis of how the costs are caused. That is, the cost of service study operates on the principle that the rate class that receives a particular service and causes the associated costs to be incurred should pay for that service. From there, time-tested <u>rate design principles</u> are used to create reasonable and sustainable rate designs. One rate design (perhaps including optional rates) is developed to apply to all customers in a rate class, as it is impractical to charge customer-specific rates (or develop customer-specific costs). This is called average ratemaking. As I will discuss below, departures from the established cost of service and rate design principles can lead to prices that do not correspond to the way utility costs are incurred, potentially resulting in cross-subsidies and inefficient customer decisions (such as choosing to consume energy when it is priced too low or failing to use the least expensive energy source because it is priced too high).

Q. You previously referenced established cost-of-service principles. To what were you referring?

A. When conducting a cost of service study, utilities try to adhere to some commonly accepted principles:

1. Costs must be approved by a regulator and based upon financial accounting costs adhering to General Accepted Accounting Principles ("GAAP") and the Federal Energy Regulatory Commission ("FERC") Uniform System of Accounts.
2. Costs should generally be known and measurable.
3. Cost allocation to customer rate groups should be based upon cost-causation. Where possible, they should align with the utility's system planning.

Q. Please explain how cost of service is used in rate design.

A. In addition to producing a cost-based revenue requirement for each rate class, the cost of service study classifies the types and amounts of the costs that are caused by each customer group (rate class). Again, this is a data-driven, mathematical exercise. As stated in the National Association of Regulatory Utility Commissioners cost allocation manual:[1]

> *The three principal cost classifications for an electric utility are demand costs (costs that vary with the KW demand imposed by the customer), energy costs (costs that vary with the energy or KWH that the utility*

[1] Electric Utility Cost Allocation Manual, January 1992, National Association of Regulatory Utility Commissioners.

provides), and customer costs (costs that are directly related to the number of customers served).

As a result of the functionalization, levelization, classification, and assignment or allocation of costs, the cost of service study produces unit costs, which are the allocated and assigned costs divided by the corresponding billing determinant (e.g., energy charges are based on the energy-related costs divided by the test-year amount of energy sold). While there may be arguments against charging these unit costs as the retail prices (e.g., pressures to recover customer-related costs through energy charges, possibly based upon a belief that low-use customers are also likely to be low-income customers), they do and should play an important role in the rate design process.

Q. What are the rate design principles that you referenced earlier?

A. The rate design for each rate class should reflect the costs and revenue requirements identified in the cost of service study as closely as possible. Subsidies should be avoided where possible and if they cannot be avoided they should be limited and transparent. The primary goal for rate design should then be to recover the class-specific revenue requirements and to consider the unit costs by component from the cost of service study for setting component prices. By basing the rates on unit costs (e.g., using monthly basic service charges to recover customer-related costs, energy charges to recover energy-related costs, and demand charges to recover demand-related costs), price signals are communicated to the customer that reflect the way in which utility costs are incurred, thus providing proper incentives for customer behavior.

Additionally, rates should be designed to be sustainable, stable, fair, and to enable efficient growth. They should be developed in a manner that maintains system reliability and power quality. Ratemaking should treat rate classes consistently. That is, if two different rate classes cause similar costs to be incurred or avoided, they should have similar treatment in rate design unless there is a compelling reason to do otherwise (and any exceptions should apply for a limited time period). These revenue requirements and subsequent rates should provide the utility with the opportunity to recover its costs and earn a rate of return sufficient to ensure its financial integrity.

Q. Does average ratemaking result in some customers paying more or less than their actual cost to serve?

A. Because cost of service studies and rate designs are conducted for customer groups (rate classes) rather than for each individual customer, it is inevitable that some customers will pay more or less than their actual cost to serve. However, the objective is to define classes such that the customers in the rate class are similarly situated, thus reducing the extent of intra-class cross subsidies.

Q. In the principles above, you have described cost of service as the basis for setting rates. Should the *value* of energy services be used as a basis for ratemaking instead of cost of service?

A. No, ratemaking should not incorporate the value of energy in lieu of the cost of service. A value basis for ratemaking has numerous shortcomings compared to cost-based rates. Cost-based rates send price signals to customers that are consistent with the way the utility costs are incurred. As stated in NARUC's report, "Aligning Rate Design Policies with Integrating Resource Planning", using cost-based rates produces desirable outcomes:

> *In practice, equity and efficiency come down to the notion that electric utility customers should pay cost-based rates. For a utility rate design, "cost-based" means based to a substantial extent on a cost-of-service study. Cost studies provide the formal and explicit linkage between the*

demands that customers place on the system and the charges they face. It is this linkage that permits the development of cost-based rates, rather than rates based for example on value of service or willingness to pay. Central to both embedded and marginal cost studies is the notion that customers should, insofar as is practical, be assigned the costs which they cause the utility to incur.

In addition, the value of energy services can be subjective and/or contentious while costs are more concrete and quantifiable. While it is true that utility-supplied electricity may provide significant value beyond its cost (e.g., economic development, etc.), it is inappropriate to include this value in the ratemaking process.

III. RATEMAKING ISSUES RELEVANT FOR SOLAR DG CUSTOMERS

Q. Please describe the ratemaking issues associated with pricing solar DG customers.

A. There are three types of pricing issues that are unique to solar DG customers:

1. How to account for the fact that solar DG tends to reduce the customer's energy by much more than it reduces its demand requirement, and how this affects the recovery of demand-related costs under standard two-part rates (in which demand-related costs are recovered through energy charges).
2. How to price the energy exported onto the grid when the solar DG system generates more load than is being used by the customer.[2]
3. How to account for additional utility grid costs that may be incurred by a solar DG system.

[2] This effect is not relevant if the customer is served under a "buy-all/sell-all" arrangement. Under this method, the customer is treated as two separate entities, paying standard retail rates for all of its energy and receiving payment (at something other than the retail rate, such as avoided energy costs) for the separately metered solar DG output.

Q. Please expand on the ratemaking impact of the first issue.

A. Under net metering, the output from solar DG is used to offset the billed energy of the customer, with the amount of the energy offset dependent on the size of the solar DG installation and its intermittent operation. However, the solar DG output is likely to have a much larger effect on the customer's net energy usage than on the customer's net demand requirement, for two reasons. First, the hourly profile of the solar DG output may not match the customer's usage profile. That is, the customer's peak usage may come at a time in which the solar DG produces little or no electricity. Second, the solar DG is an intermittent resource (e.g., not producing as much energy on a cloudy day) and when the solar DG is not producing, the customer will fully rely upon the utility's infrastructure.

Q. You described above how solar DG is likely to reduce a net metered customer's billed energy by much more than it reduces the customer's demand requirement. How does this affect the customer's bill relative to its cost to serve?

A. As described in Section II, the cost to serve a customer has three components: customer-related costs, energy-related costs, and demand-related costs. Traditionally, residential net metered customers face "two-part" rates that include only a basic service charge and energy charges. Because there is no demand charge to recover demand-related costs (for reasons I describe later), those costs are recovered through energy charges. In this case, the two-part rate is designed on the basis of the average load factor of the customers in the class, where "load factor" is defined as a customer's average usage over some period of time (e.g., a month or year) divided by its maximum hourly usage over that same time. Therefore, when a net metered solar DG customer reduces its energy without a commensurate reduction in demand, it avoids paying a (perhaps significant) portion of the demand-related costs associated with its service. Additionally, there may be a second cost effect due to the need for the utility to have available capacity in the event that the solar DG stops producing electricity. These reserve capacity costs will not show up in the solar DG customer's bill under the standard rate.

At some point (either in the next rate case or through something like a lost fixed cost recovery mechanism, or "LFCR"), the under-recovery of these demand-related costs is passed on to other customers. In summary, net metering with two-part rates leads to a cross-subsidy benefiting net metered customers to the detriment of non-net metered customers.

Q. **Please discuss the second issue you described above, regarding excess rooftop solar generation that flows onto the grid during certain time periods.**

A. The energy generated from solar DG is non-firm, which means that it cannot be relied upon by the utility as a source to serve load. Solar DG output flows onto the grid periodically depending upon the operations of the rooftop solar system and the site load requirements of the customer. This excess energy saves the utility from incurring some costs to serve, such as avoided fuel, variable operations and maintenance charges, and losses that would have occurred had the excess solar DG generated energy been otherwise produced by the utility. In addition, solar DG may impose some additional costs such as integration cost to accommodate the two-way flow of power on the distribution grid. In Section IV, I discuss the appropriate method for pricing the solar DG customer's excess generation.

Q. Please explain the third issue that you describe above with respect to the cost impacts of solar DG.

A. As more and more customers choose to install solar DG systems, the utility may experience integration issues that have to be addressed, such as voltage control and frequency response. If these issues lead to increased costs, the question of who pays for the cost increase will arise. The Commission may conclude that solar DG customers cause the increased costs and should be responsible for them, or it may conclude that public policy supports the socialization of those costs to all customers.

Q. Would it be unusual in ratemaking to separate out an abnormal cost consequence for recovery by the causing party?

A. No. An example of where this has been done for years is charging customers for having a poor power factor. If a customer has a poor power factor beyond a pre-specified threshold, there is usually a charge to the customer for the additional capacitors that may need to be added to the distribution network to correct it.

IV. RECOMMENDED RATE DESIGN CONSIDERATIONS FOR SOLAR DG CUSTOMERS

Q. What is the purpose of this section of your testimony?

A. In this section, I will describe how the issues described in Section III should be considered for rate design.

Q. In Section III you described three types of effects that solar DG customers can have on costing and pricing. Please explain how these effects should be addressed in rate design.

A. The first effect I described in Section III dealt with the under-recovery of demand-related costs from net metered solar DG customers who pay two-part rates (with only a basic service charge and energy charges). Even when the solar DG output during a billing month fully offsets the customer's site load, the customer still requires the utility to provide demand-related capacity for which the solar DG customer should be responsible. Distribution capacity demand costs pertain to the cost of equipment needed to serve the maximum amount of load that the utility expects the customer to require, with a margin for the variance in loads. When the solar DG system is operating and serving some of the customer's peak load requirements, the utility must have distribution capacity available to serve the solar DG customer whenever output from the system becomes unavailable. Additionally, there are generation and transmission reliability requirements for utility capacity to be available in the event that the solar DG is not producing output. The cost of service and rate design principles I mentioned above would require solar DG customers be responsible for these costs.

Q. Please continue discussing the generation and transmission reliability costs that you mention above.

A. Generation and transmission reliability costs are driven by the utility's system demand requirements. Generation costs for many utilities are thereby allocated by a combination of the utility's system coincident peak (CP) and the non-coincident class peaks (NCP). Transmission is usually allocated with CPs. While it is possible that the utility's CP may occur when the customer's solar DG unit is generating and reducing the utility's CP, the utility must still maintain available generation and transmission capacity for the event that the solar DG ceases to produce. This reserve requirement is a cost for which the solar DG customer should be responsible.

Q. How are distribution-capacity, generation-reliability, and transmission-reliability costs usually recovered in utility rates?

A. In traditional residential and small commercial tariffs, these demand costs are usually included in the energy charge. This is referred-to as a two-part design. A $ per kW demand charge has often been used to recover demand-related costs for medium to large commercial and industrial customers. This is referred to as a three-part design.

Q. What is the problem with two-part rates?

A. There are two primary consequences of charging two-part rates that recover demand-related costs through energy charges. First, two-part rates lead to an intra-class cross-subsidy to *all* low load factor customers (including those that have a low load factor due to net metered solar DG) from higher load factor customers. Second, two-part rates fail to provide customers with an incentive to manage their demand, which can result in some decisions that are not in the interest of all customers (e.g., plugging in an electric vehicle during peak hours). The cross subsidy and incentive issues can be corrected through improvements in rate design, such as applying three-part rates (including customer, energy, and demand charges) to all customers in the class.

Q. If two-part rates produce the intra-class cross subsidy you describe, why have they often been used for residential and small commercial customers?

A. There are two main reasons that two-part rates have often been used for residential and small commercial customers despite their shortcomings. First, meters that are capable of recording both a customer's demand and its energy use have been more expensive than meters that only record a customer's energy use. This has created a cost justification to use energy-only meters for smaller customers. Secondly, there was little interest on the part of residential and small commercial customers for demand-based rates, and two-part tariffs worked reasonably well for both customers and the utility. However, with the advent of solar DG and introduction of other behind-the-utility-meter technologies, there is a significant and growing segment of customers for whom a two-part design does not work well. New rate designs, such as a three part rate with a demand charge, should be considered as viable alternatives to the no longer tenable two-part rate structure.

Q. Can TOU energy-only rates solve the shortcomings of a two-part rate for solar DG customers?

A. No, a two-part rate that recovers demand-related costs through energy prices can allow solar DG customers to avoid paying their demand-related costs, regardless of whether the energy rates vary by time-of-use.

Q. How should solar DG customers be compensated for the excess generation that flows from the rooftop solar system onto the utility's distribution grid?

A. This excess self-generation should be considered non-firm and therefore lacking any material capacity value. As such, it should be compensated at avoided energy costs (primarily avoided fuel, O&M, and losses). These avoided costs for the utility should be credited to the solar DG customer for his or her generation, ideally on an hour-by-hour basis.[3] The credits should be based upon the specific hour in which the customer's solar DG output flowed onto the utility grid. Compensating solar DG customers at avoided energy costs prevents a subsidy that would have occurred had solar DG output been prices at above-market rates. Compensation at avoided cost would thus be fair and equitable to all stakeholders and sustainable as a tariff.

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[3] To be clear, it is preferable to define "excess generation" as the amount of solar DG output in excess of a customer's site load *in each hour*. Using the difference between the solar DG output and native load across an entire billing month (which is the current practice in Arizona) does not provide as accurate a depiction of the solar DG's energy value or its effect on the utility's costs.

Q. Instead of using avoided cost to compensate a solar DG customer, should the payment for excess generation simply be based off of the customer's standard utility tariff?

A. No, the payment for excess generation should not be based upon a bundled standard utility tariff. A bundled tariff contains cost recovery associated with generation, transmission, and distribution costs. Solar DG customers' generation output does not avoid most of these costs, and giving such customers credit for costs their systems do not avoid would create a subsidy in which non-participants' cost responsibility would increase beyond cost causation.

Q. Would the use of avoided cost as the basis of compensation for a solar DG system's excess generation be a change in Arizona from the current net metering tariff, in which excess generation is compensated using the standard tariff?

A. Yes it would, and the change would be done for the right reasons, consistent with long-standing cost of service and ratemaking principles. The resulting compensation mechanism would be sustainable and fair to all stakeholders

V. ISSUES RELATED TO THE VALUE OF SOLAR

Q. What do you see as the value of solar DG generation?

A. There is much debate in the industry as to the value of solar DG output, as it includes a subjective element with varying opinions (across stakeholders and over time) on its components and the associated monetary values. Therefore, I suggest the following guidelines for pricing solar DG:

a. Consider the VOS within two frameworks:
   i. Its value as it affects Commission-approved financial accounting costs used during rate proceedings.
   ii. Its value from an external perspective, outside of ratemaking.

b. For regulated ratemaking, avoid using the VOS from external perspectives which could otherwise result in permanent subsidies in fully approved tariffs.

Q. Please expand upon the meaning of VOS as it pertains to a utility's financial accounting costs.

A. The traditional meaning of "value" generally relates to the economic demand for a product or service beyond its pure cost. As I described in Section II, value-based pricing has no place in a cost of service ratemaking proceeding. Rather, this VOS for a possible ratemaking context relates to a determination of the effect of solar DG on the utility's incremental costs of those commonly accepted financial accounting costs employed in ratemaking and revenue requirements, such as generation, transmission, and distribution capacity cost, O&M, fuel, and losses. These incremental costs depend upon the characteristics of solar DG, including its intermittency, coincidence with the utility's demand cost drivers, physical location of the solar DG on the grid, and panel orientation.

Q. What do you mean when you refer to the VOS from an "external perspective," outside of ratemaking?

A. By "external" to ratemaking, I refer to benefits and cost valuations that are not readily found within a cost of service regulatory proceeding. This includes items such as potential environmental benefits or demand-based economic values such as an increase (or decrease) in regional employment. Other examples of these types of externalities include health benefits, reduced CO_2, and wholesale market price suppression. These types of valuations are not explicit components in ratemaking, and for good reason. The evaluation of such items is almost certainly subjective, lacking any real agreement as to the appropriate monetary figure that should be assigned. The subjectivity of the "value" analysis on such externalities can and would result in changing value over time.

Q. Please explain further your comment about avoiding the use of VOS from an external perspective in fully approved tariffs.

A. Fully approved tariffs should not be designed to include anything but approved financial accounting cost items. To include externalities such as a credit associated with the contention that solar DG creates jobs in Arizona (resulting in charges that are less than the cost to serve) could create a permanent subsidy. VOS should include only approved financial accounting costs and their impact upon a utility's incremental costs. Such costs could be used to influence rates, but only if the included incremental costs were: 1) regulator-approved, 2) already included in the design of similar electricity products such as energy efficiency, and 3) applied only to the extent that the tariff was cost-based and designed to recover the utility's embedded revenue requirements.

Using elements outside of the cost of service regime in order to benefit one particular resource or industry could result in inter- and intra-class cross-subsidies, skewed price signals, and rate instability. Rates are primarily set against the backdrop of a mathematically-determined cost regime, and it could prove quite harmful to allow a fully approved rate to contain a subjective and qualitative "value" element.

Q. Do you have other concerns that would arise in the event that the Commission were to decide, against your advice, to incorporate external costs or the value of electricity services in ratemaking for solar DG?

A. If the Commission chooses to include external costs or the value of electricity services in ratemaking (e.g., environmental benefits or regional employment effects), it could be argued that those costs and benefits should be applied uniformly. Ratemaking should avoid asymmetric treatment of specific costs and benefits, which could result in a distortion and skewing of behavioral incentives. If these external costs or sources of value were to be considered in the solar DG context, it could be proposed that the same costs and sources of value should be included in the pricing of all similar utility products that are sources of those costs and value. In other words, if there is an important source of external value that solar DG provides, and if it were deemed to be appropriate to include a "value" assessment in a cost-based rate structure, it may seem only fair that the same should be done across all similar sources of that value. To be clear, I don't believe that rates should incorporate value-based pricing or external costs, regardless of whether they are applied only to solar DG or uniformly across all sources of the cost of benefit. I simply point out the fact that asymmetric treatment of solar DG with respect to such costs and benefits leads to its own difficulties. Regulated rates cannot accurately reflect value. All sources of electricity have value. Many of these externalities are attributes of the utility's generation today—they are simply not included as explicit factors in ratemaking, nor should they be.

VI. CONCLUSIONS

Q. Do you have any concluding observations?

A. Yes, I recommend the following approaches for the pricing of solar DG customers:

1. Regulated ratemaking is and should continue to be based upon sound costing principles using approved financial accounting costs.
2. Regulated electricity rate designs that recover demand-related costs through energy charges (two-part rates) allow solar DG customers to

avoid paying the demand-related costs to serve them. The resulting cross-subsidies and improper behavioral incentives can be avoided through improved rate design. Permanent subsidies should be avoided wherever possible.

3. Excess generation from solar DG should be compensated at utility avoided costs.

4. Neither the "value" of electricity nor external costs (such as increased regional employment from solar DG subsidies) should be considered in regulated ratemaking.

Q. Does this conclude your direct testimony?

A. Yes.

BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS
DOUG LITTLE – CHAIRMAN
BOB STUMP
BOB BURNS
TOM FORESE
ANDY TOBIN

EXHIBIT
AIC-2
ADMITTED

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF THE VALUE AND COST OF DISTRIBUTED GENERATION.	))))	**DOCKET NO. E-00000J-14-0023**

Rebuttal Testimony of

Michael T. O'Sheasy

on Behalf of

Arizona Investment Council

April 7, 2016

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I. INTRODUCTION AND PURPOSE

Q. Please state your name, business address, and occupation.

A. My name is Michael T. O'Sheasy. My business address is 5001 Kingswood Drive, Roswell, Georgia 30075. I am a Vice President with Laurits R. Christensen Associates, Inc.

Q. Are you the same Michael O'Sheasy that submitted Direct Testimony on behalf of AIC in this docket?

A. Yes.

Q. What is the purpose of your Rebuttal Testimony?

A. The purpose of my Rebuttal testimony is to comment upon issues presented by other witnesses regarding topics discussed in my Direct Testimony, including the following witnesses: Briana Kobor on behalf of Vote Solar; Lon Huber on behalf of the Residential Utility Consumer Office ("RUCO"); and B. Thomas Beach on behalf of The Alliance for Solar Choice ("TASC"). The topics I will address include: (1) the extent of distributed generation ("DG") activities to which this docket should pertain; (2) rate design structure and pricing considerations; and (3) the value of DG and its use in ratemaking.

II. DG IMPACTS AND THE FOCUS OF THIS PROCEEDING

Q. Have any witnesses proposed to limit the scope of this docket to include only energy exported by NEM customers?

A. Yes. Vote Solar witness Kobor states the following: "I recommend that the study of DG costs and benefits focus on evaluation of the energy that is exported from the NEM customer to the utility grid."[1] TASC witness Beach makes a similar argument, stating "…the analysis of the economics of NEM should focus on those exports."[2]

Q. Do you agree with witnesses Kobor and Beach about the scope of the docket?

A. No. I believe that the limited scope proposed by witnesses Kobor and Beach fails to capture other important impacts that a DG customer imposes upon the utility system associated with: (1) the metered utility-provided load, exclusive of the customer's self-generation; and (2) the DG customer's actual self-generation that the utility might otherwise need to serve, exclusive of any exports. Both DG and non-DG customers have an on-site load requirement. However, the DG participants have chosen to install generation to serve all or part of their on-site load requirement. The utility should be compensated for serving the DG customers' metered load that it must serve using a rate design that covers all of the costs associated with it. Additionally, the utility must be available to serve the DG customer's entire load in the event that the customer's DG does not provide energy. This equates to a potential need for additional operating reserves and regulation services, the costs of which should be paid by the DG customers. RUCO witness Huber states that his preferred analysis framework is to include *all* DG solar generation (both exports and self-consumption) when determining

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[1] Kobor Direct Testimony at 4, lines 15-16.
[2] Beach Direct Testimony at 13, lines 18-19.

the costs and benefits of DG.[3] I agree with this view. In my opinion, it is not sufficient to focus only on the impacts of the DG participant's excess generation beyond its on-site load requirements.

III. RATE DESIGN ISSUES

Q. What is the purpose of this section of your testimony?

A. I will address the rate design discussions of TASC witness Beach and Vote Solar witness Kobor. Specifically, Mr. Beach proposes to "[a]dopt a monthly minimum bill to recover customer-related costs."[4] I will describe why a basic service charge is superior to a minimum bill design. In addition, Ms. Kobor points out the following: "Under the NEM program, participating ratepayers are credited for the kWh they export to the grid on a one-to-one basis with the kWh they take from the grid. This means that exports are valued at the full volumetric retail rate."[5] I will argue that the credits for exports should be based upon the utility's avoided cost rather than "the value of the energy provided" as defined by Ms. Kobor, which includes "environmental benefits, economic development benefits, and grid security benefits."[6] Finally, Mr. Beach argues against the use of demand charges in residential rates based on concerns about customer acceptance.[7] I will respond to this by describing why I believe demand charges are an appropriate rate design component for residential customers.

Q. Do you agree with TASC witness Beach that a minimum bill should be used to recover customer-related costs?

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[3] Huber Direct Testimony at 13, line 10.
[4] Beach Direct Testimony at 27, line 7.
[5] Kobor Direct Testimony at 26, lines 23-26.
[6] *Id.* at 49, line 18 and at 50, lines 10-11.
[7] Beach Direct Testimony at 28, lines 16-17.

A. No, I do not. I believe that a monthly basic service charge is a superior method for collecting customer-related costs.

Q. Please explain the advantages of a basic service charge relative to a minimum bill.

A. As I discussed in my direct testimony, there are three major cost drivers for an electric utility: customer-related, energy-related, and demand-related. Traditional regulation is based upon the cost of serving customer groups, and the rate design for these customer groups normally has component prices based upon these cost drivers. For example, customer-related costs do not vary with the volume of electricity used by the customer. However, these fixed costs (e.g., the cost of a meter) must be recovered and, since they do not vary with usage, an efficient way to collect customer-related costs is with a fixed monthly billing component called a basic service charge. By collecting these fixed customer-related costs in this manner, the tariff can then provide usage-based pricing components that collect usage-based costs. This process of collecting fixed costs using a fixed charge and usage-related costs using volumetric charges would send efficient price signals to the customer, allowing him or her to make decisions that reflect cost-causation.

Q. What is the problem with a minimum bill provision?

A. A minimum bill provision typically operates in a two-step manner: the customer's bill is calculated using the standard tariff components and the customer pays the greater of this calculated bill or the minimum bill amount. The minimum bill "floor" may be set with a consideration of recovering at least the customer-related costs. Therefore, when the minimum bill applies, the utility will implicitly recover its targeted customer-related costs but not all (or perhaps any) of its usage-based costs. This under-recovery of usage-based costs will need to be collected from usage-based charges that apply to customers who use more than the amount required to exceed the minimum bill amount. This means that the usage-based price signal is higher than it should be in order to simply recover the usage-related cost per kWh.

Q. Can you give an example of the problem with minimum bill provisions?

A. Yes. Assume that the customer group to which the rate will be targeted has a fixed customer-related cost of $10/month, an energy-related cost of $0.08/kWh, and a demand-related cost of $7/kW. Also assume that the average customer to whom the rate is targeted uses 1,000 kWh/month and 6 kW/month. Finally, assume that the tariff is based upon costs and therefore charges these exact cost components to the applicable customers. The resulting average monthly bill would be $132, and the pricing components in the tariff would be sending cost-based price signals to the customer. Now imagine instead that the tariff design had a minimum bill provision of $10/month, an energy charge of $0.09/kWh, and a demand charge of $7/kW. For simplicity, I assume that all customers are average and therefore the minimum bill does not apply to any of them. (The conclusion of this example is not altered if the example is made more complex such that the minimum bill applies to a small percentage of customers.) In this case, the average customer would still pay $132/month, but the energy price is now above the energy-related costs ($0.09/kWh vs. $0.08/kWh). The result of this rate design is to over-charge high-use customers within the class relative to their cost to serve and distort customer price signals.

Q. What are some of the reasons stated for favoring minimum billing?

A. TASC witness Beach provides two attributes of minimum bill provisions. In both cases, I argue that a basic service charge would perform better than the minimum bill provision.

i) Mr. Beach argues that a minimum bill can ensure that all customers make a minimum contribution and "can be set to cover the utility's customer-related costs (for metering, billing, and customer account services) which clearly do not vary with usage."[8] While he is correct that a minimum bill can be set at an amount equal to the utility's fixed customer-related costs, my example above illustrates that doing so would result in an energy charge above usage-related cost. In contrast, a basic service charge can also be set at the amount of the utility's fixed customer-related costs and a usage charge per kWh for all usage at the correct usage-based cost.

ii) Non-discrimination: Mr. Beach asserts that adverse bill impacts that might occur under higher fixed charges may be avoided with minimum billing, particularly for low-usage and/or low-income customers.[9] However, there are other ways that utilities have found to moderate the effect of higher basic service charges on low usage, low income customers such as waivers or modifications to the basic service charge for qualifying customers, or blocking of basic service charge (i.e., charging a higher basic service charge to customers with higher usage levels). Neither of these methods will distort another pricing component in the same manner as a minimum bill provision.

Q. Please expand on your point that the export credits should be based upon avoided cost.

A. As I described above, Vote Solar witness Kobor described how NEM pays the full retail rate for exported energy. I argue that because the retail rate can include fixed cost recovery, there can be a mismatch between the retail rate and the avoided costs associated with the exported kWh. If the retail rate is higher than the avoided costs, the non-participants will have to pay higher rates for overpaying avoided cost. I believe the credit for exported energy should be at the utility's avoided cost, possibly on an hourly

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[8] *Id.* at 27 lines 19-21.
[9] *Id.* at 28, lines 20-22.

or time-of-use basis (if feasible given metering and information constraints), enabling the non-participants to be held harmless. I agree with RUCO witness Huber that "the Commission's methodology should strive to be unbiased and not be unduly favorable to either utilities or DG providers."[10] If the Commission decides that the compensation for DG exports should be higher than avoided costs (perhaps due to a perceived value beyond avoided cost), then I agree with Mr. Huber that this procurement should be addressed by linking into the IRP process.[11] The procurement of exports could be treated similar to a cost of procured power and flow accordingly through the ratemaking process.

Q. What is your response to TASC witness Beach's arguments against the use of residential demand charges?

A. I believe a demand charge can send a more efficient price signal to customers (i.e., a price signal that reflects the underlying cost driver) and help ensure that NEM customers pay the demand-related costs associated with serving them. If the demand charge is designed with a proper consideration of the coincidence factor (i.e., the relationship of the demand driver to the demand billing unit), then I believe that a demand charge sends a better price signal than placing the demand cost into an energy charge and avoids the distortion of energy prices inherent in two-part rates. This was explained in my Direct Testimony comparing a three-part design to a two-part design.[12]

Q. Does recovering demand-related costs within a large basic service charge lead to rates that reflect the way costs are incurred?

A. No, it would not and it would not lead to the efficient use of electricity. Also the customer's bill would be less reflective of cost. If the utility placed all customer-related

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[10] Huber Direct Testimony at 8, lines 21-22.

[11] Huber Direct Testimony at ii, second paragraph.

[12] O'Sheasy Direct Testimony, Section IV beginning page 13.

cost and some or all of the demand-related cost into a fixed monthly basic service charge, it would lead to undercharging customers with low load factor usage and overcharging customers with high load factor usage. Even if the utility has a basic service charge that collects *all* customer-related cost, the resulting two-part rate design would still have the problem of requiring high load factor customers to pay too much demand-related cost and low load factor customers to pay too little. A three-part rate design which includes a demand charge solves this intra-class inequity caused by collected demand cost in an energy charge and enables price signals to be based upon their respective cost drivers.

Q. Does a rate design in which demand costs are placed in the energy charges encourage energy efficiency?

A. Obviously higher energy prices give customers higher incentives to engage in conservation. However, retail rates should be designed to obtain *economic* efficiency (rates that reflect the way costs are incurred) rather than to maximize energy efficiency. One maximizes economic efficiency by sending price signals to customers that reflect the cost of energy, thus letting the customer decide whether his or her energy use is worth the energy price. Likewise, a demand-based price gives the customer an incentive to reduce its demand for electricity. It is important to the overall efficient use of electricity that both energy and demand prices provide cost-based price signals to customers so they can make efficient usage decisions for the benefit of the entire system.

Q. Does your argument for economically efficient rates also apply to a minimum bill provision?

A. Yes, it does. While a minimum bill provision (used in place of a basic service charge and a demand charge) may result in charging higher energy prices (relative to a three-part rate and relative to the cost of energy) that increase customer incentives to reduce usage, the design is not as economically efficient as a three-part rate design with cost-based energy rates. In particular, a minimum bill provision coupled with only high energy prices may indeed result in reduced energy use, but it does not provide customers with an incentive to reduce their demand and over-incents the customer to reduce their energy at a price above the energy's cost.

Q. How do you respond to Mr. Beach's concerns about customer acceptance of demand charges?

A. Electricity customers are becoming more and more sophisticated in terms of understanding their bills and seeking out ways to lower them. This is a reason why DG is becoming more popular. I believe those customers interested in DG are probably savvier about utility billing and opportunities to save on their electricity bill. Mr. Beach appeared to agree with me on this point when stated: "Customers who have gone through the process to make the long-term investment to install solar lean much about their energy use, about utility rate structures, and about producing their own energy. Given their long-term investment, they will remain engaged going forward."[13] These types of customers are likely to be less daunted by the concept of a demand charge than the average customer not interested in DG, and I believe they can more readily become comfortable with demand billing. When I was a rate manager with Georgia Power in the early 1990s, we had a residential rate with very few participants (less than 100), and so the rate was terminated. A couple of years ago, Georgia Power felt that their residential customers were now more receptive and interested in an efficient demand rate and began offering one. Today there are thousands of participants on a demand rate and participation is still growing. So I indeed think a demand charge concept is efficient and appropriate for residential customers and certainly DG customers.

[13] Beach Direct Testimony at 32, lines 14-18.

IV. VALUE OF DG AND ITS USE

Q. How should the value of DG be determined and used?

A. As I explained in my Direct Testimony, the value of solar DG should be separated into two distinctions: the value to the extent it affects Commission-approved financial accounting costs used in rate case proceedings; and the value from an external perspective, outside of ratemaking. The first type of valuation (using financial embedded costs) is appropriate for determining utility revenue requirements. The second type of valuation (including externalities) is not appropriate for utility revenue requirements/ratemaking, but may be more relevant to an Integrated Resource Plan ("IRP"). For example, if, as Ms. Kobor suggests, the price paid for DG exports should consider the value of the energy provided and this value should include not only the impact upon rates but also the incorporation of externalities such as environmental, economic development, and grid reliability benefits,[14] then I believe it is appropriate to evaluate this supply resource through the same IRP process that utilities use to evaluate other supply resources. These additional values associated with DG (if they exist) would then make their way into the ratemaking process in the same manner as other supply procurements. However, I am not suggesting that externalities/social costs should necessarily be included in this type of valuation of exports (or other impacts of DG upon the utility). I am only recommending that if the Commission chooses to include this second type of valuation, the IRP is the most appropriate means to adjudicate it.

V. SUMMARY

Q. Please summarize your rebuttal testimony.

A. (A) This docket should include all impacts that a DG customer makes upon the utility, including the cost effects on the utility associated with the customer's self-

[14] Kobor Direct Testimony at 50, lines 8-11.

generation that serves the customer's on-site needs and the effects associated with the DG customer's exports to the utility network.

(B) Basic service charges are superior to minimum bill provisions.

(C) Exports should be credited based upon avoided cost.

(D) A demand charge is an efficient and appropriate pricing component.

(E) Value of DG should be considered in two contexts. Ratemaking should consider only utility financial costs. If the Commission chooses to consider potential additional costs and benefits of DG, the IRP process is the appropriate venue.

(F) Finally, the fact that I have not addressed a witness's argument at this time does not imply my agreement.

Q. Does this conclude your rebuttal testimony?

A. Yes.

Distributed Generation – Integrated Value (DG-IV)

A METHODOLOGY TO VALUE DG ON THE GRID

OCTOBER, 2015

TVA

OVERVIEW & SUMMARY

In recent years, distributed generation (DG) resources have rapidly grown in number and are playing an increasingly important role alongside traditional generation resources. From a national perspective, renewable energy growth is trending upward, although cost competitiveness and customer adoption rates of renewable resources vary by geographic region. TVA has recognized this transitional market shift towards greater renewable energy and DG adoption and has developed a methodology to determine a Distributed Generation - Integrated Value, or DG-IV.

Desired Outcome

TVA's desired outcome is to develop a comprehensive methodology that assesses both the representative benefits and costs associated with various forms of DG. The methodology components are intended to be grounded in solid, quantifiable, and defensible analytics, and serve as a robust basis for DG valuation. Although the numerical values associated with each methodology component will need to be updated to adjust to changing market conditions, the components themselves should remain relevant over time.

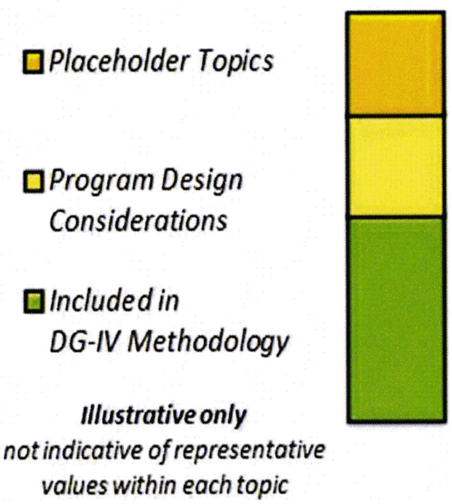

Fig. 1: *DG-IV Categories* ***(illustrative)***

As is demonstrated in Table 5 on page 23, the methodology adopted in this report includes cost and benefit components that accrue to the utility. The combination of these components, represented in green in Table 5, equate to the solar-specific avoided cost to TVA. As described below, additional benefits or costs may be applied as part of the later program design phase or as future placeholder topics. The primary focus of this effort was to select the DG-IV methodology components, but also develop a firm analytical basis for calculating each component (green components).

Within each of these categories the individual components may deliver a net benefit or cost. This versatile approach establishes a robust foundation that can be built upon to adapt to changing conditions. In the end, the DG-IV methodology establishes a representative set of building blocks used to evaluate and quantify various DG resources.

Initial Focus: Small-Scale Solar

Due to the increasing popularity and growing awareness of solar photovoltaic (PV) energy, solar PV was selected as the most representative DG resource type to evaluate. Concepts utilized in existing "Value of Solar" processes were leveraged to identify value stream components that are directly applicable and representative of the Tennessee Valley region. A maximum solar PV system size of 50 kW was selected for use with this DG-IV methodology to align with TVA's current solar PV deployment activities at the residential and small commercial scales.

EXHIBIT
AIC-3
ADMITTED

DG-IV Group Participation & Meetings

To develop the DG-IV methodology, TVA assembled a diverse cross-section of regional participants from the Tennessee Valley region. Local power companies (LPCs) served by TVA, the Tennessee Valley Public Power Association (TVPPA), various environmentally-focused non-governmental entities, solar industry representatives, academia, state governments, and national research institutions were represented. To provide objective and independent third-party facilitation and subject matter expertise, TVA contracted the Solar Electric Power Association (SEPA). Additionally, the Electric Power Research Institute (EPRI) took the lead role in analyzing distribution system impacts and losses. This analysis directly aligns with EPRI's innovative 'Integrated Grid' Initiative (www.epri.com/integratedgrid). EPRI's technical rigor not only provides insight into the DG-IV process, but helps provide understanding within the broader context of DG integration.

Involvement of external participants in the DG-IV process officially began on April 23, 2014. As part of the initial meeting, guiding principles were developed based on group collaboration and agreement on the overall intent and process (shown in Figure 2). These principles encompass the four core values of transparency, fairness, adaptability, and versatility. These principles are shown at the beginning of every meeting to ensure conversation is grounded upon a unified platform of collaborative consensus building. Subsequent meetings are detailed in Table 1 (located on following page).

We will develop a quality, actionable process that accomplishes:	
Transparency	• Accessibility to the information • Data, assumptions, calculations • Clear and well-defined • Information provided in a timely manner with sufficient time for engagement
Fairness	• Views all stakeholders on an equal footing • Compromise in process • Inventory and consider all variables
Adaptability	• Broadly applicable to multiple forms of distributed resources • Continuous learning process • Evolving in a positive way over time
Versatility	• Continues to work in a changing technology and business environment • Ensures implementation to a widespread, robust set of markets • Provides potential for differentiation so it works for a wide array of customers, locations, and environments

Fig. 2: *DG-IV Process Principles*

Table 1: *DG-IV Group Meetings*

Item	Date	Meeting Objectives & Goals
Meeting # 1	April 23, 2014	DG-IV group kick-off meeting
Webinar # 1	May 15, 2014	EPRI Distribution impact overview and discussion
Meeting # 2	June 5-6, 2014	Initial deep dive: DG-IV components and calculations
Meeting # 3	July 9, 2014	Follow-up: DG-IV components and calculations
Meeting # 4	Aug 27-28, 2014	Initial calculation methodology, inputs, and draft results
Webinar # 2	Oct 31, 2014	Draft report review summary and EPRI distribution update
Meeting # 5	Dec 3, 2014	Finalize DG-IV Methodology
Meeting #6	July 2, 2015	Share Final Draft DG-IV Report

Future Application & Considerations

The DG-IV methodology will serve as an effective input, along with other factors, to inform future TVA renewable energy decisions. Additionally, TVA's 2015 IRP study is expected to provide valuable insight regarding the future direction and associated volumes of various generation resource options. More specifically, the IRP will help inform TVA how solar PV resources compete with other generation sources across multiple future strategies and scenarios. Although the DG-IV methodology and the 2015 IRP will help provide important overall guidance, these inputs will not dictate specific renewable implementation details, such as annual capacity targets or renewable pricing structures. Ultimately, final program offering decisions consider various interrelated factors beyond the considerations of both the DG-IV and IRP processes.

Other practical considerations should also be weighed when attempting to broadly apply the results of this study in assigning a "value" to DG resources. These considerations include the uncertain nature of legislative and regulatory environments, the lack of a regulatory basis or industry consensus on selecting appropriate DG valuation components, and the many unknowns or unintended consequences that can arise when DG assets are added to a distribution system that did not originally envision two-way power flow. The issuance of this report is an important first step towards realizing a DG-IV methodology for the Tennessee Valley region, but caution should be taken in its application until more data is acquired and analyzed and greater regulatory and cost certainty becomes available.

During the development of the methodology for assigning a value to distributed resources, TVA and individuals on the stakeholder group identified a number of policy issues that are outside of the context of this work. While the components of the value have been explored and initial results determined, we have not attempted to account for system or marketing decisions that TVA and the LPC's would engage in that could increase the price offered for solar. For example, we might put an incentive on the value for location or for providing ancillary services; or TVA might decide that stimulating the market is the right thing to do and add an incentive to make it easier for the market to transact.

Reducing the uncertainty around the price signal for distributed solar depends on the policies that TVA decides it should include as part of the pricing scheme, but this policy framework builds on the value methodology rather than changes it. Some of the policy issues that will be considered as part of the implementation include how to set a framework for identifying and assessing broader environmental impact/benefit, recognizing the ancillary services value, identifying economic development benefits, and quantifying system security enhancements and disaster recovery capabilities.

DG-IV VALUE STREAM COMPONENTS

Preliminary Component Identification

Preliminary DG-IV value streams were initially developed based upon previously completed "Value of Solar" studies from other jurisdictions (e.g., Austin Energy, Minnesota). The value stream components developed and how they were independently evaluated by the DG-IV group is shown in Figure 3. Seven value streams achieved agreement rates of 94% or greater. Environmental impact had an agreement percentage of almost 70% with the remaining 30% being split between criteria B (Applicable, not currently quantifiable, placeholder for future consideration) and criteria C (Applicable, belongs in public policy discussions rather than analytic framework).

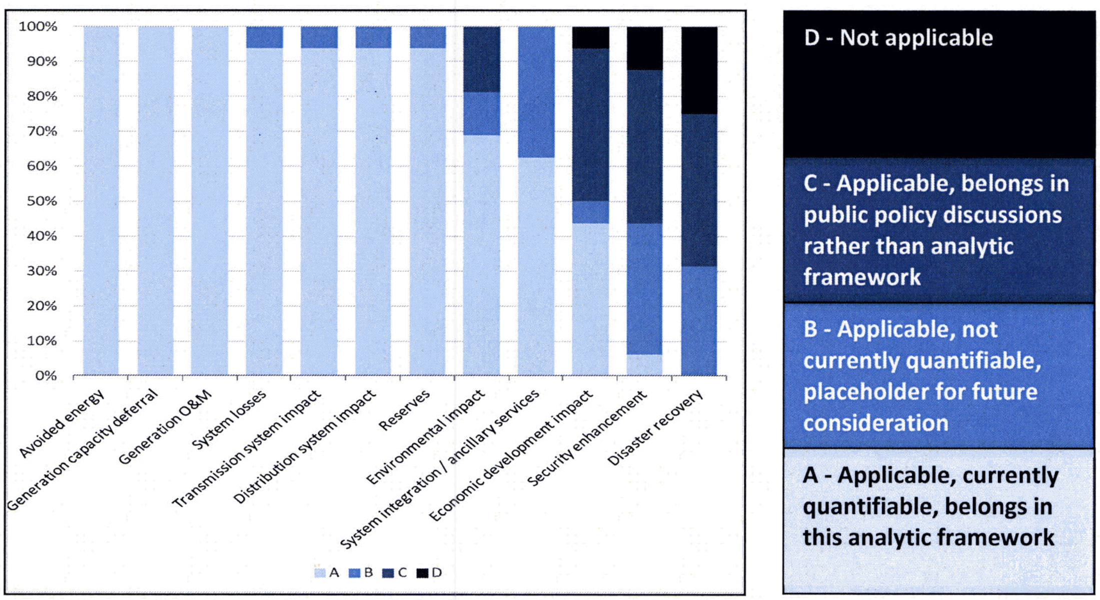

***Fig. 3:** Preliminary Scoring by DG-IV Group*

The DG-IV group also provided input regarding other value streams components not included in this initial grouping. These additional components were individually discussed and evaluated by the DG-IV group and were either merged or dropped via group consensus.

Grouping of DG-IV Components

As previously shown in Figure 1 (located on page 1), DG-IV components were divided into three distinct categories: 1) value streams included in the DG-IV methodology, 2) program design considerations, and 3) placeholder topics. The grouping of these components into these three categories was based on the preliminary scoring by the DG-IV group. Components that received strong consensus under criteria A

(Applicable, currently quantifiable, belongs in this analytic framework) were put into the first category (DG-IV methodology). Other components were divided into the other two categories. Table 3 identifies the specific components that are included within each of these categories and provides a brief description of each component. The primary purpose of the DG-IV process is to solidify the first category (methodology), since the core focus of this work is to develop a versatile and repeatable DG valuation method. The other categories are relevant as they provide a basis for potential consideration either within program design or as future DG-IV methodology components.

Table 3: *Categorization of DG-IV Components*

Categories	Components	Description
Included in DG-IV Methodology	Generation Deferral (Capital & Fixed Operations & Maintenance)	The marginal system capacity and fixed operations and maintenance value of deferred generation additions (including reserves) due to DG
	Avoided Energy (Fuel, Variable Operations & Maintenance, Start-up)	The marginal system energy, fuel, variable operations and maintenance, and start-up value of generation displaced by DG
	Environmental (Compliance & Market)	Compliance - addresses regulatory compliance components that are incorporated as part of TVA's system portfolio analysis (e.g., CO^2, coal ash, cooling water) Market - the individual market value a DG resource adds to the valuation methodology in addition to regulatory compliance value (e.g., renewable energy credits)
	Transmission System Impact	Net change in transmission system infrastructure due to presence of DG (i.e., transmission required, deferred, or eliminated)
	Distribution System Impact	Net change in distribution system infrastructure due to presence of DG (i.e., distribution required, deferred, or eliminated)
	Losses (Trans. & Distr.)	Net change in transmission and distribution system losses due to presence of DG
Program Design Considerations	Local Power Company (LPC) Costs & Benefits	Associated costs of implementing renewable energy programs (e.g., administrative, operational, engineering), and potential LPC-specific distribution system benefits
	Economic Development	Regional job and economic growth caused by DG growth
	Customer Satisfaction	Enhanced customer value due to preference, optionality, or flexibility
	Local Differentiation	Site-specific benefits and optimization (e.g., geographic location, placement & optimization of distribution grid, load demand reduction)
Placeholder Topics	System Integration/ Ancillary Services	The symbiotic value of smart grid resources and high levels of DG penetration, and cost of integration of non-dispatchable resources - further study and data required
	Additional Environmental Considerations	Additional environmental factors that are not specifically addressed as part of the environmental compliance or market values
	Security Enhancement	Increased system resiliency to reduce power outages and rolling blackouts due to presence of DG
	Disaster Recovery	The ability and pace of DG assets to assist with system restoration after significant damages caused by natural disasters
	Technology Innovation	Impact value associated with technology-driven investment in DG

DG-IV CALCULATIONS

Comparing Solar PV to Traditional Generation Resources
It is important to consider applicable differences between solar PV and traditional energy resources. These differences include both benefits and challenges that not only require identification, but also analytical interpretation into quantifiable values.

Some of the primary benefits associated with solar energy compared to conventional power plants include: scalability and locational versatility, elimination of fuel costs, and emissions-free generation. Scalability and locational versatility are addressed at some level with regards to transmission and distribution impacts and losses. Capacity sizing and locational-specific siting of solar PV facilities to more effectively accommodate the needs of the distribution system may also be addressed via renewable program design or other utility implementation strategies. Elimination of fuel costs is addressed via avoided energy calculations, which includes consideration of fuel price hedging capability and the associated avoidance of volatility risk of natural gas prices. Lastly, emissions-free generation provides various environmental benefits, but has its own environmental impacts.

These benefits are realized over the life of the solar PV system, which typically exceeds 25 years.[1] The merit of considering a 25 year life was discussed by the group, however this would exceed TVA's typical contractual terms for generation. TVA's contract terms for power purchase agreements are typically for 20 years or less because this provides a reasonable balance between TVA's power supply planning and financial planning risk tolerance and 3rd party market attractiveness.

Some of the primary challenges associated with solar energy include: intermittent generation, inability to dispatch, and an inability to control when generation is produced (a.k.a. "must take" energy). Intermittent generation, or energy that is not continuously available, is primarily an operational concern that depends on real-time generation profiles. To address these concerns from a system-wide portfolio perspective, solar energy profiles are compared against historic TVA load profiles to determine how much of the capacity can be deemed as being "net-dependable capacity", or NDC. The NDC value indicates how much capacity is counted towards offsetting TVA's peak demand requirements, which currently occur in the summer months. As part of the 2015 Integrated Resource Plan (IRP) process, the summer NDC value was determined to be 50% for fixed-axis solar PV (see the Technical Appendix for more details). The NDC value is relevant to the portfolio analysis process, since TVA is currently a summer peaking utility. If TVA's system transitioned to primarily winter peaking, the value would likely be at or near zero since our system peak in the winter is during the 7:00 am hour Eastern Time. The inability to dispatch solar energy also changes operational expectations, specifically with regard to how and where other generation resources are dispatched. This concern is somewhat addressed via the NDC correction, but future work is needed to best understand possible operational impacts.

[1] Solar panels typically have a 25-year warranty. National Renewable Energy Laboratory. *Solar Ready Buildings Planning Guide*. December 2009. Found at: http://www.nrel.gov/docs/fy10osti/46078.pdf

Solar PV along with other "must take" energy sources, such as wind, provides less system operations flexibility when compared to traditional dispatchable resources. Solar PV generation is a function of solar irradiance which is considered a variable fuel source. Therefore, to meet the needs of continuous energy loads on the utility grid, traditional sources such as natural gas must be dispatched to fill in any "gaps" in solar energy generation profiles. During clear sky conditions, solar generation profiles are fairly manageable, however during irregular cloud pattern conditions, dynamic solar capacity ramping events can occur repeatedly. This generation volatility and reliability risk is greater for large utility-scale solar PV projects but still exists for distributed solar generation. However, this risk is somewhat mitigated under the scope of this methodology, which targets small-scale solar deployment that is more evenly distributed across the distribution network. Traditional resources are still needed to back-up variable generation conditions associated with solar PV generation when the sun is not shining or during nighttime hours. The cost of this "backup generation" is included in the methodology and is addressed through a combined analysis of generation deferral and avoided energy that recognizes both the solar energy profile and the contribution of solar resources at the time of the system peak. While some think this backup generation should cost more than we have computed in this methodology, others believe it is not necessary.

DG-IV Calculation Method

After selecting the components to be included in the DG-IV methodology, calculation approaches and associated boundary conditions were identified to derive individual component values.

Generation Deferral (Capital & Fixed O&M)

Capital deferral relates to the deferral of new generation capacity, typically from a natural gas combustion turbine or combined cycle asset. This deferral results in both capital and fixed operations and maintenance (O&M) savings. Capital and fixed O&M costs can vary substantially based on the type of asset deferred and the timing of the deferral. As part of TVA's resource planning process, capacity expansion and production cost models are utilized as strategic tools in making future generation assets decisions. The overarching goal of both of these models is to minimize the net present value of TVA's total system cost. A visual reference of how these models interact is shown in Figure 4.

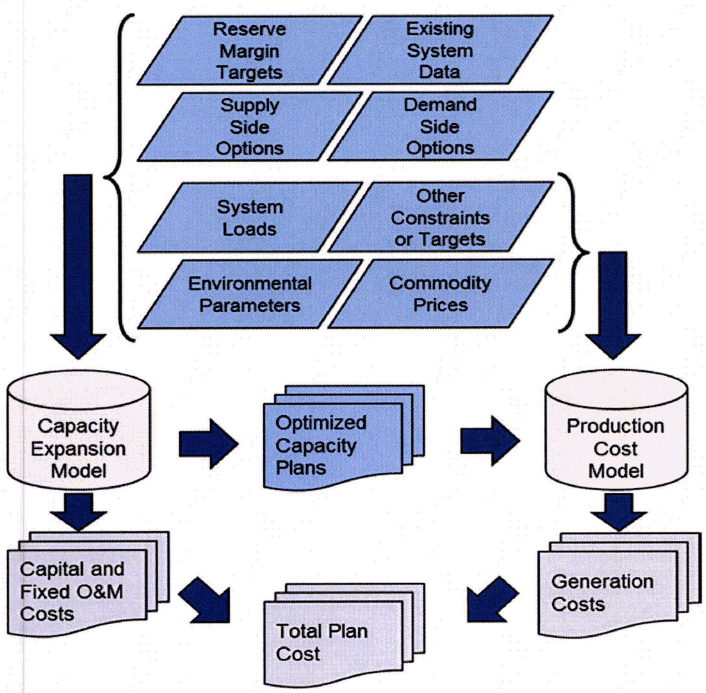

Fig. 4: *Resource Planning Modeling Process*

Total plan costs are first examined according to TVA's existing base case scenario. Then, 2,000 MW [2] of solar PV (AC-rated) was added to TVA's generation resources in the first year of the evaluation period (2015) at no cost. This capacity value was selected to represent a significant amount of solar PV adoption that would have a material impact on the modeling results (the capacity expansion plan). The differential in cost between the base case and solar PV scenario provides an indication of the value of solar PV on the TVA system. This system-wide analysis method, which is applied over a 20-year term (2015-2034), is an effective means of determining a value that is specific to TVA's capacity and generation additions forecast. The system analysis approach is not only effective in determining generation deferral, but also avoided energy and a system environmental value.

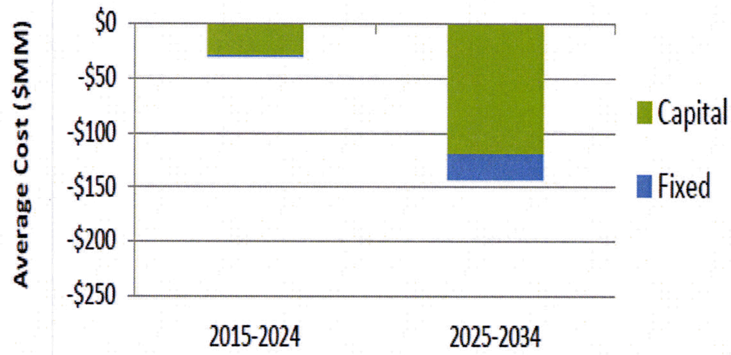

***Fig. 5:** Generation Deferral (annual average)*

Regarding solar PV capacity, 1,000 MW (net dependable capacity value) are applied toward meeting TVA's resource adequacy requirements, including its 15% reserve margin target. The ten-year average capital and fixed O&M costs that would be avoided by 1,000 MW AC of solar are shown in Figure 5. The increases over the second ten year period are a result of customer energy growth which create the need for additional summer capacity. Solar additions help offset expected spending on assets that provide system capacity. In this particular analysis reference case, the calculated levelized value for the generation deferral value is 1.53 cents/kWh.

Avoided Energy (Fuel, Variable O&M, Start-up)

Avoided energy values are derived from the system-wide analysis approach mentioned previously. Similar to capacity deferral, when new generation is deferred there are associated savings from the following components: fuel, variable operations and maintenance, and start-up costs for the total generation fleet. The model is currently limited to an hourly time step so there may be intra-hour impacts not captured at in this analysis. Unlike firm

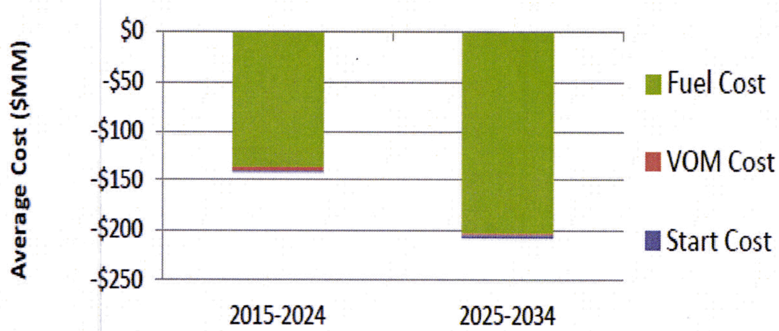

***Fig. 6:** Avoided Energy (annual average)*

[2] Number used for modeling purposes; not indicative of program targets.

capacity requirements associated with capacity deferral (discussed above), 100% of the solar PV energy profile is applied towards the avoided energy value. As seen in Figure 6, fuel costs account for most of the total avoided energy value. As commodity fuel costs increase over time, the avoided energy value related to fuel also increases. Fuel, variable O&M (VOM), and start-up costs[3] can vary substantially based on the type of asset deferred and the timing of the deferral. For example, because more coal generation is avoided in the first ten years, VOM savings are higher than the second ten year period when more natural gas generation is avoided. For this particular analysis reference case, the calculated levelized value for the avoided energy value is 4.58 cents/kWh.

As part of this analysis, fuel volatility and associated fuel price risk were also explored. TVA's internal analysis, which simulates generation costs via different scenarios, found that solar PV additions can yield slightly greater avoided costs during high summer load conditions with high marginal fuel prices. Conversely, solar PV additions can also result in slightly less avoided costs in situations with low loads and low marginal fuel prices. TVA determined that these upside and downside conditions tend to offset each other as part of a balanced base case planning scenario and generally apply to any fixed-price generation or hedge. A DG-IV participant conducted a separate analysis by examining the change in fuel savings from solar (which has zero fuel cost) under periods of natural gas price run-ups and decreases compared to the base price forecast. The effect using New York Mercantile Exchange (NYMEX) contract options as well as simulations of generation cost found that when using a two-tailed probability distribution, the volatility value was either entirely dependent on forecasts of NYMEX market options or cancelled out over time. As a result, no material fuel volatility value was included in the methodology at this time.

Environmental

Of all the categories discussed, the environmental category garnered the most discussion. After much deliberation and discussion by the DG-IV group, the group decided to divide the environmental component into three distinct sections (Figure 7):

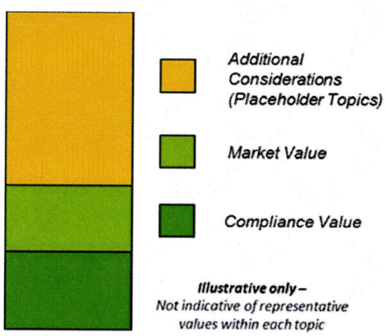

Fig. 7: *Environmental Sections* ***(illustrative)***

1) **Environmental Compliance Value** - addresses regulatory compliance components that are incorporated as part of TVA's system portfolio analysis

2) **Environmental Market Value** - the individual market value a DG resource adds to the valuation methodology in addition to regulatory compliance value (e.g., renewable energy credits)

3) **Additional Environmental Considerations** – Additional environmental factors that are not specifically addressed as part of the environmental compliance or market values

[3] Start-up costs capture the number of times units are cycled

The DG-IV group reached unanimous consensus on the inclusion of the first two topics within the DG-IV methodology (shown in green). Consensus was not reached by the group on the third topic (shown in orange). However, group participants did decide that it was important to document the various opinions associated with the third topic. As potential regulations and future markets evolve, individual items captured within the 'additional environmental considerations' topic could become avoided costs to the utility, and thus transition into either the environmental compliance or market value as deemed appropriate.

Environmental Compliance Value

The environmental compliance value is consistent with the system-wide analysis method utilized in calculating generation deferral and avoided energy. TVA's production cost model is leveraged to calculate the impacts of known environmental regulations whose compliance costs can be discretely itemized. Some compliance-related costs are already inherently captured in the model based on both historical and forward-looking asset decisions. These compliance values address topics such as coal ash management, cooling water, mercury, air pollution, and water discharges and are embedded calculations which are difficult to disaggregate and independently value. Environmental regulatory programs limit or restrict outputs from fossil generation that depend in large part on the actual use of fossil assets. Carbon dioxide emissions provide a good surrogate for fossil system generation. For these reasons, the environmental compliance value is based upon the carbon intensity of the generation assets deferred. TVA assumes a CO_2 compliance cost curve in terms of dollars per ton of CO_2 equivalent beginning in 2022[4]. The actual value is based on the carbon intensity of the avoided fuel combustion, which depends on the type of fuel and efficiency of the generating unit.

For example, coal deferrals result in a greater environmental compliance value than gas deferrals due to higher carbon content of coal than natural gas per electricity generated. As future environmental legislation or regulations develop, the environmental compliance value will also adjust to reflect these changes. The calculated levelized value for the environmental compliance value is 0.22 cents/kWh.

Environmental Market Value

The environmental market value refers to the individual value a DG resource adds to the valuation methodology, which is not expressly captured as part of the system portfolio analysis. Renewable energy is unique due to the fact that a market mechanism exists to help stimulate its ongoing development. To address this additional market value, renewable energy credits (REC) and carbon markets were considered to identify an appropriate market opportunity value. A REC is defined as a tradable, non-tangible energy commodity that represent evidence that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource.

Carbon accounting associated with the indirect CO_2 emissions is inextricably linked within the solar REC (SREC) and cannot be separated. Unlike solar PV, landfill gas assets have an additional carbon offset value, in addition to the REC itself, and these commodities can be treated separately and therefore

[4] Based on assumption developed collaboratively in TVA's IRP process and used here for consistency

monetized independently. To determine an environmental market value for solar PV, only one voluntary market can be utilized to assign a market opportunity value. Voluntary carbon markets currently exist but have limited market maturity. REC markets are more established and vary based upon the applicable market (compliance or voluntary) and resource type (e.g., solar REC or wind REC). Since a large majority of TVA's service territory is free of Renewable Portfolio Standards (RPS) compliance obligations (North Carolina being the exception), the voluntary REC market was selected as a representative proxy.

SREC prices can vary dramatically within various compliance markets and in comparison to other renewable resource types. In voluntary markets, REC prices vary, but with much less price differentiation between resource types. Based on current and near-term REC quotes[5], national voluntary SREC markets are trading between $3-$5/MWh per REC, while National voluntary RECs (any resource type) are closer to $1/MWh. The primary differences between these two markets are trading volume and liquidity. Currently, national voluntary SREC markets are trading at fairly low volume levels. According to REC market analysts[6], trading of only 140 MW AC solar PV (~7% of the value explored in this methodology) could create imbalances to the national voluntary SREC market. Additionally, trading would need to occur as several discrete transactions between 1 to 10 MW AC in scale. In contrast, the National voluntary "any REC" markets can handle well in excess of the solar PV capacity explored in this methodology.

For these reasons, TVA has applied a $1/MWh REC value for this component with a 1.9% escalation that is consistent with TVA's IRP process. This value is carried from the first year in this analysis through the year before carbon compliance is applied (2015-2021). After 2021 it is assumed that the REC would need to be retired to meet compliance obligations. The calculated levelized value for the environmental market value is 0.11 cents/kWh. This valuation is based upon current, voluntary REC market data, and similar to other DG-IV methodology values, will require periodic updating.

Additional Environmental Considerations

These considerations encompass additional environmental factors that are not specifically addressed as part of the environmental compliance or market values. Within this topic, three distinct items were discussed: carbon impacts, common air pollutant impacts and water impacts.

Carbon Impacts

Carbon impacts in addition to TVA's CO_2 cost proxy cost curve were discussed by the DG-IV group with a diverse set of opinions on whether monetization of additional carbon impacts should be included or not. The federal social cost of carbon (SCC) was introduced by some of the participants as an estimate of the monetized damages associated with an incremental increase in carbon emissions in a given year. It is intended to include (but is not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change. Although SCC was the primary area of consideration under 'Carbon Impacts', various opinions on this topic existed among participants.

[5] Based on independent TVA conversations with various REC brokers or traders
[6] Based on independent TVA conversations with various REC brokers or traders

In 2009, the Obama Administration's Council of Economic Advisers and the Office of Management and Budget initiated an Interagency Working Group on the SCC. The Interagency Working Group determined a range of SCC values based on three pre-existing, integrated assessment models. Those in favor of the SCC pointed to a significant body of research, the bulk of which suggests that the federal SCC is conservative and likely underestimates the economic impact of climate change[7],[8].

The determined carbon cost, over the analysis term period of 20 years, is approximately 2.42 cents per kWh. This value was calculated according to TVA's annual carbon intensity (provided by TVA) and the value associated with the generation avoided by 2,000 MW of solar PV at a 3 percent average discount rate. The SCC was scaled at a 2 percent increase per year over the modeling horizon (2015-2033).[9]

Those opposed to inclusion of SCC within the DG-IV methodology were primarily concerned with the uncertainty of the SCC values, application of SCC within the DG-IV process, the analytical rigor of the SCC modeling process, and inappropriate application of the SCC to a specific sector (electric power) and localized vs. global allocation. The primary document referenced to justify these concerns, was the Executive Summary of 'Understanding the Social Cost of Carbon: A Technical Assessment' produced by EPRI in October 2014[10].

Common Pollutant Impacts
TVA complies with regulations governing the emissions of EPA's criteria pollutants, which is incorporated as part of the system portfolio analysis described in the 'Environmental Compliance Value'. However, some participants in the DG-IV group believe that additional health effects and monetary damages associated with public exposure to common air pollutants should also be considered. These considerations are primarily driven by asserted adverse effects on human health, but also include some other values such as reduced yields of agricultural crops and timber and damages due to lost recreational services.

Those in favor of valuing 'Common Pollutant Impacts' within the DG-IV process utilized an Air Pollution Emission Experiments and Policy (AP2)[11] model to conduct preliminary analysis. Using that model, and

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[7] Interagency Working Group on Social Cost of Carbon (2010) and (2013); Greenstone, Kopits and Wolverton (2011). Pindyck, R. S. (2013); Climate Change Policy: What do the models tell us? (No. w19244). National Bureau of Economic Research; Nordhaus, William D. 2011 "Estimates of the Social Cost of Carbon: Background and Results from the RICE-2011 Model." National Bureau of Economic Research Working Paper 17540.
[8] Southern Environmental Law Center, Southern Alliance for Clean Energy and TenneSEIA (2014). The Cost of Carbon to the Tennessee Valley.
[9] Ed Regan, P.E., Strategic Utility Management LLC (2014). Social Cost of Carbon Methodology.
Original methodology submitted to the Tennessee Valley Authority Distributed Generation-Integrated Value Stakeholder Group.
[10] Electric Power Research Institute (2014). Understanding the Social Cost of Carbon: A Technical Assessment, Executive Summary. EPRI, Palo Alto, CA. Report number 3002004699.
[11] Muller, N. Z., & Mendelsohn, R. (2007). Measuring the damages of air pollution in the United States. *Journal of Environmental Economics and Management,54*(1), 1-14.

given TVA's current profile, results of an analysis[12] conducted by a third party retained by the stakeholder group[13] estimated the societal cost associated with common pollutants of SO2, VOCs, NOx, PM2.5, PM10 and NH3 to be $35.76/MWh.

A group of DG-IV participants opposed the inclusion of this additional value relating to common air pollutants, cited that TVA is in compliance with regulations governing the emissions of EPA's criteria pollutants, which is incorporated as part of the system portfolio analysis described in the 'Environmental Compliance Value'. In addition, TVA has spent over $5.6 billion from 1977-2013 to reduce these emissions.

Water Impacts

Water impacts associated with water consumption due to electrical energy generation were additionally explored. Multiple approaches to investigate water impacts were discussed, such as competing economic uses, reliable drinking supply and ecosystem stability. A group of DG-IV participants proposed to assess the value that distributed solar provides as a buffer from the marginal or system impacts of decreased thermoelectric generation in times of drought or heat waves. Using the method proposed by the these participants, from 2003 to 2012, thermal derates at TVA Fossil and Nuclear plants cost an average of $0.06/MWh due to the cost of replacement power. [12]

Other DG-IV participants cited TVA's policy on integrated river management. TVA's policy on operating an integrated river management system optimizes flow requirements to enhance flood risk reduction, navigation and power generation and, consistent with these purposes, recreation, protecting water quality and aquatic resources, and providing water for municipal and industrial use.

Determination on Additional Environmental Considerations

Regarding the inclusion of these additional environmental considerations within the DG-IV methodology, the individual in the DG-IV group did not agree on the inclusion of SCC within the DG-IV methodology, which reflects a broader lack of consensus on a national level. The SCC will be addressed only after industry regulation or strong national consensus provides a consistent basis for its consideration and inclusion. If the SCC becomes part of national regulation, the DG-IV methodology would incorporate it into the 'Environmental Compliance Value' discussed previously. Similarly, no consensus was reached on including common air pollutants and it was not included in the methodology at this time. Finally, as TVA operates as an integrated system, any additional value associated with water impacts is already included in its system optimization.

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[12] The analysis using the AP2 model was led by Caroline Burkhard Golin, of The Greenlink Group and Georgia Institute of Technology. It builds off other studies which utilized AP2, such as: "Evaluating the Risks of Alternative Energy Policies: A Case Study of Industrial Energy Efficiency" (Brown, Baer, Cox and Kim (2014); Energy Efficiency Journal).

[13] Caroline Golin, The Greenlink Group (2014), Additional Explanation of Methodologies Underlying Additional Environmental Considerations Section, submitted by the Southern Environmental Law Center

TVA believes that considering broad perspectives on issues such as environmental impact added significantly to the DG-IV process. While consensus could not be reached, all participants found value in the conversations and unanimously supported the inclusion of all points of view within this document. TVA encourages all interested parties to see Appendix A for a list of additional references that were provided by the DG-IV group around these issues.

Transmission System Impact & Losses

The primary component for solar PV's transmission system impact is transmission spending deferral by reducing localized peaks. As discussed below, this component is not trivial to calculate, as it varies by location. Transmission system loss improvements result from solar PV being located closer to the load than centralized utility generators. Loss improvements also vary by location, but computer simulation tools make it possible to calculate an average loss improvement for all locations on the TVA grid.

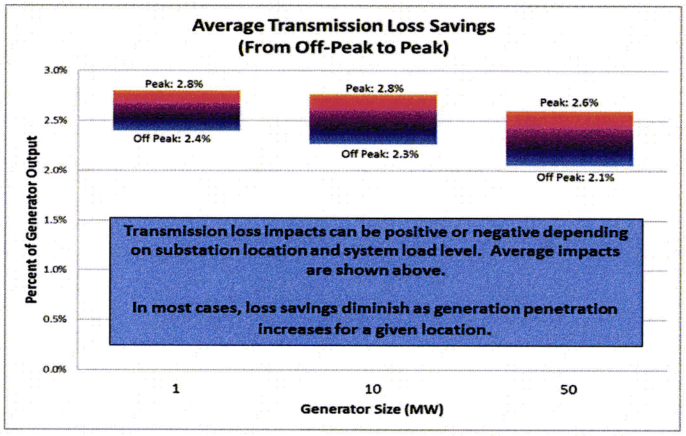

Fig. 8: *Average Transmission Loss Savings*

Load growth and forecast transmission spending requirements were studied, along with peak timing, to determine if a transmission deferral associated with solar PV deployment was appropriate. Timing of the transmission spend is critical to the value calculation. TVA explored three different transmission impact case studies that framed the positive, neutral, and negative impacts to the TVA transmission system. In this initial analysis, several factors were found to be key contributors in impacting potential transmission investment: location (matching sites with solar PV and transmission benefit), winter vs. summer peaking location, forecast load growth, and the generation geographic footprint. A transmission impact value can be derived from considering peak coincidence factors, load growth, NDC, solar PV energy profiles, and avoided capacity costs. The positive transmission impact scenario was selected based on the assumption that solar PV projects being approved by TVA would be done so in a manner that was increasingly favorable towards enhancing the existing grid infrastructure.

Another transmission impact calculation method was proposed by a DG-IV participant and was analyzed by TVA. This proposal focuses on TVA's point-to-point transmission service rate along with peak factors for each month. This transmission service rate is comparable to savings resulting from reducing monthly peak demand by installing solar PV generation. This proposed approach produced very similar values as the initial calculation, but utilized a more simplified calculation method and was therefore adopted by the DG-IV group. The calculated levelized value for the transmission impact value is 0.43 cents/kWh.

As part of the transmission loss analysis, all of TVA's transmission buses (arrays of switches used to route power in a substation) were investigated on an individual basis. Load flow modeling analysis was applied to roughly 1,300 transmission substation buses to investigate the effects of solar PV on various load pockets across the TVA transmission system. To remain consistent with the 2,000 MW of AC solar PV analyzed in other parts of the DG-IV methodology, equal distribution of the solar PV was applied across the substation buses resulting in roughly 1-2 MW AC of solar PV per substation bus. This became the basis for the selection of a 1 MW AC PV system for both the transmission impact and loss analysis.

Transmission losses can be analyzed in several different forms. Some of the primary methods are to utilize actual observed losses, apply an average loss value, or develop a marginal loss value based on modeling. Marginal losses are the difference between losses with and without PV resources and typically account for peak and off-peak conditions. Although transmission loss impacts can be positive or negative and are location specific, an average marginal loss savings value per unit of solar PV capacity was utilized. Lower generation levels are typically absorbed by nearby loads. Higher generation levels can exceed the area loads and require the transmission system to carry the excess generation to loads further away. Therefore, the value of average marginal loss savings tends to diminish as solar PV aggregation is increased for a given location (Figure 8, page 15). As mentioned previously, the 1 MW AC solar PV case was utilized to develop an average transmission loss value of 2.6%.

Distribution System Impact & Losses

One of TVA's primary roles is to serve as a generation and transmission utility serving the 59 directly served industrial customers and 155 local power companies, who in turn serve the 9 million people across the Tennessee Valley region. The public power model we enjoy in the Valley supports both region-wide planning and cost efficiency in generation and transmission, coupled with the local control and decision making in distribution. As such, acquiring access to the individual feeders of all 155 local power companies would be a very challenging endeavor.

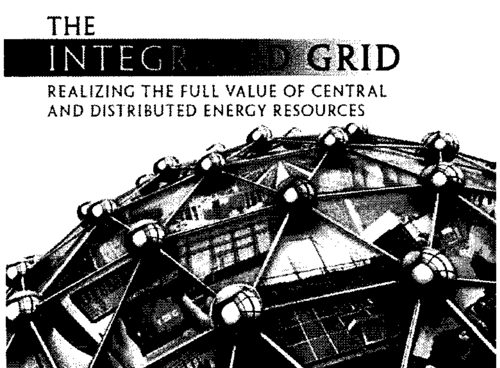

Fig. 9: *EPRI's Integrated Grid Initiative*

Within the scope of this initiative, TVA analyzed selected feeders across the region to gain further understanding and to help validate the approach. Similar to the 'Environmental Component', much deliberation and discussion was held by the DG-IV group on this topic. Two system attributes were analyzed - distribution impact and distribution net marginal losses. The distribution impact component analyzes the effect of DG on distribution system capacity, voltage, and protection while the distribution net marginal losses component analyzes increases or decreases in energy due to the DG.

The distribution analysis leverages work from EPRI's "Integrated Grid" Initiative[14] (Figure 9), which includes an impact evaluation of DG on local distribution systems. EPRI's method is unique in

[14] Electric Power Research Institute (2015).The Integrated Grid: A Benefit-Cost Framework," EPRI, Palo Alto, CA. Report number 3002004878.

comparison to other industry distribution impact studies. EPRI accounts for the detailed characteristics of each feeder and individual DG technology, unique operational response of the feeder to DG, and the specific placement of DG within the distribution system. This is done through a streamlined approach[15] without the need for a costly, time intensive feeder-by-feeder analysis. The analysis method is in-line with current distribution system planning practices. Furthermore, EPRI is working with distribution planning software companies to incorporate the approach in future software packages that will make the analytic capabilities widely available across the utility industry.

The concept of feeder hosting capacity[16] forms the core of the distribution analysis process, focusing on accommodating PV while maintaining established standards of reliability and power quality. Hosting capacity is defined as the amount of DG a feeder can support under its existing topology, configuration, and physical characteristics. When the hosting capacity is reached, any further additions will result in a deterioration of service until remedial actions are taken. The amount of DG that can be accommodated is unique to every feeder and can be correlated to a combination of feeder performance characteristics (e.g., voltage, protection, power quality, construction/design, and loading) as well as the location of the DG resource on the feeder.

To provide the complete analytical perspective of additional DG on a feeder, the hosting capacity is increased through a series of mitigation options (distribution system upgrades) while at the same time accounting for the costs and benefits the DG resource provides to the distribution system. To complete this ground up approach, a benefit-cost analysis then converts all of the associated costs and benefits into a representative monetary value range.

DG also has the potential to reduce distribution losses because the generation is provided closer to the point of energy consumption by customers. For this effort, a marginal loss approach is being used. Marginal losses are the difference between losses with and without PV resources and typically account for peak and off-peak conditions. The extent to which DG can reduce distribution losses depends on the location of the resource and the time for which the energy is provided to the grid. Since the electrical resistance of a distribution conductor is directly proportional to the distance or length of the line, the resistive losses can be reduced by siting generation sources closer to the customer load. The distance from the customer load may vary depending on the coincidence of generation and local load levels. Feeder losses are analyzed by performing an annual hourly simulation to capture the energy performance of the feeders under varying DG penetration levels and deployment scenarios. The results from the analysis include detailed loss results at increasing penetration levels for the selected feeders.

[15] Electric Power Research Institute (2014). A new method for characterizing distribution system hosting capacity for DER: A streamlined approach for PV," EPRI , Palo Alto, CA. Report number 3002003278.
[16] Electric Power Research Institute (EPRI) (2013). Distributed photovoltaic feeder analysis: Preliminary findings from hosting capacity analysis of 18 distribution feeders," EPRI , Palo Alto, CA. Report number 3002001245.; Electric Power Research Institute (2012). Stochastic Analysis to Determine Feeder Hosting Capacity for Distributed Solar PV," EPRI, Palo Alto, CA. Report number 1026640.

To illustrate and validate the overall methodology, previous research[17] on a set of typical Tennessee Valley distribution feeders was leveraged. From a starting point of sixteen feeders of varying length, voltage class, and design, five were chosen for the detailed hosting capacity analysis. Upon completion two of the five feeders were chosen to compute example results. In each of these steps, best efforts were made to select feeders that would test the methodology and reveal a range of costs and benefits for the distribution grid. A penetration level of 500 kW was chosen for performing the analytics on each of the two feeders. This is the approximate penetration level that 2,000 MW AC of solar PV would represent when scaled down from a TVA system-wide perspective to a selected distribution feeder. This approach was selected to remain consistent with the 2,000 MW of AC solar PV analyzed in other parts of the DG-IV methodology. Table 4, on the following page, provides an overview of the distribution analysis in this effort.

[17] Electric Power Research Institute (EPRI) (2013). Distributed photovoltaic feeder analysis: Preliminary findings from hosting capacity analysis of 18 distribution feeders," EPRI , Palo Alto, CA. Report number 3002001245.

Table 4: *EPRI Distribution Component Analysis*

Analysis Topic	Focus Area	Description	Key Finding (based on 2 feeder study)
Distribution Impacts	Distribution Capacity	Net feeder demand reduction and relief on capacity of existing distribution infrastructure (potentially deferring capacity upgrades and equipment life)	Minimal capacity deferral was seen due to lightly loaded feeder with abundant available capacity for growth
	Voltage	Analysis of overvoltage deviation and voltage regulation issues due to PV along with mitigation options and associated costs	One of the two feeders required mitigation due to voltage issues. Several options were determined to mitigate the issue and the associated costs were compared.
	Protection	Analysis of protection coordination issues due to changes in fault current along with mitigation options and associated costs	Neither feeder required mitigation due to protection issues at or below 1MW of PV generation
Distribution Net Marginal Losses	Losses	Reduction in distribution line and transformer losses due to the PV being located closer to the load	Loss reduction varied based upon the feeder characteristics, ranging from 1.7% to 3.8% at 0.5 MW of PV penetration
	Energy Consumption	Effect of customer-based PV on delivery voltages that may increase local energy consumption due to higher delivery voltages.	Increased consumption ranged from 0.9% to 1.4% at 0.5 MW of PV penetration. This value is subtracted from the losses calculation.
Economic Analysis	Net Financial Impacts	Cost/Benefit analysis	

The analysis results from the two example distribution feeders are as follows:

1. *Distribution Impacts* - For the two example feeders, minimal system benefits were observed. Based on this preliminary analysis, the calculated distribution impact value ranged from 0 cents/kWh to a cost of 0.185 cents/kWh at 0.5 MW of PV penetration. This was primarily due to the fact that with current loading and planned growth, both feeders will not be capacity constrained for the foreseeable future and one feeder required mitigation to address voltage issues due to the PV. This finding may be feeder specific, the result of LPC planning practices, or both. *Rather than assign the average value of -0.09 cents/kWh for distribution impact, participants in DG-IV group agreed to assign an initial value of 0 cents/kWh, pending further data analysis.*

2. *Distribution Net Marginal Losses* - Distribution losses were reduced by the local PV generation. However, local energy consumption actually increased due to higher local voltages from the PV

generation. The increased energy consumption is a consequence of distributed PV systems being local generators, a resultant increase in local voltage, and higher energy consumption due to this boosted voltage. The increased energy consumption was approximately one percent increase at 0.5 MW of PV penetration. This increase in energy consumption resulted in a decrease in the net marginal distribution loss reduction for the two feeders studied. *The example DG-IV methodology value used for Distribution Net Marginal Losses is 1.6%, calculated at a 0.5 MW AC PV penetration level. This represents an average value of the two feeders analyzed (0.8% to 2.4%).*

The distribution component captured as part of the DG-IV methodology encompasses a generalized distribution impact value for the LPC community and demonstrates how the value is derived on two example feeders. Future research will inform this analysis and the DG-IV methodology as it is expanded to an entire LPC distribution system. As knowledge in this area develops, there may be a need for individual LPCs to either add to or subtract from this generalized value. This type of value modification, and potentially others, is best addressed outside of the DG-IV methodology. For this reason, an "LPC Costs and Benefits" component has been included under the program design considerations category. This approach enables TVA to establish an initial valuation method for distribution impacts and losses, while at the same time allowing the flexibility for LPCs to make representative adjustments based on their individual distribution grid systems.

DG-IV Example Values

Table 5 (located on page 23) presents example values derived from the calculation methods described. A few points of clarification are necessary to ensure that the DG-IV example value presented is clearly understood.

1. **The example value is intended to be representative not definitive.** The primary purpose of the DG-IV process is to determine a methodology that provides a firm foundation for DG valuation, while at the same time enabling flexibility and adaptability to respond to future change. Therefore, the example value presented should be viewed as a representative sampling, not as a definitive number that is indefinitely representative of a solar PV value. Rather, the methodology itself is to be viewed as a robust analytical foundation and basis for further investigation.

2. **Some values required further analysis.** As can be seen in Table 5, the distribution components have been footnoted. These footnotes express that the current data set applied is not adequately robust to pinpoint a representative value. The numerical values expressed are preliminary and require further optimization and analysis.

3. **The example value only reflects the DG-IV methodology components.** As stated previously and expressed visually in Figure 1, the methodology components expressed are intended to represent solid, quantifiable, and defensible analytics. Additional benefits or costs may be applied as part of a program design considerations or as future placeholder topics. Ultimately, this categorization approach provides a robust methodology that is able to adapt to changing conditions.

4. **The example value is presented as both an average and first year value.** (Figure 10) The average value represents the flat, or levelized value, as expressed over a twenty year period with the same net present value as the annual values. The annual cost indicates how the value would change annually and provides a representative first year value.

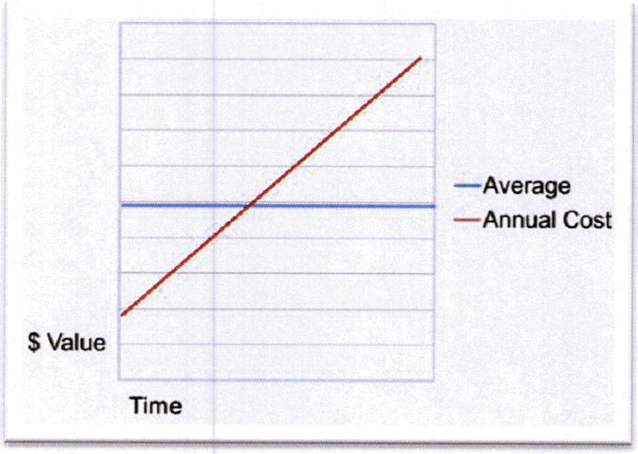

Fig. 10: *Average vs. Annual Cost*

Using a levelized or fixed number presumes a value proposition over 20-years that is consistent with the current perspective and key inputs. The value of distributed solar to TVA is subject to considerable uncertainty and will likely change over time. Any actual "fixing" of a value would shift risk to TVA.

5. **Transmission and distribution losses impact most – but not all – components of the DG-IV.** Regarding the utilization of a loss value in the DG-IV methodology, both transmission and distribution losses can be treated as independent components or as combined multipliers applied to the other methodology components. TVA has selected the latter approach as a representative means to capture the value of losses across both the bulk and distribution grid network. The only value not multiplied by loss savings is the environmental market value. This is done to reflect the fact that this value is completely independent of typical system capacity and energy analysis and functions as a standalone environmental component.

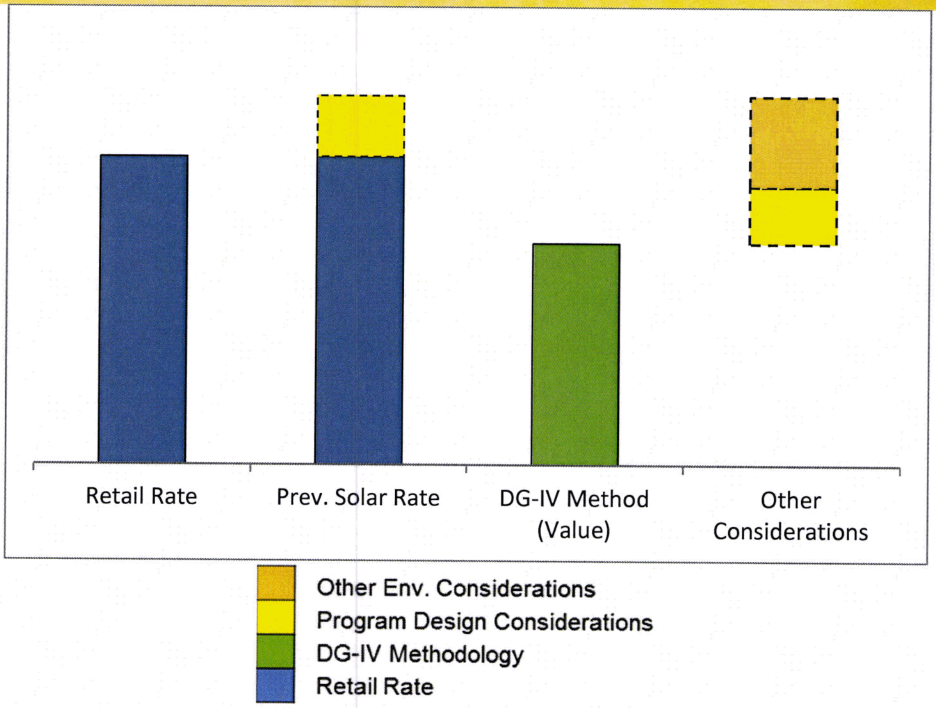

Fig. 11 *Retail Rate vs Value* ***<u>(illustrative)</u>***

6. **The example value is less than the current retail rate** (Figure 11). Based on the methodology outlined, and using the component values discussed in this report, the calculated DG value for solar PV small systems, which represents the solar-specific avoided cost to TVA, is below the current average retail rate in the TVA service territory, and is less than the solar rate currently being offered by TVA (an incentive paid above the retail rate). However, the example value does not reflect any program design considerations that could act as potential incentives for solar deployment in addition to the DG-IV "price signal". The DG-IV price signal is a reasonable value on a system-wide basis; the difference between the solar rate and the DG-IV price signal represents an opportunity to explore additional incentives that are locational and/or driven by LPC benefit/cost considerations. However, the chart is not intended to imply that incentives will definitely be added to the system value to ensure the composite is equal to the existing solar rate. Now that value stream components of solar have been identified, and a methodology for quantifying value streams is established, appropriate incentives can be explored. These issues will be investigated in subsequent program design efforts.

Table 5:
*DG-IV Calculation and **Example Values***

Values Provided are for Illustrative Purposes Only

DG-IV Methodology Components	20-Year Average Example Values (¢/kWh)[a]	Boundary Conditions & Additional Comments
Generation Deferral (G)		Total Solar Penetration = 2000 MW AC solar; Solar Penetration Rate = All loaded into model in 1st year; Solar NDC = 50%
Capital	1.3	
Fixed O&M	0.2	
TOTAL	1.5	
Avoided Energy (E)		NOTE: Values for Generation Deferral and Avoided Energy are derived from base condition input ranges at a defined point in time. These values will change across various planning horizons and can range between +/- 15% or more of the values listed
Fuel	4.4	
Variable O&M	0.1	
Start-Up	0.1	
TOTAL	4.6	
Environmental		
Compliance (ENVC)	0.2	Compliance – CO2 proxy cost curve beginning in 2022
Market (ENVM)	0.1	Market – Voluntary REC value ($1/MWh) applied from 2015-2021 at an 1.9% escalation rate
Transmission Impact (T)[b]	0.4	Point-to-Point Transmission Service Rate = $1.73 per kw-month
		Solar NDC = 50%
		Escalation rate = 2% per year
Distribution Impact (D)[c]	0	Total Solar Penetration = 0.5 MW AC on feeder
		Solar Penetration Rate = All loaded in 1st year
Losses		
Transmission Losses (TL)	2.6%	Transmission – Average marginal loss savings at 1 MW AC
Distribution Losses (DL)	1.6%	Distribution – Average net marginal loss savings at 0.5 MW AC
DG-IV Calculation	(G + E + ENVC + T + D) * (1 + TL + DL) + ENVM	
DG-IV Example Value	7.2	20 Year Average Value[d] - approximate value that is subject to change (from base condition input ranges at a defined point in time)
	5.7	1st Year Value[e] - approximate value that is subject to change (from base condition input ranges at a defined point in time)
Values Provided are for Illustrative Purposes Only		
Carbon Impacts[f]	0-2.4	Based on the social cost of carbon and the projected carbon intensity of the TVA generation fleet.
Common Pollutant Impacts[f]	0-3.5	Estimated societal cost associated with common pollutants of SO2, VOCs, NOx, PM2.5, PM10 and NH3
Water Impacts[f]	0-0.01	The value that distributed solar provides as a buffer from the marginal or system impacts of decreased thermoelectric generation in times of drought or heat waves. Based on the replacement cost of power related to thermal derates (fossil and nuclear).

[a] All values are levelized over 2015-2034 at an 8% discount rate
[b] This value may be revised to include integration costs (if applicable)
[c] Additional explanation provided in 'Distribution Impact & Losses' section of this document
[d] See Figure 10 for further explanation of average vs. 1st year value
[e] Based on a 3% escalation rate
[f] These values, proposed by stakeholders, did not gain group consensus. They are shown here for information only and are not included in the example calculation.

TVA finds considerable value in undertaking the development of this methodology, and especially appreciates the input, review, and insights of individuals on the DG-IV working group. They spent significant time to help us develop a robust approach grounded in solid, quantifiable, and defensible analytics that can serve as a robust basis for DG valuation. We value their involvement and expertise on behalf of all our stakeholders. We look forward to continued meaningful engagement with our stakeholders.

ABBREVIATIONS/ACRONYMS

AC	Alternating Current
AP2	Air Pollution Emission Experiments and Policy model
CF	Capacity Factor
CO^2	Carbon Dioxide
CPR	Clean Power Research
DC	Direct Current
DG	Distributed Generation
DG-IV	Distributed Generation - Integrated Value
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
GPP	Green Power Providers
IRP	Integrated Resource Plan
kW	Kilowatts
kWh	Kilowatt-hour
LPCs	Local Power Companies
MW	Megawatts
MWh	Megawatt hour
NDC	Net Dependable Capacity
NH3	Ammonia
NOx	Nitrous Oxide
NYMEX	New York Mercantile Exchange
O&M	Operations & Maintenance
PM 2.5	Particulate Matter (2.5 micrometers in diameter)
PM 10	Particulate Matter (10 micrometers in diameter)
PV	Photovoltaic
REC	Renewable Energy Credit (or Certificate)
RPS	Renewable Portfolio Standards
SEPA	Solar Electric Power Association
SCC	Social Cost of Carbon
SO2	Sulfur Dioxide
SREC	Solar Renewable Energy Credit
TVA	Tennessee Valley Authority
TVPPA	Tennessee Valley Public Power Association
VOC	Volatile Organic Compounds
VOM	Variable Operations & Maintenance

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Technical Appendix: Solar Modeling Assumptions

(extracted from the 2015 IRP Report - Appendix B)

Solar resources are energy-limited and therefore dispatched in TVA's resource planning model using an hourly energy production profile to ensure that solar generation is not utilized by the model when the sun is not available. Solar resources also are similar to the capacity-limited wind resources where the availability of the unit at the time of the TVA system peak is less than the full nameplate capacity. We applied a 68 percent capacity credit for the utility tracking unit and a 50 percent capacity credit for the fixed axis options.

Wind and solar resources have unique operating characteristics that are different from thermal and other more traditional resources. To properly account for the contribution from these intermittent resources, the energy contribution is represented using hourly energy profiles that are imported into the model, and the seasonal capacity of these resources is represented by a computed Net Dependable Capacity (NDC) value. The annual capacity factor of the hourly energy profiles are also computed to ensure the total amount of energy is comparable to industry benchmark sources.

Solar resources are weather and location dependent. Modeling of solar options in resource planning studies requires determination of solar shapes, capacity factors and NDC values. Solar data was provided by members of a stakeholder group who commissioned Clean Power Research (CPR) to provide TVA with the solar energy profiles for 26 sites across the Tennessee Valley shown in the map below. CPR provided SolarAnywhere® data for 15 plus years of consistent, validated, time-series irradiance measurements that provided the historical basis for the NDC, capacity factors and hourly energy patterns.

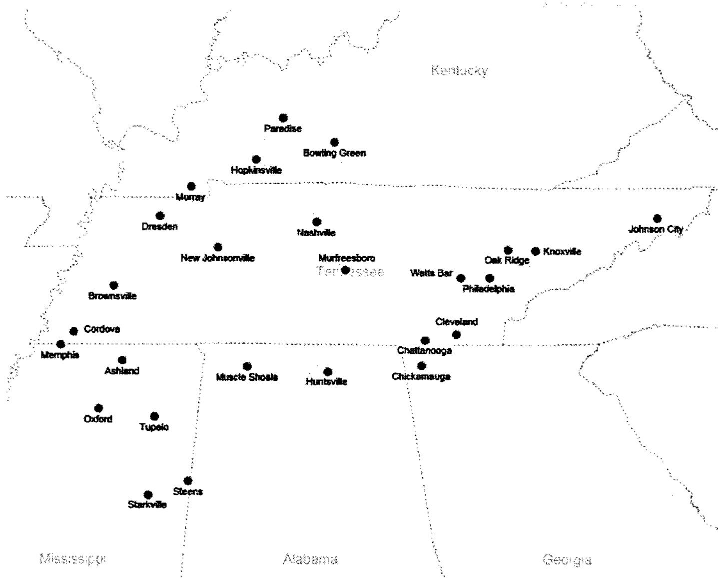


Figure B-1: Sites across Tennessee Valley with historical solar irradiance data supplied by CPR

Solar Capacity Factors

Using the data supplied through CPR, TVA determined that annual capacity factors are 20 percent for the fixed axis and 23 percent for the single-axis tracking option. The monthly capacity factors vary as shown in the following chart.

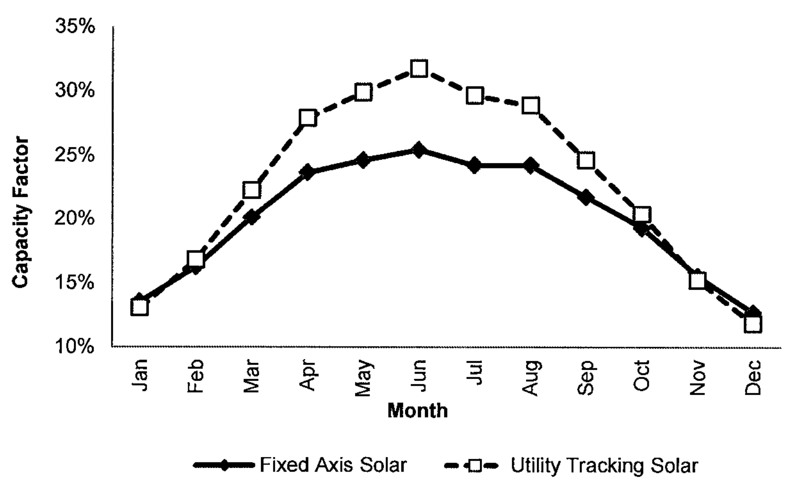


Figure B-2: Solar Fixed Axis and Utility Tracking Capacity Factors by Month

Solar NDC values

Planners must determine how much solar generation is likely at the system peak hour so that appropriate credit can be given to this resources when computing the capacity/load balance to determine if the required reserve margin has been met in a given year. That capacity credit value is called the Net Dependable Capacity (NDC).

The NDC is applied to the nameplate capacity and is used by the expansion planning model to meet the 15 percent reserve margin requirement. It is calculated in a six-step process and repeated for annual, summer and winter periods:

1. For each year of the sample period, select the summer season (June-Sept).
   - TVA focuses this process on the summer because the system peak occurs in that season.
2. Identify the top 20 load days of the summer.
   - Using the top 20 days in the summer produces a distribution of solar PV generation in the sample year.
3. Find the peak hour for each of those top 20 days.
4. Determine the solar generation for each of those 20 peak hours and convert to capacity factors.
   - These generation values are converted to capacity factors by dividing the hourly generation by the nameplate capacity of the resource.
5. Choose the 25th percentile of this capacity factor distribution.
   - TVA selects the 25th percentile value to ensure that solar generation at the time of the system peak will exceed this value 75 percent of the time.
6. Then these 25th percentile annual capacity factor values are averaged across all the years of the sample to produce the NDC used for planning purposes.

The figure below shows the range of NDC values for solar fixed-axis systems computed using data covering the period 1998-2013:

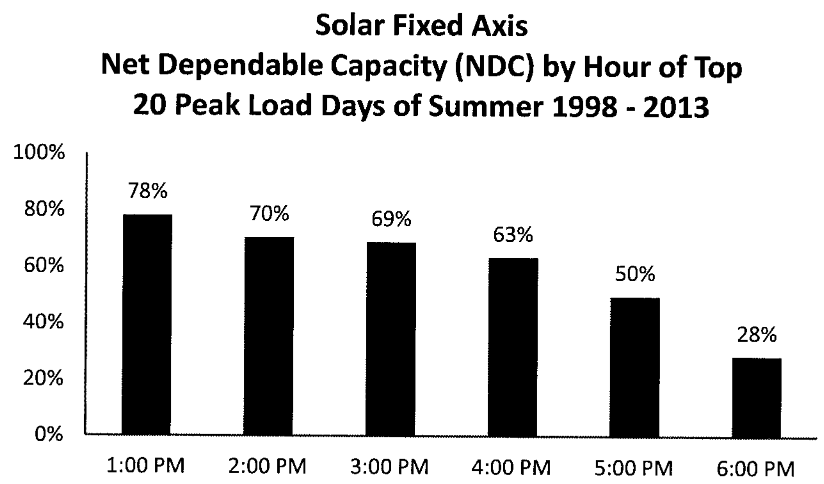
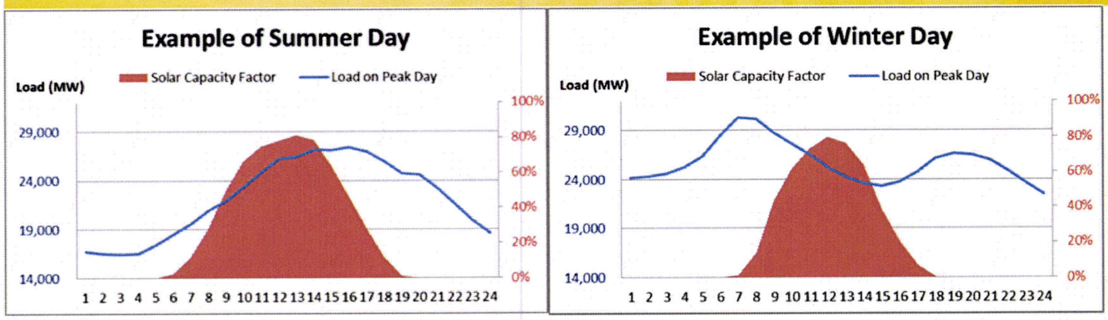


Figure B-3: NDC by hour of the top 20 peak load days of Summer 1998-2013

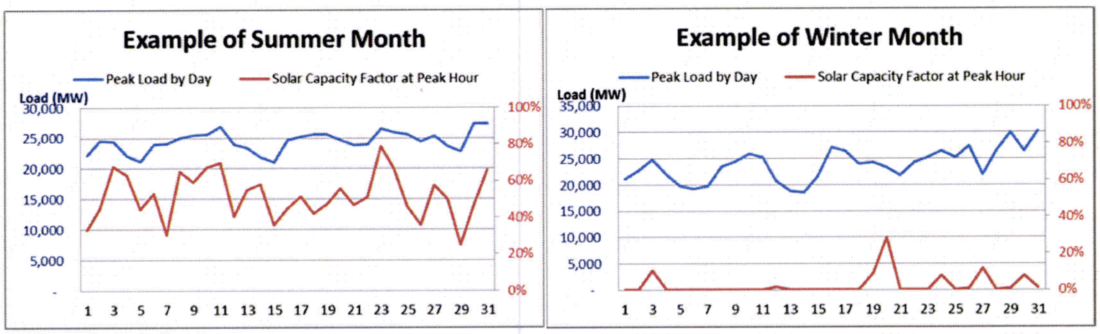
In the summer, TVA normally has a peak load at 5:00 p.m. EST, but can also see a peak load between the hours of 2:00 p.m. and 6:00 p.m. EST. The 25th percentile of solar generation of those hours would occur at 5:00 p.m. or 6:00 p.m. EST as the sun is setting. Therefore, the summer NDC was set at 50 percent for fixed axis, including utility scale, small and large-commercial. The utility tracking option has a 68 percent NDC.

All solar options have a 0 percent NDC during the winter, since TVA's winter peaks normally occur at 7:00 a.m. EST when solar is not available.

The figures below show the alignment of the solar production shape used in both the IRP and the DG-IV methodology with the system load shape. The first set of charts shows the alignment for a summer peak day and a winter peak day; the second set of charts displays the alignment of the peak load of each day with the solar production in that hour of peak load for a typical summer (July) and winter (January) peak month.



Example Solar Production Curve Compared to System Peak Days



Example Solar Production Curve Compared to System Peak Month

Rooftop Solar Policy

Distributed or rooftop solar power delivers many benefits. It puts energy consumers in charge of their own power sources and utility bills. Locally produced clean power can also reduce expensive grid infrastructure costs, line losses and harmful air pollution – which benefits us all. These state and local policies help Americans meet their own energy needs with solar power:

Net Metering:

Like rollover minutes on a cell phone bill, net metering gives solar energy customers full credit on their utility bills for the excess clean power they contribute to the grid. This simple crediting arrangement is one of the most important state policies for enabling Americans to generate their own power from the sun. See IREC's Net Metering Model Rules for best practices in state policy design (PDF). And learn more about our active campaigns to advance or defend net metering policy around the country at www.oursolarrights.org.

Rate Design:

The way that utility rates are structured has a tremendous impact on the pay-back of a customer' solar energy system. While rate design is complex, as a general rule, Time-of-Use rates and other structures that closely match customer charges with the true cost to the utility of delivering any given kwh help improve the economics of solar. High fixed charges that remain steady regardless of how much electricity the customer consumes discourage investment in solar and other energy saving measures. Rate design is closely related to net metering. Read our 6 guiding policies of good rate design here.

Interconnection:

Interconnection standards are the legal rules and procedures for "plugging" a customer's renewable energy system into the utility power grid. State regulators should ensure that these standards are transparent and efficient. See IREC's Model Interconnection Procedures for best practices in state policy design (PDF).

Local Permitting:

With solar technology costs at record lows, solar "soft" costs like local permitting represent the greatest opportunity for continued cost reduction. Long waits, high fees, excessive inspections, and avoidable paperwork can all add unnecessary costs to what should be a simple, transparent process at your local building permit office. Visit Vote Solar's Project Permit to learn more about permitting best practices.

Incentives:

Stable, long-term state or local incentives can help lower the upfront cost of going solar for customers and build a strong local solar marketplace that further drives down costs.

Financing Options:

When it comes to making rooftop solar a mainstream option, innovations in financing are as important as innovations in technology. Third-party PPAs, leases, PACE and on-bill financing all serve to transform the solar investment from a big upfront cost to manageable payments over time that more closely match the energy bill savings it delivers. State policy should clear the way for these kinds of business model innovations.

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New York: Bringing Reason to the Net Metering Conversation

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Solar Power

America's energy problems — from rising costs to global climate change — can be solved by a transition to clean energy. Reliable, homegrown solar energy is ready to be a large part of the solution. It is our fastest growing electricity source, but we have still just scratched the surface of our vast solar potential.

State of Play

Once a niche resource, solar is now an important part of our new energy economy. Tremendous price reduction and business innovation mean that Americans are plugging into solar power at record rates. Solar faces new challenges and opportunities for continued growth in this rapidly changing energy landscape.

Our Mission

Vote Solar is a non-profit organization working to foster economic opportunity, promote energy security and fight climate change by making solar a mainstream energy resource. We work at the state level all across the country to support the policies and programs needed to repower our grid with sunshine.

Join Us

We focus on making solar more accessible and more affordable to more Americans — and we could use your help. Get involved by joining Vote Solar. Sign up for email action alerts. Make a donation. Find us on Facebook. Follow us on Twitter. Most importantly: let your policymakers know that you support solar progress.

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Campaigns

Vote Solar works all across the country to support the policies and programs needed to repower our grid with sunshine. We focus on policies that make solar more accessible and more affordable to more Americans. And we could use your help!

State Campaigns

States have a proud tradition of driving solar energy progress in the U.S. These state campaigns are keeping us busiest ...

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Vote Solar was founded nearly 15 years ago with this plan: bring solar into the mainstream by supporting smart policies that make solar cheaper and ...

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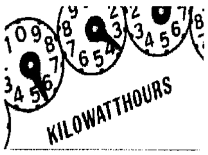

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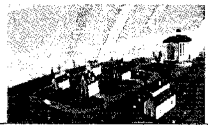
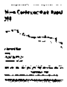


Project Permit

Like any home improvement project, you first need to get a building permit when you go solar. Those solar permitting ...

What's New


National Lab Report: Tracking the Sun


Big Win! New York Approves Solar for All


Introducing the new Shared Renewables HQ


Mass Solar Coalition Applauds Progress on Solar Policy Roadmap


What Hawaii can learn from the Sunshine State: Postcards from Florida


Diverse Support for NY Shared Solar Proposal


Break out the spandex: Vote Solar is doing Climate Ride Northeast


Equinox 2015: all it was quacked up to be


Vote Solar Announces 2015 Solar Champion Awards

States have a proud tradition of driving solar energy progress in the U.S. These state campaigns are keeping us busiest today:

Arizona

Arizona has more solar installed per capita than any other state in the nation. But now utilities are working behind ...

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California

Thanks to policy leadership, the Golden State is the most robust and diverse solar market in the United States. The state has ...

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- Diverse Support for NY Shared Solar Proposal
- Break out the spandex: Vote Solar is doing Climate Ride Northeast
- Equinox 2015: all it was quacked up to be
- Vote Solar Announces 2015 Solar Champion Awards

Arizona

Arizona has more solar installed per capita than any other state in the nation. But now utilities are working behind the scenes – and spending millions of dollars in high profile PR campaigns – to block Arizonans' right to go solar and reduce their power bills.

Despite strong opposition from its own customers, one of Arizona's largest utilities – Salt River Project (SRP) – approved a discriminatory solar rate hike that will cost the average customer $50 per month. SRP's anti-solar action has unleashed a flurry of proposals from other utilities for discriminatory fees or rates that make solar a bad deal for Arizonans.

By reducing the need for expensive and polluting traditional utility infrastructure, local solar power delivers savings to all Arizona energy users. Rooftop solar also means energy self-reliance for Arizona, cleaner air, local jobs, and finally, some much needed competition for the monopoly utilities. We need to encourage regulators at the ACC to recognize these benefits and stand strong for customer solar options in the state.

Resources:

Study: Net metered solar delivers $34 M in annual net benefits to APS customers (Source: SEIA)

Fact Sheet: Stop the Utility Power Grab (Source: Vote Solar)

Polling: Support for rooftop solar grows as APS approval drops (Source: TUSK)

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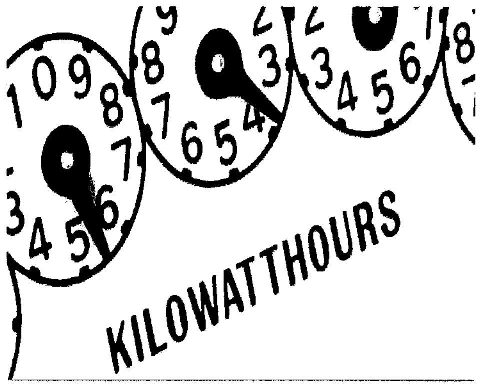

Net Metering

Like rollover minutes for a cell phone, net metering gives solar energy customers full credit on their utility bills for the excess clean power they contribute to the grid.

This simple billing arrangement is one of the most important state policies for helping Americans generate their own power from the sun. By encouraging private investment in local solar power, it's creating jobs, reducing utility costs, and building a cleaner energy future for us all.

It's fair. It's working. But now it's at risk in many states . . .

Utilities around the country view more rooftop solar as a threat to their old way of doing business. They're attacking net metering rather than finding new ways to make solar work for Americans.

We say the interests of a few monopoly utilities shouldn't outshine the rest of us.

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Vote Solar Board of Directors

Danny Kennedy is the managing director at CalCEF, a clean energy fund, and president of CalCharge, an energy storage consortium. He is also an entrepreneur, an activist, and the author of the book *Rooftop Revolution: How Solar Power Can Save Our Economy— and Our Planet—from Dirty Energy* (2012). He founded Sungevity, a leading global residential solar power company and is also Cofounder and President of the world's only Incubator and Accelerator for solar entrepreneurs - known as the SfunCube in Oakland, CA. Danny sits on the Boards of several solar start-ups including Mosaic, Powerhive and Sunergise. He serves with several non-profits including the Board of the Solar Foundation, the Clean Tech Council of the Sierra Club and WRI's New Innovators Council.

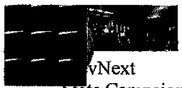
Sheridan Pauker is regulatory counsel in the San Francisco office of Wilson Sonsini Goodrich & Rosati. Her practice focuses on renewable energy, energy storage and energy efficiency regulation, incentives, and financing, with particular emphasis on state energy regulatory programs. Sheridan's expertise includes the development of novel public-private structures to finance and advance clean energy and energy efficiency improvements, including Property Assessed Clean Energy (PACE) and On Bill Repayment programs and legislation. She also advises clients regarding climate change regulation, including California's Global Warming Solutions Act (AB 32), and drafts and provides counsel regarding carbon offset transactions. Sheridan brings more than 15 years of experience in energy and climate policy and regulation, environmental law, finance, and sustainability. Prior to joining the firm, she practiced as an environmental fellow at Shute, Mihaly and Weinberger in San Francisco, and clerked for the Honorable Richard A. Paez of the U.S. Court of Appeals for the Ninth Circuit. Sheridan previously served as a financial advisor with a focus on sustainable investments in U.S. Bancorp Piper Jaffray's Social Equity Investment Group, and as an aide to U.S. Representative Henry A. Waxman.

Kate Gordon is vice chair of Climate and Sustainable Urbanization at the Paulson Institute, where she provides overall strategy and coordination for the Institute's climate change, air quality, and sustainable urbanization programs both in the US and China. She is also a Senior Fellow at the Center for American Progress and a regular contributor to the Wall Street Journal as one of the paper's "Energy Experts."

Gordon is a nationally recognized expert on the intersection of clean energy and economic development. Before joining the Paulson Institute, she was Senior Vice President for Climate and Energy at Next Generation, a non-partisan think tank based in San Francisco, where she worked on California policy development as well as large-scale national communications and research projects. While at Next Generation, she helped launch and lead the

"Risky Business Project," co-chaired by Michael Bloomberg, Henry Paulson, and Tom Steyer, and focused on the economic risks the U.S. faces from unmitigated climate change. Earlier in her career Gordon served as Vice President of Energy and Environment at the Washington D.C.-based Center for American Progress, where helped develop and author policy recommendations related to the Congressional cap-and-trade negotiations, Gulf oil spill, and American Reinvestment and Recovery Act implementation. Prior to CAP, Gordon was the Co-Director of the national Apollo Alliance (now part of the Blue Green Alliance). She still serves on the Apollo Alliance board.
Gordon earned a law degree and a master's degree in city planning from the University of California-Berkeley, and an undergraduate degree from Wesleyan University.

Kris Mayes is the founding faculty director of the Program on Law and Sustainability at Arizona State University's (ASU) Sandra Day O'Connor College of Law and is a member of the faculty at ASU's Global Institute of Sustainability. She served as an Arizona Corporation Commissioner (ACC) from 2003 to 2010, where she was also its chairman for two years. Prior to that, Kris was a reporter for the Arizona Republic and Phoenix Gazette newspapers, and worked as Arizona Governor Janet Napolitano's communications director. She received her B.S. in political science and law degree from ASU, and an M.A. in Public Administration from Columbia University in New York.



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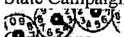

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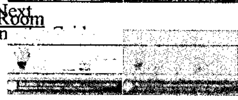
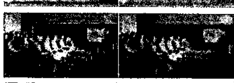


  - Fast Facts



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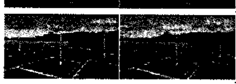

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Equinox 2015: all it was quacked up to be

By Adam Browning April 7, 2015

We have a lot of people to thank for making Equinox 2015 one of our best yet.

First and foremost, thanks to all our friends and colleagues who attended. Yes, there is photo documentation: party pics here, and the always infamous photo booth here. Those pics really quack us up.

Big thanks to the many local luminary policymakers who attended, including San Francisco Mayor Ed Lee, California Energy Commissioner David Hochschild, and Senator Mark Leno, co-author of the effort to expand California's renewable standard to a mind-blowing 50%. Not only are they all tremendous clean energy leaders, but they also had the career-lengthening sense not to duck in the photo booth.

We'd also like to thank this year's Solar Champions: Jacqui Patterson of the NAACP, Dr Ernest Moniz, and NRG/David Crane in the Utility category. Read our celebration of their accomplishments here. Thanks for your leadership, Champions.

Finally, a special thank you to our Equinox 2015 sponsors for their generous support: NRG Home Solar, Sungevity, Enphase Energy, Recurrent Energy, SolarCity, SunEdison, The Village, Wells Fargo, Borrego Solar, Clean Power Finance, Enact Systems, Keyes Fox & Wiedman LLP, NexTracker, Renewable Funding, Renovate America, SunPower, DBL Investors, Mosaic, Radian Generation and Sol Systems. You are all awesome — waddle we do without you?

Equinox is more than just a great party, or even a once-in-a-lifetime opportunity to ride a 7-foot duck. Proceeds go directly towards Vote Solar's continued dedication to making solar an affordable and accessible mainstream energy solution. We had a lot to celebrate this year – including 10x more solar in New York, developing Shared Solar programs to increase access, and fighting to defend fair solar rate design around the country. Here's our 2014 Annual Report with more details. While solar energy falls free from the sky, solar policy doesn't — so if you weren't able to join us for the event in person, please consider making a contribution today.

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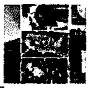

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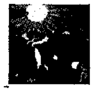

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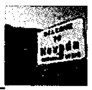

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defined in R14-2-1618(C)(1) and Solar Economic Development Extra Credit Multipliers as defined in R14-2-1618(C)(2)(b).

Historical Note

Adopted by an emergency action effective August 10, 1998, pursuant to A.R.S. § 41-1026, in effect for a maximum of 180 days (Supp. 98-3). Emergency adoption replaced by exempt permanent adoption effective December 31, 1998 (Supp. 98-4). Section R14-2-1618 renumbered to R14-2-1617 by exempt rulemaking at 5 A.A.R. 3933, effective September 24, 1999 (Supp. 99-3). New Section adopted by exempt rulemaking at 7 A.A.R. 1661, effective March 20, 2001 (Supp. 01-1).

ARTICLE 17. RESERVED

ARTICLE 18. RENEWABLE ENERGY STANDARD AND TARIFF

R14-2-1801. Definitions

A. "Affected Utility" means a public service corporation serving retail electric load in Arizona, but excluding any Utility Distribution Company with more than half of its customers located outside of Arizona.

B. "Annual Renewable Energy Requirement" means the portion of an Affected Utility's annual retail electricity sales that must come from Eligible Renewable Energy Resources.

C. "Conventional Energy Resource" means an energy resource that is non-renewable in nature, such as natural gas, coal, oil, and uranium, or electricity that is produced with energy resources that are not Renewable Energy Resources.

D. "Customer Self-Directed Renewable Energy Option" means a Commission-approved program under which an Eligible Customer may self-direct the use of its allocation of funds collected pursuant to an Affected Utility's Tariff.

E. "Distributed Generation" means electric generation sited at a customer premises, providing electric energy to the customer load on that site or providing wholesale capacity and energy to the local Utility Distribution Company for use by multiple customers in contiguous distribution substation service areas. The generator size and transmission needs shall be such that the plant or associated transmission lines do not require a Certificate of Environmental Compatibility from the Corporation Commission.

F. "Distributed Renewable Energy Requirement" means a portion of the Annual Renewable Energy Requirement that must be met with Renewable Energy Credits derived from resources that qualify as Distributed Renewable Energy Resources pursuant to R14-2-1802(B).

G. "Distributed Solar Electric Generator" means electric generation sited at a customer premises, providing electric energy from solar electric resources to the customer load on that site or providing wholesale capacity and energy to the local Utility Distribution Company for use by multiple customers in contiguous distribution substation service areas. The generator size and transmission needs shall be such that the plant or associated transmission lines do not require a Certificate of Environmental Compatibility from the Corporation Commission.

H. "Eligible Customer" means an entity that pays Tariff funds of at least $25,000 annually for any number of related accounts or services within an Affected Utility's service area.

I. "Extra Credit Multiplier" means a way to increase the Renewable Energy Credits attributable to specific Eligible Renewable Energy Resources in order to encourage specific renewable applications.

J. "Green Pricing" means a rate option in which a customer elects to pay a tariffed rate premium for electricity derived from Eligible Renewable Energy Resources.

K. "Market Cost of Comparable Conventional Generation" means the Affected Utility's energy and capacity cost of producing or procuring the incremental electricity that would be avoided by the resources used to meet the Annual Renewable Energy Requirement, taking into account hourly, seasonal, and long-term supply and demand circumstances. Avoided costs include any avoided transmission and distribution costs and any avoided environmental compliance costs.

L. "Net Billing" means a system of billing a customer who installs an Eligible Renewable Energy Resource generator on the customer's premises for retail electricity purchased at retail rates while crediting the customer's bill for any customer-generated electricity sold to the Affected Utility at avoided cost.

M. "Net Metering" means a system of metering electricity by which the Affected Utility credits the customer at the full retail rate for each kilowatt-hour of electricity produced by an Eligible Renewable Energy Resource system installed on the customer-generator's side of the electric meter, up to the total amount of electricity used by that customer during an annualized period, and which compensates the customer-generator at the end of the annualized period for any excess credits at a rate equal to the Affected Utility's avoided cost of wholesale power. The Affected Utility does not charge the customer-generator any additional fees or charges or impose any equipment or other requirements unless the same is imposed on customers in the same rate class that the customer-generator would qualify for if the customer-generator did not have generation equipment.

N. "Renewable Energy Credit" means the unit created to track kWh derived from an Eligible Renewable Energy Resource or kWh equivalent of Conventional Energy Resources displaced by Distributed Renewable Energy Resources.

O. "Renewable Energy Resource" means an energy resource that is replaced rapidly by a natural, ongoing process and that is not nuclear or fossil fuel.

P. "Tariff" means a Commission-approved rate designed to recover an Affected Utility's reasonable and prudent costs of complying with these rules.

Q. "Utility Distribution Company" means a public service corporation that operates, constructs, or maintains a distribution system for the delivery of power to retail customers.

R. "Wholesale Distributed Generation Component" means non-utility owners of Eligible Renewable Energy Resources that are located within the distribution system and that do not require a transmission line over 69 kv to deliver power at wholesale to an Affected Utility to meet its Annual Renewable Energy Requirements.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1802. Eligible Renewable Energy Resources

A. "Eligible Renewable Energy Resources" are applications of the following defined technologies that displace Conventional Energy Resources that would otherwise be used to provide electricity to an Affected Utility's Arizona customers:

1. "Biogas Electricity Generator" is a generator that produces electricity from gases that are derived from plant-derived organic matter, agricultural food and feed matter, wood wastes, aquatic plants, animal wastes, vegetative wastes, or wastewater treatment facilities using anaerobic digestion or from municipal solid waste through a

digester process, an oxidation process, or other gasification process.

2. "Biomass Electricity Generator" is an electricity generator that uses any raw or processed plant-derived organic matter available on a renewable basis, including: dedicated energy crops and trees; agricultural food and feed crops; agricultural crop wastes and residues; wood wastes and residues, including landscape waste, right-of-way tree trimmings, or small diameter forest thinnings that are 12" in diameter or less; dead and downed forest products; aquatic plants; animal wastes; other vegetative waste materials; non-hazardous plant matter waste material that is segregated from other waste; forest-related resources, such as harvesting and mill residue, pre-commercial thinnings, slash, and brush; miscellaneous waste, such as waste pellets, crates, and dunnage; and recycled paper fibers that are no longer suitable for recycled paper production, but not including painted, treated, or pressurized wood, wood contaminated with plastics or metals, tires, or recyclable post-consumer waste paper.
3. "Distributed Renewable Energy Resources" as defined in subsection (B).
4. "Eligible Hydropower Facilities" are hydropower generators that were in existence prior to 1997 and that satisfy one of the following two criteria:
   a. New Increased Capacity of Existing Hydropower Facilities: A hydropower facility that increases capacity due to improved technological or operational efficiencies or operational improvements resulting from improved or modified turbine design, improved or modified wicket gate assembly design, improved hydrological flow conditions, improved generator windings, improved electrical excitation systems, increases in transformation capacity, and improved system control and operating limit modifications. The electricity kWh that are eligible to meet the Annual Renewable Energy Requirements shall be limited to the new, incremental kWh output resulting from the capacity increase that is delivered to Arizona customers to meet the Annual Renewable Energy Requirement.
   b. Generation from pre-1997 hydropower facilities that is used to firm or regulate the output of other eligible, intermittent renewable resources. The electricity kWh that are eligible to meet the Annual Renewable Energy Requirements shall be limited to the kWh actually generated to firm or regulate the output of eligible intermittent Renewable Energy Resources and that are delivered to Arizona customers to meet the Annual Renewable Energy Requirements.
5. "Fuel Cells that Use Only Renewable Fuels" are fuel cell electricity generators that operate on renewable fuels, such as hydrogen created from water by Eligible Renewable Energy Resources. Hydrogen created from non-Renewable Energy Resources, such as natural gas or petroleum products, is not a renewable fuel.
6. "Geothermal Generator" is an electricity generator that uses heat from within the earth's surface to produce electricity.
7. "Hybrid Wind and Solar Electric Generator" is a system in which a Wind Generator and a solar electric generator are combined to provide electricity.
8. "Landfill Gas Generator" is an electricity generator that uses methane gas obtained from landfills to produce electricity.
9. "New Hydropower Generator of 10 MW or Less" is a generator, installed after January 1, 2006, that produces 10 MW or less and is either:
   a. A low-head, micro hydro run-of-the-river system that does not require any new damming of the flow of the stream; or
   b. An existing dam that adds power generation equipment without requiring a new dam, diversion structures, or a change in water flow that will adversely impact fish, wildlife, or water quality; or
   c. Generation using canals or other irrigation systems.
10. "Solar Electricity Resources" use sunlight to produce electricity by either photovoltaic devices or solar thermal electric resources.
11. "Wind Generator" is a mechanical device that is driven by wind to produce electricity.

B. "Distributed Renewable Energy Resources" are applications of the following defined technologies that are located at a customer's premises and that displace Conventional Energy Resources that would otherwise be used to provide electricity to Arizona customers:

1. "Biogas Electricity Generator," "Biomass Electricity Generator," "Geothermal Generator," "Fuel Cells that Use Only Renewable Fuels," "New Hydropower Generator of 10 MW or Less," or "Solar Electricity Resources," as each of those terms is defined in subsections (A)(1), (A)(2), (A)(5), (A)(6), (A)(9), and (A)(10).
2. "Biomass Thermal Systems" and "Biogas Thermal Systems" are systems which use fuels as defined in subsections (A)(1) and (A)(2) to produce thermal energy and that comply with Environmental Protection Agency Certification Programs or are permitted by state, county, or local air quality authorities. For purposes of this definition "Biomass Thermal Systems" and "Biogas Thermal Systems" do not include biomass and wood stoves, furnaces, and fireplaces.
3. "Commercial Solar Pool Heaters" are devices that use solar energy to heat commercial or municipal swimming pools.
4. "Geothermal Space Heating and Process Heating Systems" are systems that use heat from within the earth's surface for space heating or for process heating.
5. "Renewable Combined Heat and Power System" is a Distributed Generation system, fueled by an Eligible Renewable Energy Resource, that produces both electricity and useful renewable process heat. Both the electricity and renewable process heat may be used to meet the Distributed Renewable Energy Requirement.
6. "Solar Daylighting" is the non-residential application of a device specifically designed to capture and redirect the visible portion of the solar beam, while controlling the infrared portion, for use in illuminating interior building spaces in lieu of artificial lighting.
7. "Solar Heating, Ventilation, and Air Conditioning" ("HVAC") is the combination of Solar Space Cooling and Solar Space Heating as part of one system.
8. "Solar Industrial Process Heating and Cooling" is the use of solar thermal energy for industrial or commercial manufacturing or processing applications.
9. "Solar Space Cooling" is a technology that uses solar thermal energy absent the generation of electricity to drive a refrigeration machine that provides for space cooling in a building.
10. "Solar Space Heating" is a method whereby a mechanical system is used to collect solar energy to provide space heating for buildings.

11. "Solar Water Heater" is a device that uses solar energy rather than electricity or fossil fuel to heat water for residential, commercial, or industrial purposes.
12. "Wind Generator of 1 MW or Less" is a mechanical device, with an output of 1 MW or less, that is driven by wind to produce electricity.

C. Except as provided in subsection (A)(4), Eligible Renewable Energy Resources shall not include facilities installed before January 1, 1997.

D. The Commission may adopt pilot programs in which additional technologies are established as Eligible Renewable Energy Resources. Any such additional technologies shall be Renewable Energy Resources that produce electricity, replace electricity generated by Conventional Energy Resources, or replace the use of fossil fuels with Renewable Energy Resources. Energy conservation products, energy management products, energy efficiency products, or products that use non-renewable fuels shall not be eligible for these pilot programs.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1803. Renewable Energy Credits

A. One Renewable Energy Credit shall be created for each kWh derived from an Eligible Renewable Energy Resource.

B. For Distributed Renewable Energy Resources, one Renewable Energy Credit shall be created for each 3,415 British Thermal Units of heat produced by a Solar Water Heating System, a Solar Industrial Process Heating and Cooling System, Solar Space Cooling System, Biomass Thermal System, Biogas Thermal System, or a Solar Space Heating System.

C. An Affected Utility may transfer Renewable Energy Credits to another party and may acquire Renewable Energy Credits from another party. A Renewable Energy Credit is owned by the owner of the Eligible Renewable Energy Resource from which it was derived unless specifically transferred.

D. All transfers of Renewable Energy Credits shall be appropriately documented to demonstrate that the energy associated with the Renewable Energy Credits meets the provisions of R14-2-1802.

E. Any contract by an Affected Utility for purchase or sale of energy or Renewable Energy Credits to meet the requirements of this Rule shall explicitly describe the transfer of rights concerning both energy and Renewable Energy Credits.

F. Except in the case of Distributed Renewable Energy Resources, Affected Utilities must demonstrate the delivery of energy from Eligible Renewable Energy Resources to their retail consumers such as by providing proof that the necessary transmission rights were reserved and utilized to deliver energy from Eligible Renewable Energy Resources to the Affected Utility's system, if transmission is required, or that the appropriate control area operators scheduled the energy from Eligible Renewable Energy Resources for delivery to the Affected Utility's system.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1804. Annual Renewable Energy Requirement

A. In order to ensure reliable electric service at reasonable rates, each Affected Utility shall be required to satisfy an Annual Renewable Energy Requirement by obtaining Renewable Energy Credits from Eligible Renewable Energy Resources.

B. An Affected Utility's Annual Renewable Energy Requirement shall be calculated each calendar year by applying the following applicable annual percentage to the retail kWh sold by the Affected Utility during that calendar year:

2006	1.25%
2007	1.50%
2008	1.75%
2009	2.00%
2010	2.50%
2011	3.00%
2012	3.50%
2013	4.00%
2014	4.50%
2015	5.00%
2016	6.00%
2017	7.00%
2018	8.00%
2019	9.00%
2020	10.00%
2021	11.00%
2022	12.00%
2023	13.00%
2024	14.00%
After 2024	15.00%

The annual increase in the annual percentage for each Affected Utility will be pro rated for the first year based on when the Affected Utility's funding mechanism is approved.

C. An Affected Utility may use Renewable Energy Credits acquired in any year to meet its Annual Renewable Energy Requirement.

D. Once a Renewable Energy Credit is used by any Affected Utility to satisfy these requirements, the credit is retired and cannot be subsequently used to satisfy these rules or any other regulatory requirement.

E. If an Affected Utility trades or sells environmental pollution reduction credits or any other environmental attributes associated with kWh produced by an Eligible Renewable Energy Resource, the Affected Utility may not apply Renewable Energy Credits derived from that same kWh to satisfy the requirements of these rules.

F. No more than 20 percent of an Affected Utility's Annual Renewable Energy Requirement may be met with Renewable Energy Credits derived pursuant to R14-2-1807.

G. An Affected Utility may ask the Commission to preapprove agreements to purchase energy or Renewable Energy Credits from Eligible Renewable Energy Resources.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1805. Distributed Renewable Energy Requirement

A. In order to improve system reliability, each Affected Utility shall be required to satisfy a Distributed Renewable Energy Requirement by obtaining Renewable Energy Credits from Distributed Renewable Energy Resources.

B. An Affected Utility's Distributed Renewable Energy Requirement shall be calculated each calendar year by applying the following applicable annual percentage to the Affected Utility's Annual Renewable Energy Requirement:

2007 5%

2008	10%
2009	15%
2010	20%
2011	25%
After 2011	30%

The annual increase in the annual percentage for each Affected Utility will be pro rated for the first year based on when the Affected Utility's funding mechanism is approved.

C. An Affected Utility may use Renewable Energy Credits acquired in any year to meet its Distributed Renewable Energy Requirement. Once a Renewable Energy Credit is used by any Affected Utility to satisfy these requirements, the credit is retired.

D. An Affected Utility shall meet one-half of its annual Distributed Renewable Energy Requirement from residential applications and the remaining one-half from non-residential, non-utility applications.

E. An Affected Utility may satisfy no more than 10 percent of its annual Distributed Renewable Energy Requirement from Renewable Energy Credits derived from distributed Renewable Energy Resources that are non-utility owned generators that sell electricity at wholesale to Affected Utilities. This Wholesale Distributed Generation Component shall qualify for the non-residential portion of the Distributed Renewable Energy Requirement.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1806. Extra Credit Multipliers

A. Renewable Energy Credits derived from Eligible Renewable Energy Resources installed after December 31, 2005, shall not be eligible for Extra Credit Multipliers.

B. The extra Renewable Energy Credits resulting from any applicable multiplier shall be added to the Renewable Energy Credits produced by the Eligible Renewable Energy Resource to determine the total Renewable Energy Credits that may be used to meet an Affected Utility's Annual Renewable Energy Requirement.

C. "Early Installation Extra Credit Multiplier." Affected Utilities acquiring Renewable Energy Credits from a Solar Electricity Resource, a Solar Water Heater, a Solar Space Cooling system, a Landfill Gas Generator, a Wind Generator, or a Biomass Electricity Generator that was installed and began operations between January 1, 2001, and December 31, 2003, shall be eligible for an Early Installation Extra Credit Multiplier. Renewable Energy Credits derived from such facilities and acquired by Affected Utilities shall be eligible for five years following the facility's operational start-up. The multiplier shall vary according to the year in which the system began operating:

2001	.3
2002	.2
2003	.1

D. "In-state Power Plant Installation Extra Credit Multiplier." Affected Utilities acquiring Renewable Energy Credits from a Solar Electricity Resource that was installed in Arizona on or before December 31, 2005, shall be eligible for an In-state Power Plant Installation Extra Credit Multiplier. The Renewable Energy Credits derived from such a facility and acquired by an Affected Utility shall be multiplied by .5 annually for the life of the facility. The extra Renewable Energy Credits resulting from the multiplier shall be added to the Renewable Energy Credits produced by the Eligible Renewable Energy Resource to determine the total Renewable Energy Credits that may be used to meet an Affected Utility's Annual Renewable Energy Requirement.

E. "In-state Manufacturing and Installation Content Extra Credit Multiplier." Affected Utilities acquiring Renewable Energy Credits from a Solar Electricity Resource, a Solar Water Heater, a Solar Space Cooling system, a Landfill Gas Generator, a Wind Generator, or a Biomass Electricity Generator that was installed in Arizona on or before December 31, 2005, and that contains components manufactured in Arizona shall be eligible for an In-state Manufacturing and Installation Content Extra Credit Multiplier. The Renewable Energy Credits derived from such a facility and acquired by an Affected Utility shall be multiplied annually for the life of the facility by a factor determined by multiplying .5 times the percent of Arizona content of the total installed plant.

F. "Distributed Solar Electric Generator and Solar Incentive Program Extra Credit Multiplier." Affected Utilities acquiring Renewable Energy Credits from a Distributed Solar Electric Generator that was installed in Arizona on or before December 31, 2005, shall be eligible for a Distributed Solar Electric Generator and Solar Incentive Program Extra Credit Multiplier if the facility meets at least two of the following criteria:

1. The facility is installed on customer premises,
2. The facility is included in any Affected Utility's approved Green Pricing program,
3. The facility is included in any Affected Utility's approved Net Metering or Net Billing program,
4. The facility is included in any Affected Utility's approved solar leasing program, or
5. The facility is owned by and located on an Affected Utility's property or customer property. The Renewable Energy Credits derived from such a facility and acquired by an Affected Utility shall be multiplied by .5 annually for the life of the facility. Meters will be attached to each solar electric generator and read at least once annually to verify solar performance.

G. All multipliers are additive, except that the maximum combined Extra Credit Multiplier shall not exceed 2.0.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1807. Manufacturing Partial Credit

A. An Affected Utility may acquire Renewable Energy Credits to apply to the non-distributed portion of its Annual Renewable Energy Requirement if it or its affiliate owns or makes a significant investment in any solar electric manufacturing plant located in Arizona or if it or its affiliate provides incentives to a manufacturer of solar electric products to locate a manufacturing facility in Arizona.

B. The Renewable Energy Credits shall be equal to the nameplate capacity of the solar electric generators produced and sold in a calendar year times 2,190 hours, which approximates a 25 percent capacity factor.

C. Extra credit multipliers shall not apply to Renewable Energy Credits created by this Section.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1808. Tariff

A. Within 60 days of the effective date of these rules, each Affected Utility shall file with the Commission a Tariff in substantially the same form as the Sample Tariff set forth in these rules that proposes methods for recovering the reasonable and prudent costs of complying with these rules. The specific amounts in the Sample Tariff are for illustrative purposes only and Affected Utilities may submit, with proper support, Tariff filings with alternative surcharge amounts.

B. The Affected Utility's Tariff filing shall provide the following information:
1. Financial information and supporting data sufficient to allow the Commission to determine the Affected Utility's fair value for purposes of evaluating the Affected Utility's proposed Tariff. Information submitted in the format of the Annual Report required under R14-2-212(G)(4) will be the minimum information necessary for filing a Tariff application but Commission Staff may request additional information depending upon the type of Tariff filing that is submitted;
2. A discussion of the suitability of the Sample Tariff set forth in Appendix A for recovering the Affected Utility's reasonable and prudent costs of complying with these rules;
3. Data to support the level of costs that the Affected Utility contends will be incurred in order to comply with these rules;
4. Data to demonstrate that the Affected Utility's proposed Tariff is designed to recover only the costs in excess of the Market Cost of Comparable Conventional Generation; and
5. Any other information that the Commission believes will be relevant to the Commission's consideration of the Tariff filing.

C. The Commission will approve, modify, or deny a Tariff proposed pursuant to subsection (A) within 180 days after the Tariff has been filed. The Commission may suspend this deadline or adopt an alternative procedural schedule for good cause. The Affected Utility's Annual Renewable Energy Requirement, as set forth in R14-2-1804(B), and Distributed Renewable Energy Requirement, as set forth in R14-2-1805(B), will be effective upon Commission approval of the Tariff filed pursuant to this Section.

D. If an Affected Utility has an adjustor mechanism for the recovery of costs related to Annual Renewable Energy Requirements, the Affected Utility may file a request to reset its adjustor mechanism in lieu of a Tariff pursuant to subsection (A). The Affected Utility's filing shall provide all the information required by subsection (B), except that it may omit information specifically related to the fair value determination. The Affected Utility's Annual Renewable Energy Requirement, as set forth in R14-2-1804(B), and Distributed Renewable Energy Requirement, as set forth in R14-2-1805(B), will be effective upon Commission approval of the adjustor mechanism rate filed pursuant to this Section.

E. An Affected Utility may file a rate case pursuant to R14-2-103 in lieu of a Tariff pursuant to subsection (A). The Affected Utility's filing shall provide all information required by subsection (B).

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1809. Customer Self-Directed Renewable Energy Option

A. By January 1, 2007, each Affected Utility shall file with Docket Control a Tariff by which an Eligible Customer may apply to an Affected Utility to receive funds to install distributed Renewable Energy Resources. The funds annually received by an Eligible Customer pursuant to this Tariff may not exceed the amount annually paid by the Eligible Customer pursuant to the Affected Utility's Tariff.

B. An Eligible Customer seeking to participate in this program shall submit to the Affected Utility a written application that describes the Renewable Energy Resources that it proposes to install and the projected cost of the project. An Eligible Customer shall provide at least half of the funding necessary to complete the project described in its application.

C. All Renewable Energy Credits derived from the project, including generation and Extra Credit Multipliers, shall be applied to satisfy the Affected Utility's Annual Renewable Energy Requirement.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1810. Uniform Credit Purchase Program

A. The Director of the Utilities Division shall establish a Uniform Credit Purchase Program working group, which will study issues related to implementing Distributed Renewable Energy Resources. The working group shall address the consumer participation process, budgets, incentive levels, eligible technologies, system requirements, installation requirements, and any other issues that are relevant to encouraging the implementation of Distributed Renewable Energy Resources. No later than March 1, 2007, the Director of the Utilities Division shall file a staff report with recommendations for Uniform Credit Purchase Programs.

B. No later than July 1, 2007, each Affected Utility shall file a Uniform Credit Purchase Program for Commission review and approval.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1811. Net Metering and Interconnection Standards

The Commission Staff shall host a series of workshops addressing the issues of rate design including Net Metering and interconnection standards. Upon completion of this task, and the adoption of rules or standards, if appropriate, each Affected Utility shall file conforming Net Metering tariffs and interconnection standards in Docket Control.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1812. Compliance Reports

A. Beginning April 1, 2007, and every April 1st thereafter, each Affected Utility shall file with Docket Control a report that describes its compliance with the requirements of these rules for the previous calendar year. The Affected Utility shall also transmit to the Director of the Utilities Division an electronic copy of this report that is suitable for posting on the Commission's web site.

B. The compliance report shall include the following information:
1. The actual kWh of energy or equivalent obtained from Eligible Renewable Energy Resources;
2. The kWh of energy or equivalent obtained from Eligible Renewable Energy Resources normalized to reflect a full year's production;
3. The kW of generation capacity, disaggregated by technology type;
4. Cost information regarding cents per actual kWh of energy obtained from Eligible Renewable Energy Resources and cents per kW of generation capacity, disaggregated by technology type;

5. A breakdown of the Renewable Energy Credits used to satisfy both the Annual Renewable Energy Requirement and the Distributed Renewable Energy Requirement and appropriate documentation of the Affected Utility's receipt of those Renewable Energy Credits; and
6. A description of the Affected Utility's procedures for choosing Eligible Renewable Energy Resources and a certification from an independent auditor that those procedures are fair and unbiased and have been appropriately applied.

C. The Commission may hold a hearing to determine whether an Affected Utility's compliance report satisfies the requirements of these rules.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1813. Implementation Plans

A. Beginning July 1, 2007, and every July 1st thereafter, each Affected Utility shall file with Docket Control for Commission review and approval a plan that describes how it intends to comply with these rules for the next calendar year. The Affected Utility shall also transmit an electronic copy of this plan that is suitable for posting on the Commission's web site to the Director of the Utilities Division.

B. The implementation plan shall include the following information:
1. A description of the Eligible Renewable Energy Resources, identified by technology, proposed to be added by year for the next five years and a description of the kW and kWh to be obtained from each of those resources;
2. The estimated cost of each Eligible Renewable Energy Resource proposed to be added, including cost per kWh and total cost per year;
3. A description of the method by which each Eligible Renewable Energy Resource is to be obtained, such as self-build, customer installation, or request for proposals;
4. A proposal that evaluates whether the Affected Utility's existing rates allow for the ongoing recovery of the reasonable and prudent costs of complying with these rules, including a Tariff application that meets the requirements of R14-2-1808 and addresses the Sample Tariff set forth in Appendix A if necessary; and
5. A line item budget that allocates specific funding for Distributed Renewable Energy Resources, for the Customer Self-Directed Renewable Energy Option, for power purchase agreements, for utility-owned systems, and for each Eligible Renewable Energy Resource described in the Affected Utility's implementation plan.

C. The Commission may hold a hearing to determine whether an Affected Utility's implementation plan satisfies the requirements of these rules.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1814. Electric Power Cooperatives

A. Within 60 days of the effective date of these rules, every electric cooperative that is an Affected Utility shall file with Docket Control an appropriate plan for acquiring Renewable Energy Credits from Eligible Renewable Energy Resources for the next calendar year and a Tariff that proposes methods for recovering the reasonable and prudent costs of complying with its proposed plan and addresses the Sample Tariff set forth in Appendix A. The cooperative shall also transmit electronic copies of these filings that are suitable for posting on the Commission's web site to the Director of the Utilities Division. Upon Commission approval of this plan, its provisions shall substitute for the requirements of R14-2-1804 and R14-2-1805 for the electric power cooperative proposing the plan.

B. Beginning July 1, 2007, and every July 1st thereafter, every electric cooperative that is an Affected Utility shall file with Docket Control an appropriate plan for acquiring Renewable Energy Credits from Eligible Renewable Energy Resources for the next calendar year. The cooperative shall also transmit an electronic copy of this plan that is suitable for posting on the Commission's web site to the Director of the Utilities Division.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1815. Enforcement and Penalties

A. If an Affected Utility fails to meet the annual requirements set forth in R14-2-1804 and R14-2-1805, it shall include with its annual compliance report a notice of noncompliance.

B. The notice of noncompliance shall provide the following information:
1. A computation of the difference between the Renewable Energy Credits required by R14-2-1804 and R14-2-1805 and the amount actually obtained,
2. A plan describing how the Affected Utility intends to meet the shortfall from the previous calendar year in the current calendar year, and
3. An estimate of the costs of meeting the shortfall.

C. If the Commission finds after affording an Affected Utility notice and an opportunity to be heard that the Affected Utility has failed to comply with its implementation plan approved by the Commission as set forth in R14-2-1813, the Commission may find that the Affected Utility shall not recover the costs of meeting the shortfall described in R14-2-1815(B) in rates.

D. Nothing herein is intended to limit the actions the Commission may take or the penalties the Commission may impose pursuant to Arizona Revised Statutes, Chapter 2, Article 9. An Affected Utility is entitled to notice and an opportunity to be heard prior to Commission action or imposition of penalties.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

R14-2-1816. Waiver from the Provisions of this Article

A. The Commission may waive compliance with any provision of this Article for good cause.

B. Any Affected Utility may petition the Commission to waive its compliance with any provision of this Article for good cause.

C. A petition filed pursuant to these rules shall have priority over other matters filed at the Commission.

Historical Note

New Section made by final rulemaking at 13 A.A.R. 2389, effective August 14, 2007 (Supp. 07-2).

Appendix A. Sample Tariff

Unless otherwise ordered by the Commission, the renewable energy standard surcharge shall be assessed monthly to every retail electric service. This monthly assessment will be the lesser of $0.004988 per kWh or:
1. For residential customers, $1.05 per service;
2. For non-residential customers, $39.00 per service;
3. For non-residential customers whose metered demand is 3,000 kW or more for three consecutive months, $117.00 per service;

A\C 8

American Solar Energy

Society

Leading the Renewable Energy Revolution

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The Alliance for Solar Choice is Formed Among the Nation's Leading Rooftop Solar Companies!

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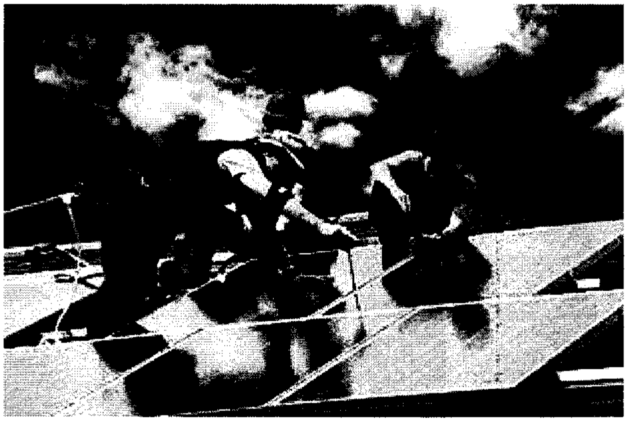

Source: http://inhabitat.com/americans-installed-a-record-number-of-rooftop-solar-panels-this-year/

As of May 10, 2013, the nation's leading rooftop solar companies announced the formation of The Alliance for Solar Choice (TASC). TASC believes that anyone should have the option to switch from utility power to distributed solar power. The founding members represent the majority of the U.S. rooftop solar market, including: SolarCity, Sungevity, Sunrun, and Verengo. TASC will focus immediately on the continuation of Net Energy Metering (NEM), currently in place in 43 states, which provides solar consumers with fair credit for the energy they put back on the grid. Monopoly utilities are trying to eliminate NEM to half the consumer-driven popularity of rooftop solar, which is helping create thousands of local jobs around the country. "Without consumer choice and empowerment, the utilities will continue to increase their rates and profits," said TASC member and SolarCity CEO Lyndon Rive.

Studies in Arizona, California, Hawaii, Idaho, and Vermont have all found that solar provides a net benefit to ratepayers and to state economies. Over the next 30 years, California schools and public agencies are projected to save more than $2.5 billion on energy bills through net-metered solar systems. By contrast, the utility trade

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association Edison Electric Institute (EEI) recently issued a report that describes the increasing popularity of consumer-driven rooftop solar, energy efficiency, and demand response as a "vicious cycle." The report shows that utilities view rooftop solar as a threat to their monopoly business model, which guarantees utilities high profits from large infrastructure projects funded by ratepayers. TASC executive director Anne Smart was previously the Director of Energy for the Silicon Valley Leadership Group. She will oversee TASC's expansion and manage the organization's policy and public outreach efforts to combat growing threats to consumer energy choice in states across the nation.

Source: News Release- Leading Clean Energy Companies Launch New Alliance to Protect Solar Choice, Combat Monopoly Utilities

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solar choice *solar market* *TASC*

American Solar Energy Society Office

2525 Arapahoe Ave, Ste E4-253
Boulder, CO 80302

(303) 443-3130

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ORIGINAL

INTERVENTION

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7144 E. Stetson Drive, Suite 300
Scottsdale, Arizona 85251
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Attorney for Intervenor, The Alliance of Solar Choice

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DOUG LITTLE, CHAIRMAN
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BOB BURNS, COMMISSIONER
TOM FORESE, COMMISSIONER
ANDY TOBIN, COMMISSIONER

IN THE MATTER OF THE APPLICATION OF TUCSON ELECTRIC POWER COMPANY FOR THE ESTABLISHMENT OF JUST AND REASONABLE RATES AND CHARGES DESIGNED TO REALIZE A REASONABLE RATE OF RETURN ON THE FAIR VALUE OF THE PROPERTIES OF TUCSON ELECTRIC POWER COMPANY DEVOTED TO ITS OPERATIONS THROUGHOUT THE STATE OF ARIZONA AND FOR RELATED APPROVALS.

DOCKET NO. E-01933A-15-0322

THE ALLIANCE OF SOLAR CHOICE'S APPLICATION FOR LEAVE TO INTERVENE

Arizona Corporation Commission
DOCKETED
MAR 03 2016
DOCKETED BY

Pursuant to A.A.C. R14-3-105, The Alliance for Solar Choice ("TASC") hereby makes its Application for Leave to Intervene (the "Application") in the above captioned proceedings (the "Proceeding").

TASC is a solar energy advocacy association. TASC's membership represents the majority of the nation's rooftop solar market and includes Demeter Power Group, Geostellar, Inc., LGCY Power, REPOWER by Solar Universe, Sunrun Inc. and SunTime Energy. These companies are important stakeholders in Arizona's rooftop solar industry. Additionally, TASC's members are responsible for thousands of residential, school, church, government and commercial solar

EXHIBIT
AIC-9
ADMITTED

installations in the State. Together, TASC's members have brought hundreds of jobs and many tens of millions of dollars of investment to Arizona's cities and towns.

TASC is entitled to intervene because TASC is directly and substantially affected by the Proceeding and TASC's intervention will not unduly broaden the issues presented. In support of this Application, TASC submits the following information.

I. TASC is Directly and Substantially Affected

In the Application, Tucson Electric Power Company ("TEP")" seeks to alter rate structures for solar customers and end the policy of net metering in its service territory, all of which will negatively impact TASC members and their customers.

II. TASC's Intervention can Assist the Commission

TASC is uniquely well positioned to offer insight to assist the Commission in its evaluation of the issues in the Proceedings.

III. TASC's Intervention Will Not Expand These Proceedings

Granting TASC intervenor status will not delay this proceeding, unduly broaden the issues, or prejudice other parties to the Docket.

Service of all documents or pleadings should be made to TASC counsel at the following address:

Court S. Rich
Rose Law Group pc
7144 E. Stetson Drive, Suite 300
Scottsdale, Arizona 85251

Respectfully submitted this 3rd day of March, 2016.

Court S. Rich
Rose Law Group pc
Attorney for Intervenor TASC

Original and 13 copies filed on this 3rd day of March, 2016 with:

Docket Control
Arizona Corporation Commission
1200 W. Washington Street
Phoenix, Arizona 85007

Copies of the foregoing sent by electronic and regular mail to:

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By: ____________________

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Get the FAQs...then relax

It's time to soak up the sun.

GET A FREE QUOTE (HTTPS://GOSOLAR.SUNRUN.COM/151130B/?CAMPID=SUNRUN2GOSOLAR)

Going Solar

Where is Sunrun available?

Sunrun is available in 14 states, listed below. You can read more about which utility companies Sunrun works with by clicking on each of the state links. If we're not in your neck of the woods, don't worry! We're expanding quickly and may be there any day.

- Arizona (/solar-by-state/az)
- California (/solar-by-state/ca)
- Colorado (/solar-by-state/co)
- Connecticut (/solar-by-state/ct)
- Delaware (/solar-by-state/de)
- Hawaii (/solar-by-state/hi)
- Maryland (/solar-by-state/md)
- Massachusetts (/solar-by-state/ma)
- New Hampshire (/solar-by-state/nh)
- New Jersey (/solar-by-state/nj)
- New York (/solar-by-state/ny)
- Oregon (/solar-by-state/or)
- Pennsylvania (/solar-by-state/pa)
- South Carolina (/solar-by-state/sc)

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A1C-10
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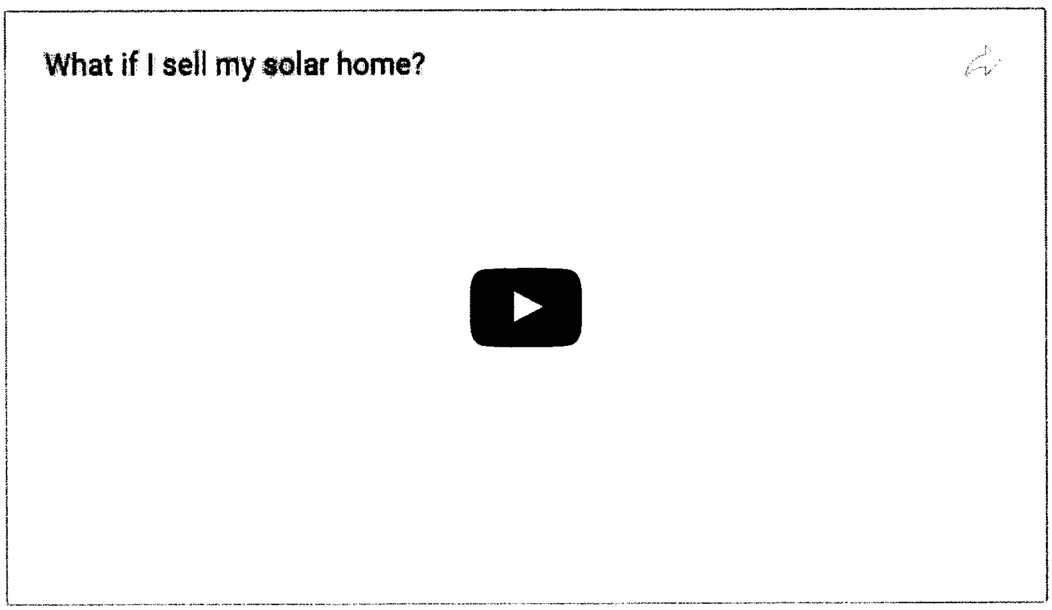
What happens if I move?

The hardest thing about moving isn't selling your home—it's saying sayonara to those beautiful, money-saving panels on your roof. That's right, no need to find a suitcase big enough to hold your solar panels. Sunrun makes it easy to transfer your solar lease agreement and pass along those ridiculously low energy bills to the new owners. Our Service Transfer Specialists handle everything from educating realtors and potential buyers, to working with escrow officers, title agents, home inspectors, and anyone else who might need to know about your system or solar lease agreement. Here are some tips to help ensure a smooth move:

- Connect with our Service Transfer team before your home goes on the market. We'll help prepare your realtor to sell the value of solar.
- Inform potential buyers early on that the solar lease agreement is a contingency of the home sale to avoid hiccups during negotiations.
- Once you've got a buyer, you'll both sign Sunrun's service transfer form and we'll run a credit check on the buyer.
- Then just send us confirmation that escrow has closed and you'll be home free.
- In the unlikely event that the buyer doesn't want to take on the agreement, you can prepay for the remainder of your service and bundle it into the selling price of your home.
- You can also buy the system outright and move it to your new home, but is generally easier and more cost effective to transfer the agreement.



How will I pay for electricity when I have solar?

There you are, daydreaming about all the money you'll save by going solar (http://www.sunrun.com/solar-savings), the cleaner skies, the lower electric bill and the… wait. About that electric bill. What exactly happens to your bill when you make the switch to solar?

Before you spend a single minute worrying about it, let us explain. Paying for electricity is no harder when you have solar. In fact, it's a lot easier because you won't have to worry about surprise rate hikes or hidden fees. Here's how it works:

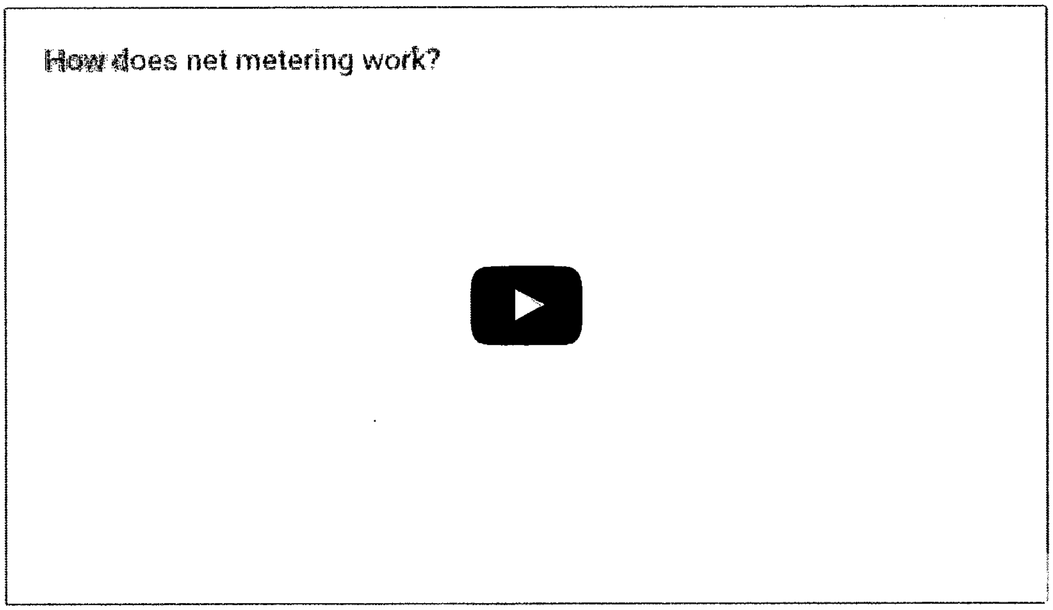
- Your solar system will be connected to your local utility, and your energy usage affects how much you'll save.
- You'll owe less or even earn energy credit when you produce more electricity than you use.
- When you use more than you produce, say if you forget to turn off the AC, you could owe the utility company more.
- Annually, electricity costs will be lower with solar (http://www.sunrun.com/solar-lease/cost-of-solar), even though your savings will vary month-to-month due to seasonality—you'll earn more energy credits during summer's longer, sunny days than in winter's short ones, but they'll balance each other out over the course of a year.
- You'll get two bills if you choose a monthly plan like most customers. One from the utility company and one from Sunrun. The Sunrun bill is your low, predictable solar rate. The utility bill covers any additional electricity used above and beyond what your solar system produces.

Will I get credits from my utility with Sunrun?

Remember back in school when extra credit was kind of a big deal? Well now that you're thinking about going solar, it is again. That's because when your uber-efficient power-generating panels produce more energy than you need, you get automatic solar energy credit from the utility company. It's like they're paying you for once. Here's how it works:

- When the sun is up, your panels crank out energy like there's no tomorrow. If they produce more than it takes to power your life, that extra electricity is sent to the utility grid and you earn solar energy credit.
- When you have more power than you use, you owe the utility less.
- Conversely when you use more electricity than your system makes, like at night for example, when the sun is down, you draw from the grid.
- When you use more power than you make, you owe the utility more.

See? It's a give and take, but you don't have to lift a finger because the utility company's net meter keeps track of it all. You can expect to see some ups and downs on your utility bill throughout the year because you'll likely generate more power in the summer and less in the winter. But your total annual savings will be greater thanks to solar. Your system will be grid tied and you'll get credits from your utility when you're a Sunrun customer whether you choose to own your system or go solar through a lease or PPA.



What if my panels don't produce enough power?

When the system is designed, we make sure it fits your household electricity needs to a tee, helping maximize your electricity savings (http://www.sunrun.com/solar-savings) over time. If the system produces less than predicted, we'll cover the difference.

How many solar panels will I need?

Yup. Size Matters.You're ready for a highly efficient, money-saving solar power system on your roof. Great! So, what size home solar system should you have? Hey, you've got better things to do than worry about that. Which is why Sunrun will help handle all the details for you. Not only are we an experienced provider, we have proprietary solar design technology called BrightPath to help us create a customized system that maximizes energy production better and faster than if we did it by hand.

So instead of wracking your brain over "how many solar panels will I need?" or "what kind of inverter do I buy?", ask yourself these questions instead:

- How much power do I need? Check your electric bills to see how many kilowatts you use on an average day. A typical system generates 5 kilowatts per day but your home may need more or less.
- What's your climate like? The number of panels you need depends on how much solar radiation reaches the ground where you are. Believe it or not, solar can work well even if it's cloudy a lot!
- How much direct sun hits your roof? In general you'll need 100 square feet of south-facing roof space for every kilowatt of power, avoiding shadows from chimneys, trees or taller buildings. But don't worry, we can take a look and help with that, too.

What happens at a solar installation?

After your sign your Sunrun agreement, you're ready for solar panel installation (https://www.sunrun.com/how-it-works/solar-panel-installation). Now the real fun begins! The best part? You don't have to lift a finger because we take care of everything from scheduling to submitting permits, to working with the city, and securing those big, beautiful panels to your roof. Naturally you'll have questions, and we'll be right there with you answering them every step of the way. Here's what you can expect:

- **Site Assessment**

A technician will visit you in your home to confirm your system design, verify measurements, and adjust for shade and obstructions on your roof. *Timing: 1-2 weeks*

- **Design Approval**

Following site evaluation, our solar design experts will make any necessary adjustments and email you for final approval. *Timing: 1-3 weeks*

- **Permitting**

Once you give the green light we'll submit your design to the city for permitting. The timing now depends on how quickly local government works and can take up to eight weeks. *Timing: 2-8 weeks*

- **Solar Installation** (https://www.sunrun.com/how-it-works/solar-panel-installation)

After your permit is granted we'll get to work placing those gorgeous new panels on the roof! *Timing: 2-5 days*

- **City/County Inspections**

When construction is finished, the city or county will do a final inspection before your system can be connected to the grid. *Timing: 1-4 weeks*

- **Utility Interconnection**

Now you're in the home stretch. We'll submit your documents to the utility company and they'll install a net meter allowing Sunrun to track how much solar electricity you produce and use. *Timing: 3-6 weeks*

- **Power Up and Start Saving**

When the utility company grants Permission to Operate, that means you're free to flip the switch and start generating clean, affordable, money-saving energy right from your roof. Congratulations, you're in!

How does Sunrun compare to other solar companies?

You have a choice when it comes to solar providers. Actually, a lot of choices. With everybody vying for your business, your ability to compare solar companies (http://www.sunrun.com/why-sunrun) effectively is critical. And since you'll be working with your provider for the life of your system you'll want to choose an established one you can count on for the long haul.

	sunrun	Industry Standard
Guarantees Production?	Yes	No
Roof Warranty	10 years, regardless of whether your roof has a warranty.	10 years, regardless of whether your roof has a warranty.
Free overproduction?	Yes	No
Free Monitoring? (Provided wireless signal vs. customer owned internet)	Yes	No
Exclusive focus on residential solar?	Yes	No

**Sunrun direct sales PPA compared to SolarCity and Vivint Solar PPA, and SunPower and NRG lease. Claims based on contracts created in February, May, & July 2014

Here are some other key things to look for:

- A high volume of positive ratings and a great track record of service before, during and after installation.
- The best solar companies will make it easy by taking care of the paperwork, inspections, and working with the city.
- Flexible payment options including lease agreements and PPAs.
- Lifetime maintenance on your system should be included, not an add-on.
- An honest provider won't sell you solar if it can't save you money—insist on a performance guarantee.
- Choose a provider with the most residential experience.

Solar Basics

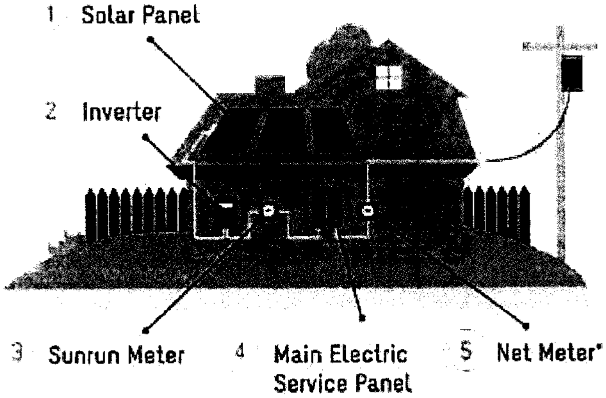
What's a solar lease or PPA?

Until recently, you couldn't go solar without buying your system outright, and that meant hefting over a small fortune—we're talking anywhere from $18,000 to $25,000 up front, and maintenance and repairs are extra. Knowing there had to be a more affordable way to bring clean energy to the people, we invented solar leasing and power purchase agreements, or PPAs. So instead of waiting years for a return on your investment, most Sunrun customers see big savings in just the first year.

- The difference between a solar lease (http://www.sunrun.com/solar-lease) and solar PPA is simple: With a lease you pay a fixed monthly "rent" in return for use of the system. With a PPA you pay a fixed price per kWh for power generated.
- Both often require $0 down.

- It's hassle free—your provider handles installation, maintenance and repairs for the life of the agreement.
- You're entitled to all the energy your system produces, including any excess energy credits.
- You can transfer the agreement easily if you sell your home.
- Your provider passes down savings from rebates, tax incentives, and credits in the form of a lower bill.
- Flexible financing options let you pay as you go, or you can maximize savings with a prepaid option that eliminates monthly billing from Sunrun.
- Still think solar's out of reach? Learn all about how it works, then get your free quote.

How does a solar system work?



1. **Solar Panels**
   Convert sunlight to direct current (DC electricity)
2. **Inverter**
   Converts the DC electricity produced by the panels into alternating current (AC electricity).
3. **Sunrun Meter**
   Monitors system production and sends the information to Sunrun through a wireless signal.
4. **Main Electric Service Panel**
   Solar electricity from inverter flows through this service panel to your home or the grid.
5. **Net Meter**
   Reads electricity that you use from the grid as well as the excess solar electricity that flows into the grid from your solar system.

What are tiered utility rates?

Tiered utility rates are a structure in which the more electricity you use, the higher your rate gets. You are allowed a certain amount of power (kilowatt hours) in each tier. Once you've exceeded the amount in the tier, you move into the next highest tier. The lower tier rates are affordable and the higher tier rates are very expensive. In many cases, we'll recommend a system that only offsets only your expensive tiers to help you maximize your savings. Solar systems built for people with tiered rates often are designed to eliminate the expensive high tier electricity from your utility.

Sunrun Partners

If I go solar with Sunrun, who will do my installation?

Depending on where you live, Sunrun or one of our certified installer partners will do the installation. We partner city-by-city with local installers. They not only know the ins and outs of installing in your neighborhood, it also keeps thousands of jobs local. You can find a list of Sunrun's local installers below.

I heard about Sunrun through another solar company. How does Sunrun work with partners?

Top drawer. Crème de la crème. The A-team.

Partnership is one of those terms that's easy to throw around. But at Sunrun, it really means something. Our nationwide network of certified partners are the bedrock our business because they allow us to provide stellar Sunrun service where you live. How's that for convenience?

What's more, they're are a huge part of why it's so easy to go solar with Sunrun.We only work with the best of the best so you can rest easy knowing that whether Sunrun installs your system or one of our trusted partners does, you'll have top-notch service as long as you're a customer.

Sunrun certified partners:

- 1st Light Energy
- 360 Management Group, Inc.
- 360 Solar Energy
- Acos Energy LLC
- AGR Group
- All Seasons Solar
- Amergy Solar Inc.
- American Electric
- American Solar
- Arcadia Solar Solutions, LLC
- Argent Solar Electric

- Arise Solar
- Arizona Solar Solutions
- ASI Heating, Air & Solar
- Bland A/C and Heating, Inc.
- Bonterra Solar Hawaii
- C-TEC SOLAR
- Clean Solar
- Complete Solar Solution
- Corbin Electrical Services Inc.
- DRH Solar and Electrical
- Eco Solar
- Enlighten Power Solutions
- Green Engineering Solar Corp
- Green Homes of California
- Harmon Solar
- Harvest Power
- Heliopower
- Horizon Solar Power
- IES
- Imagine Energy
- Infinity Solar Systems
- Islandwide Solar
- Kopp Electric Company
- LG Energy (Hi-Tech Remodeling Group)
- LGCY Power
- Munro
- Neil Kelly
- Next Step Living
- OnForce Solar
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- Precis Solar
- Premier Solar Solutions
- RCL Enterprises, Inc
- Reliable Power Services
- Responsible Solar
- RevoluSun
- Rising Sun Solar
- Smart Energy Solar
- Solar Alliance of America
- Solar Energy World
- Solar Optimum
- Solar Service Center
- Solar Universe
- SolarFlair Energy, Inc.
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- SolarMax Technology Inc.
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- Solcius
- Standard Energy Solutions
- Start To Finish Solar
- Streamline Solar Power Systems LLC
- Summerwind Solar LLC
- Sun Phase Energy
- Sun Time Energy
- Sunlight Solar
- SunLux Energy
- Sunny Energy LLC
- Sunpro Solar
- Sunrun Installers
- SunWize Home
- Synergy Solar
- Taylor Energy
- Trinity Solar
- Uptown Solar
- Valley Solar Solutions

Looking to partner with Sunrun? Learn about our partnerships (/partner-with-us).

CATEGORIES

Going Solar

Solar Basics

Sunrun Partners

(/solar-lease/cost-of-solar)

cost of solar (/solar-lease/cost-of-solar)

Electricity rates are skyrocketing but the cost of solar panels (/solar-lease/cost-of-solar/solar-panels) has never been lower. Learn why now's the time to switch.

(/solar-lease)

solar leasing (/solar-lease)

No need to buy. Learn how to get a solar lease (/solar-lease) or PPA for as little as $0 down.

(/solar-by-state)

where we are (/solar-by-state)

Solar in 14 states (/solar-by-state) and growing! If we aren't in yours yet stay tuned, we are rapidly growing.

PARTNER DIRECTORY (HTTP://WWW.SUNRUN.COM/HOW-IT-WORKS/FAQ#ITEM-2406)

WHERE'S SUNRUN?

(http://www.sunrun.com/calculator/?utm_content=fixed-cta)

State Contractor License Information (/state-contractor-license-information)

Terms (/terms-of-service)

Privacy (/privacy-policy)

Sitemap (/sitemap)

(https://www.facebook.com/sunrun) (https://twitter.com/Sunrun/) (https://www.youtube.com/user/SunRunHomeSolar/) (https://plus.google.com/+sunrun)

*Estimated savings based on a projected annual utility rate increase of 3.16% over the life of the system. Actual savings will vary. Savings depends on several factors, including product type, system production, geography, weather, shade, electricity usage, full utilization of the 30% solar Investment Tax Credit by the system owner, and utility rate structures and rate increases. Analysis based on customers who enrolled with Sunrun between October 15, 2014 and October 15, 2015.

AIC 11

http://demeterpower.com/who-we-serve

LMS+ My Clients | Family Court Case Infor... | - Arizona Corporation Co... | images.edocket.azcc.gov | The Alliance for Solar Ch... | How It Works Solar FAQ |... | Who We Serve - Dem...

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Page Safety Tools

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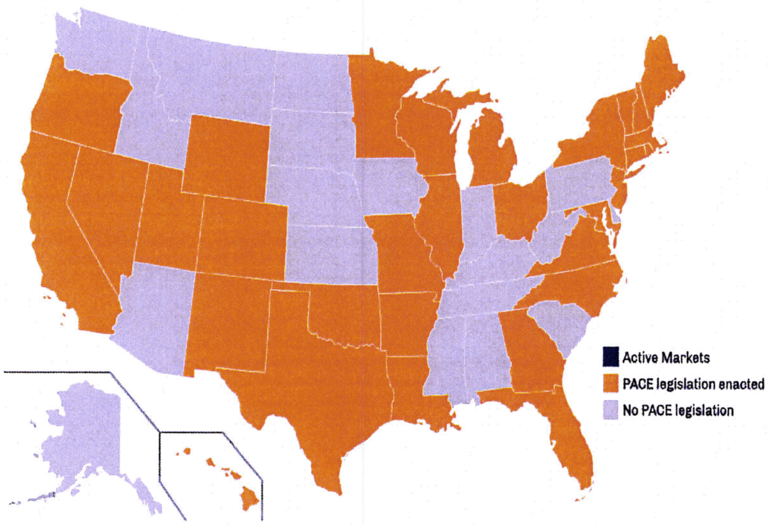
Who We Serve | Register | Login

can be of assistance. Or visit PACENow.org for more information about PACE.

Current Markets

We offer a variety of financial solutions that are available in "open market" commercial PACE markets.



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AIC-11
ADMITTED

AIC 12

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

(Mark One)
☒ ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2015
OR
☐ TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
Commission File Number 001-37511

EXHIBIT AIC-12 ADMITTED

Sunrun Inc.
(Exact name of Registrant as specified in its Charter)

Delaware (State or other jurisdiction of incorporation or organization)	26-2841711 (I.R.S. Employer Identification No.)
595 Market Street, 29th Floor San Francisco, California (Address of principal executive offices)	94105 (Zip Code)

Registrant's telephone number, including area code: (415) 580-6900

Securities registered pursuant to Section 12(b) of the Act: Common Stock, Par Value $0.0001 Per Share; Common stock traded on the NASDAQ Global Select Stock Market

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the Registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. YES ☐ NO ☒

Indicate by check mark if the Registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act. YES ☐ NO ☒

Indicate by check mark whether the Registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the Registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. YES ☒ NO ☐

Indicate by check mark whether the Registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the Registrant was required to submit and post such files). YES ☒ NO ☐

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§229.405) is not contained herein, and will not be contained, to the best of Registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ☒

Indicate by check mark whether the Registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, or a smaller reporting company. See the definition of "large accelerated filer", "accelerated filer", and "smaller reporting company" in Rule 12b-2 of the Exchange Act. (Check one):

Large accelerated filer	☐	Accelerated filer	☐
Non-accelerated filer	☒ (Do not check if a small reporting company)	Small reporting company	☐

Indicate by check mark whether the Registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). YES ☐ NO ☒

The aggregate market value of the voting and non-voting common equity held by non-affiliates of the Registrant, based on the closing price of the shares of common stock on The NASDAQ Stock Market on August 5, 2015, was approximately $371.9 million. The Registrant has elected to use August 5, 2015, which was the initial trading date on the NASDAQ Global Select Market, as the calculation date because June 30, 2015 (the last business day of the Registrant's most recently completed second fiscal quarter), the Registrant was a privately held company.

The number of shares of Registrant's Common Stock outstanding as of March 8, 2016 was 101,495,385.

Portions of the information called for by Part III of this Form 10-K is hereby incorporated by reference from the definitive Proxy Statements for our annual meeting of stockholders, which will be filed with the Securities and Exchange Commission not later than 120 days after December 31, 2015.

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SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

The discussion in this Annual Report on Form 10-K contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended (the "Exchange Act"), which statements involve substantial risks and uncertainties. Forward-looking statements generally relate to future events or our future financial or operating performance. In some cases, you can identify forward-looking statements because they contain words such as "may," "will," "should," "expects," "plans," "anticipates," "could," "intends," "target," "projects," "contemplates," "believes," "estimates," "predicts," "potential" or "continue" or the negative of these words or other similar terms or expressions that concern our expectations, strategy, plans or intentions. Forward-looking statements contained in this Annual Report on Form 10-K include, but are not limited to, statements about:

- our ability to finance solar energy systems through financing arrangements with fund or other investors;
- our ability and intent to establish new investment funds;
- our dependence on the availability of rebates, tax credits and other financial incentives;
- determinations by the Internal Revenue Service or the U.S. Treasury Department of the fair market value of our solar energy systems;
- the retail price of utility-generated electricity or electricity from other energy sources;
- regulatory and policy development and changes;
- our ability to maintain an adequate rate of revenue growth;
- the sufficiency of our cash, investments fund commitments and available borrowings to meet our anticipated cash needs;
- our business plan and our ability to effectively manage our growth;
- our ability to further penetrate existing markets and expand into new markets;
- our expectations concerning relationships with third parties, including the attraction and retention of qualified channel partners;
- the impact of seasonality of our business
- our investment in research and development; and
- the calculation of certain of our key financial and operating metrics and accounting policies.

These forward-looking statements are subject to a number of risks, uncertainties and assumptions, including those described in the section titled "Risk Factors" and elsewhere in this Annual Report on Form 10-K. Moreover, we operate in a very competitive and rapidly changing environment, and new risks emerge from time to time. It is not possible for our management to predict all risks, nor can we assess the impact of all factors on our business or the extent to which any factor, or combination of factors, may cause actual results to differ materially from those contained in any forward-looking statements we may make. In light of these risks, uncertainties and assumptions, the forward-looking events and circumstances discussed in this Annual Report on Form 10-K may not occur and actual results could differ materially and adversely from those anticipated or implied in the forward-looking statements.

You should not rely upon forward-looking statements as predictions of future events. Although we believe that the expectations reflected in the forward-looking statements are reasonable, we cannot guarantee that the future results, levels of activity, performance or events and circumstances reflected in the forward-looking statements will be achieved or occur. Moreover, neither we nor any other person assumes responsibility for the accuracy and completeness of the forward-looking statements. We undertake no obligation to update publicly any forward-looking statements for any reason after the date of this Annual Report on Form 10-K to conform these statements to actual results or to changes in our expectations, except as required by law.

You should read this Annual Report on Form 10-K and the documents that we reference in this Annual Report on Form 10-K and have filed with the SEC as exhibits to this Annual Report on Form 10-K with the understanding that our actual future results, levels of activity, performance, and events and circumstances may be materially different from what we expect.

PART I

Item 1. Business.

Overview

Sunrun's mission is to provide homeowners with clean, affordable solar energy and a best-in-class customer experience. In 2007, we pioneered the residential solar service model, creating a hassle-free, low-cost solution for homeowners seeking to lower their energy bills. By removing the high initial cost and complexity that used to define the residential solar industry, we have fostered the industry's rapid growth and exposed an enormous market opportunity. Our relentless drive to increase the accessibility of solar energy is fueled by our enduring vision: to create a planet run by the sun.

We provide clean, solar energy to homeowners at a significant savings to traditional utility energy. After inventing the residential solar service model and recognizing its enormous market potential, we have built the infrastructure and capabilities necessary to rapidly acquire and serve customers in a low-cost and scalable manner. Today, our scalable operating platform provides us with a number of unique advantages. First, we are able to drive distribution by marketing our solar service offerings through multiple channels, including our diverse partner network and direct-to-consumer operations. This multi-channel model supports broad sales and installation capabilities, which together allow us to achieve capital-efficient growth. Second, we are able to provide differentiated solutions to our customers that, combined with a great customer experience, we believe will drive meaningful margin advantages for us over the long term as we strive to create the industry's most valuable and satisfied customer base.

Our core solar service offerings are provided through our customer agreements (leases and PPAs) which provide homeowners with simple, predictable pricing for solar energy that is insulated from rising retail electricity prices. While homeowners have the option to purchase a solar energy system outright from us, most of our customers choose to buy solar as a service from us through our solar service offerings and enjoy the flexibility and savings that come from purchasing solar energy without the significant upfront investment of purchasing a solar energy system. With our solar service offerings, we install solar energy systems on our customers' homes and provide them the solar power produced by those systems for a 20-year initial term. In addition, we monitor, maintain and insure the system at no additional cost during the term of the contract. In exchange, we receive 20 years of predictable cash flows from high credit quality customers and qualify for tax and other benefits. We finance portions of these tax benefits and cash flows through tax equity and non-recourse debt structures in order to fund our upfront costs, overhead and growth investments. We develop valuable customer relationships that can extend beyond this initial contract term and provide us an opportunity to offer additional services in the future.

Since our founding we have continued to invest in a platform of services and tools to enable large scale operations for us and our partner network. The platform includes processes and software, as well as fulfillment through AEE Solar, racking through SnapNrack and acquisition marketing through Clean Energy Experts, LLC ("CEE"). We believe our platform empowers new market entrants and smaller industry participants to profitably serve our large and underpenetrated market without making the significant investments in technology and infrastructure required to compete effectively against established industry players by improving efficiencies and driving down system-wide costs. Our platform provides the support for our multi-channel model, which drives broad customer reach and capital-efficient growth.

Delivering a differentiated customer experience is core to our strategy. We emphasize a customized solution, including a design specific to each customer's home and pricing configurations that typically drive both customer savings and value to us. We believe that our passion for engaging our customers, developing a trusted brand, and providing a customized solar service offering resonates with our customers who are accustomed to a traditional residential power market that is often overpriced and lacking in customer choice.

We have experienced substantial growth in our business and operations since our inception in 2007. As of December 31, 2015, we operated the second largest fleet of residential solar energy systems in the United States, with approximately 111,000 customers across 15 states, as well as the District of Columbia. We have deployed an aggregate of 596.2 megawatts ("MW") as of December 31, 2015. As of December 31, 2015, our estimated nominal contracted payments remaining was approximately $2.4 billion, and our estimated retained value was $1.5 billion.

We also have a long track record of attracting low-cost capital from diverse sources, including tax equity and debt investors. Since inception through March 8, 2016, we have raised tax equity investment funds to finance the previous and future installation of solar energy systems with an estimated value of $4.0 billion. Although we have been successful in raising capital, we have incurred net losses since inception and had an accumulated deficit of $87.2 million as of December 31, 2015.

Our Multi-Channel Capabilities

Our unique, multi-channel capabilities offer consumers a compelling solar service through scalable, cost-effective and consumer-friendly channels. Homeowners can access our products through three channels: direct-to-consumer, solar partnerships, and strategic partnerships.

Direct-to-Consumer

We sell solar service offerings and install solar energy systems for homeowners through our direct-to-consumer channel. We also sell and install solar energy systems for cash through our direct-to-consumer channel. This channel consists of an online lead generation function, a telesales and field sales team, a direct-to-home sales force, a retail sales team and an industry-leading installation organization.

Solar Partnerships

We contract with diverse solar organizations that act as either exclusive or non-exclusive (depending on the terms of their contract with us) distributors of our solar service offerings and subcontractors for the installation of the related solar energy systems. Because of our commitment to these solar organizations and our vested interest in their success, we refer to them as our "solar partners," although the actual legal relationship is that of an independent contractor. Our solar partners include:

- Solar integrators: trained and trusted partners who originate customers for our solar service offerings and procure and install the solar energy systems on our customers' homes on our behalf as our subcontractors. Partnerships with solar integrators allow us to expand our brand, quickly enter new markets, and drive capital-efficient growth. We compensate our solar integrators on a per solar energy system basis for the sales and installation work they perform for us.
- Sales partners: sales and lead generation partners who provide us with high-quality leads and customers at competitive prices. We compensate our sales partners on a per customer basis for the sales and lead generation services they perform for us.
- Installation partners: trusted installation partners who procure and install a subset of our solar energy systems as our subcontractors and allow us to more efficiently deploy a mix of in-house and outsourced installation capabilities. We compensate our installation partners on a per solar energy system basis for the procurement of materials and installation work they perform for us.

Our ability to connect specialized sales and installation firms on a single platform, which we license to our solar partners at no cost, allows us to enjoy the benefits of vertical integration without the additional fixed cost structure. This creates margin opportunities, system efficiencies and benefits from network effects in matching these ecosystem participants.

Strategic Partnerships

Our strategic partnerships encompass relationships with new market entrants not previously engaged in solar, including cable, consumer marketing, retail, and specialized energy retail companies. Our strategic partners find the residential solar market attractive but recognize that significant barriers to entry make partnership the preferred method to reach solar homeowners. Through these strategic arrangements, we typically market our solar service offerings to the strategic partner's customer base and install the solar energy system directly or through one of our solar partners. We manage the customer experience and retain the value of the economic relationship through the term of the homeowner's contract and potential renewal period. We have executed strategic partnerships in competitive processes that give us access to millions of potential customers. As our industry grows, we believe that our unique platform and deep partnership experience position us to be the partner of choice for new market entrants. We believe that these broad strategic relationships will help us drive down our customer acquisition costs and make solar accessible to even more homeowners.

The combination of direct-to-consumer, solar partnerships and strategic partnerships offers distinct advantages. The direct-to-consumer channel allows us to scale rapidly, drive incremental unit costs down over the long term, and refine operational processes to share with our partners. Our solar partnerships and strategic partnerships enable nimble market entry and exit, while allowing for capital efficient growth. Together, this multi-channel strategy supported by our open platform allows us to reach more customers with our leading solar service without compromising our ability to provide exceptional customer service.

Customer Agreements

Since we were founded in 2007, we have been selling solar energy to residential customers at prices typically below utility rates through a variety of offerings, most commonly through our leases and power purchase agreements which we refer to as our "customer agreements." Our two forms of customer agreements work the same way economically and have substantially the same contractual terms. However, under our lease agreements, customers lease their solar energy systems from us, while under our power purchase agreements, customers purchase the power produced by the solar energy system. Either directly or through a partner, we construct a solar energy system on a customer's home and sell the electricity generated by the system at set prices through customer agreements which typically have an initial term of 20 years. Rates for both forms of our customer agreements can be fixed for the duration of the contract or escalated at a pre-determined percentage annually. Upon installation, a system is interconnected to the local utility grid. The home's energy usage is provided by the solar energy system with any additional energy needs provided by the local utility. Through the use of a bi-directional utility net meter, any excess solar energy that is not immediately used by our customers is exported to the utility grid, and the customer receives a credit for this excess power from their utility to offset future usage.

Although many of our homeowners choose to pay little to nothing upfront and instead receive a monthly bill, some customers choose to prepay for some or all of the electricity produced by their systems, thereby reducing their monthly bill. The amount of an upfront payment is customized for each customer and typically ranges from $0 to $3,000 for customers paying monthly. Customers may also choose to fully prepay their 20-year contracts, and the average cost of these prepaid contracts is approximately $16,000. The prepayment amount is based on the estimated amount of the solar energy system's output over the 20-year term of the customer agreement. If the estimated production of the solar energy system is less than the actual production for a given year after the first full year of the agreement, prepaid customers are refunded the difference at the end of each such year. If the solar energy system's energy production is in excess of the estimate, we allow customers to keep the excess energy at no charge. After the initial term of the customer agreement, customers have the option to renew their contracts for the remaining life of the solar energy system typically at a 10% discount to then-prevailing power prices, to purchase the system from us at its fair market value, or have us remove the system.

Regardless of the type of customer agreement our customers choose, we operate the system and agree to monitor and maintain it in good condition at no cost to the customer. We offer an industry-leading performance guarantee to ensure that our customers are receiving the energy they expect at the price they expect. Our customers also receive a five-year warranty for roof penetration for our partner-built systems and a ten-year warranty for systems built directly by us.

If a customer sells their home, the customer has the right to purchase the system or assign their customer agreement to the new homeowner, provided the new homeowner meets our credit requirements and agrees to be bound by the terms and conditions of the agreement. In connection with this service transfer, the customer may prepay all or a portion of the remaining payments due under the customer agreement to lower the monthly rate to be paid by the new homeowner. The amount of this prepayment may be reflected in the sales price of the home. If the customer fails to purchase the system or assign the agreement to a new owner, we may negotiate an agreement directly with the new homeowner on modified terms and/or look to the original customer for any past due or lost payments. We have completed thousands of service transfers and, from inception through December 31, 2015, the aggregate expected net present value of the customer agreements once assigned represented approximately 99% of what it was prior to assignment.

Sales and Marketing

We sell our solar energy offerings through a scalable sales organization using both a direct-to-consumer approach across online and offline channels and a diverse partner network that originates and/or installs our systems. We market and sell our products using direct channels, partner channels, mass media, digital media, canvassing, referral, retail, and field marketing. We sell to homeowners over the phone, in the field through canvassing and in-home sales and through retail sales channels through our strategic partners. We also partner with sales-only organizations that focus on direct-to-consumer marketing and sales on our behalf, typically with a Sunrun-branded offering at point of sale, which further increases our brand and reach. We believe that a customized, homeowner-focused selling process is important before, during and after the sale of our solar services.

We train our sales team to customize their consultative presentation to the individual homeowner, based on guidelines and principles outlined in our training materials. We are able to provide our sales team with real-time data and pricing tools through our proprietary technology which is designed to generate a tailored product offering with optimized pricing based on the actual characteristics of a homeowner's home, including roof characteristics and shading, as well as actual energy usage. This allows our sales team to differentially price homes in the same geographic region quickly and effectively.

Competition

We believe that our primary competitors are the traditional utilities that supply electricity to our potential customers. We compete with these traditional utilities primarily based on price (cents per kilowatt hour), predictability of future prices (by providing pre-determined annual price escalations) and the ease by which homeowners can switch to electricity generated by our solar energy systems.

We also compete with companies that are not regulated like traditional utilities but that have access to the traditional utility electricity transmission and distribution infrastructure pursuant to state and local pro-competitive and consumer choice policies and with solar companies with business models that are similar to ours. We believe that we compete favorably with these companies based on our unique multi-channel approach and differentiated customer experience.

We also face competition from purely finance-driven organizations that acquire homeowners and then subcontract out the installation of solar energy systems, from installation businesses that seek financing from external parties, from large construction companies and utilities and from sophisticated electrical and roofing companies.

Research and Development

We believe continued investment in research and development is an important component of our on-going efforts to improve and expand our platform of services and tools. Our research and development expenses were $9.7 million in 2015, $8.4 million in 2014 and $10.0 million in 2013. These expenses include costs related to the development, maintenance and research associated with our BrightPath software and our SnapNrack racking equipment. We also capitalized additional costs of $8.3 million in 2015, $7.3 million in 2014 and $1.9 million in 2013 associated with our software, including BrightPath.

Intellectual Property

As of December 31, 2015, we had 13 issued patents and 22 filed patent applications in the United States and foreign countries relating to a variety of aspects of our solar solutions. Our issued United States patents will expire 20 years from their respective filing dates, with the earliest expiring in 2029. We intend to file additional patent applications as we innovate through our research and development efforts.

Government Regulation and Incentives

Government Regulation

Although we are not regulated as a public utility in the United States under applicable national, state or other local regulatory regimes where we conduct business, we compete primarily with regulated utilities. As a result, we have developed and are committed to maintaining a policy team to focus on the key regulatory and legislative issues impacting the entire industry. We believe these efforts help us better navigate local markets through relationships with key stakeholders and facilitate a deep understanding of the regional policy environment.

To operate our systems we obtain interconnection permission from the applicable local primary electric utility. Depending on the size of the solar energy system and local law requirements, interconnection permission is provided by the local utility and us and/or our homeowners. In almost all cases, interconnection permissions are issued on the basis of a standard process that has been pre-approved by the local public utility commission or other regulatory body with jurisdiction over net metering policies. As such, no additional regulatory approvals are required once interconnection permission is given.

Our operations are subject to stringent and complex federal, state and local laws, including regulations governing the occupational health and safety of our employees and wage regulations. For example, we are subject to the requirements of the federal Occupational Safety and Health Act, as amended ("OSHA"), the U.S. Department of Transportation ("DOT"), and comparable state laws that protect and regulate employee health and safety.

Government Incentives

Federal, state and local government bodies provide incentives to owners, distributors, system integrators and manufacturers of solar energy systems to promote solar energy in the form of rebates, tax credits and other financial incentives such as system performance payments, payments for renewable energy credits associated with renewable energy generation and exclusion of solar energy systems from property tax assessments. These incentives enable us to lower the price we charge homeowners for energy from, and to lease, our solar energy systems, helping to catalyze homeowner acceptance of solar energy as an alternative to utility-provided power.

The federal government currently offers a 30% investment tax credit under Section 48(a) of the Internal Revenue Code ("Commercial ITC"), for the installation of certain solar power facilities owned for business purposes. The depreciable basis of a solar facility is also reduced by 50% of the tax credit claimed. Similarly, the federal government currently offers a 30% investment tax credit under Section 25D of the Internal Revenue Code ("Individual ITC"), for the installation of certain solar power facilities owned by individuals. The Commercial ITC was set to step down to 10% and the Individual ITC was set to expire at the end of 2016. In December 2015, Congress passed legislation extending both the Commercial and Individual ITC for an additional five years with a ramp down from 30% to 26% in 2020 and 22% in 2021. The Commercial ITC will remain at 10% permanently after 2021 and the Individual ITC will expire after 2021.

More than half of the states, and many local jurisdictions, have established property tax incentives for renewable energy systems that include exemptions, exclusions, abatements and credits. Many states also have adopted procurement requirements for renewable energy production. Twenty-nine states and the District of Columbia have adopted a renewable portfolio standard (and nine other states have some voluntary goal) that requires regulated utilities to procure a specified percentage of total electricity delivered in the state from eligible renewable energy sources, such as solar energy systems, by a specified date. To prove compliance with such mandates, utilities must surrender renewable energy certificates or SRECs to the applicable authority. Solar energy system owners such as our investment funds often are able to sell SRECs to utilities directly or in SREC markets.

While there are numerous federal, state and local government incentives that benefit our business, some adverse interpretations or determinations of new and existing laws can have a negative impact on our business. For example, in the state of Arizona, the Arizona Department of Revenue has determined that a personal property tax exemption on solar panels does not apply to solar panels that are leased (as opposed to owned), such that leased panels in Arizona may ultimately subject us and other solar companies to an increase in personal property taxes. If we pass this additional tax on to our customers in the form of higher prices, it could reduce or eliminate entirely the savings that these solar panels would otherwise provide to the customer. Although we are involved in ongoing litigation challenging the Arizona personal property tax determination, there can be no assurances that this litigation will be resolved in a manner that is favorable to us or other solar companies. If this litigation is not resolved in a manner that is favorable to us and other solar companies, it will adversely impact our operations in Arizona, and if we decide to pass the tax cost on to our customers, the price increase could adversely impact our ability to attract new customers in Arizona if it reduces or eliminates the savings that the solar panels would otherwise provide.

Employees

As of December 31, 2015, we had approximately 3,380 employees. We also engage independent contractors and consultants. None of our employees are covered by collective bargaining agreements. We have not experienced any work stoppages.

Corporate Information

Our principal executive offices are located at 595 Market Street, 29th Floor, San Francisco, California 94105, and our telephone number is (415) 580-6900. Our website address is www.sunrun.com. Information contained on, or that can be accessed through, our website does not constitute part of this prospectus and inclusions of our website address in this prospectus are inactive textual references only. We were formed in 2007 as a California limited liability company, and converted in 2008 into a Delaware corporation.

The Sunrun design logo, "Sunrun" and our other registered or common law trademarks, service marks or trade names appearing in this prospectus are the property of Sunrun Inc. Other trademarks and trade names referred to in this prospectus are the property of their respective owners.

Available Information

We file annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K, and amendments to reports filed or furnished pursuant to Sections 13(a) and 15(d) of the Securities Exchange Act of 1934, as amended. The public may obtain these filings at the Securities and Exchange Commission (the SEC)'s Public Reference Room at 100 F Street, NE, Washington, DC 20549 or by calling the SEC at 1-800-SEC-0330. The SEC also maintains a website at www.sec.gov that contains reports, proxy and information statements and other information that we file with the SEC electronically. Copies of our reports on Form 10-K, Forms 10-Q, Forms 8-K, and amendments to those reports may also be obtained, free of charge, electronically on the investor relations page on our website located at investors.sunrun.com as soon as reasonably practical after we file such material with, or furnish it to, the SEC.

We also use the investor relations page on our website as a channel of distribution for important company information. Important information, including press releases, analyst presentations and financial information regarding us, as well as corporate governance information, is routinely posted and accessible on the investor relations page on our website. Information on or that can be accessed through our website is not part of this Annual Report on Form 10-K, and the inclusion of our website address is an inactive textual reference only.

Item 1A. Risk Factors.

Investing in our common stock involves a high degree of risk. You should carefully consider the risks and uncertainties described below, together with all of the other information in this Annual Report on Form 10-K, including the section titled "Management's Discussion and Analysis of Financial Condition and Results of Operations" and our consolidated financial statements and related notes, before making a decision to invest in our common stock. The risks and uncertainties described below may not be the only ones we face. If any of the risks actually occur, our business, financial condition, results of operations, cash flows and prospects could be materially and adversely affected. In that event, the market price of our common stock could decline, and you could lose part or all of your investment.

Risks Related to Our Business and Our Industry

We need to raise capital to finance the continued growth of our residential solar service business. If capital is not available to us on acceptable terms, as and when needed, our business and prospects would be materially and adversely impacted.

Our future success depends on our ability to raise capital from third parties to grow our business. To date, we have funded our business principally through low-cost tax equity investment funds. If we are unable to establish new investment funds when needed, or upon desirable terms, the growth of our solar service business would be impaired.

The contract terms in certain of our existing investment fund documents contain various conditions with respect to our ability to draw on financing commitments from the fund investors, including conditions that restrict our ability to draw on such commitments if an event occurs that could reasonably be expected to have a material adverse effect on the fund or, in some instances, us. If we were not able to satisfy such conditions due to events related to our business, a specific investment fund, developments in our industry, including tax or regulatory changes, or otherwise, and as a result, we were unable to draw on existing funding commitments, we could experience a material adverse effect on our business, liquidity, financial condition, results of operations and prospects. If any of the investors that currently invest in our investment funds were to decide not to invest in future investment funds to finance our solar service offerings due to general market conditions, concerns about our business or prospects or any other reason, or materially change the terms under which they were willing to provide future financing, we would need to identify new investors to invest in our investment funds and our cost of capital may increase.

There can be no assurance that we will be able to continue to successfully access capital in a manner that supports the growth of our business. Certain sources of capital may not be available in the future, and competition for any available funding may increase. We cannot be sure that we will be able to maintain necessary levels of funding without incurring high funding costs, unfavorable changes in the terms of funding instruments or the liquidation of certain assets. If we are unable to continue to offer a competitive investment profile, we may lose access to these funds or they may only be available on less favorable terms than those provided to our competitors or currently provided to us. If we are to be unable to arrange new or alternative methods of financing on favorable terms, our business, financial condition, results of operations and prospects could be materially and adversely affected.

The solar energy industry is an emerging market that is constantly evolving and may not develop to the size or at the rate we expect.

The solar energy industry is an emerging and constantly evolving market opportunity. We believe the solar energy industry will take several years to fully develop and mature, and we cannot be certain that the market will grow at the rate we expect. Any future growth of the solar energy market and the success of our solar service offerings depend on many factors beyond our control, including recognition and acceptance of the solar service market by consumers, the pricing of alternative sources of energy and our ability to provide our solar service offerings cost effectively. If the markets for solar energy do not develop at the rate we expect, our business may be adversely affected. Solar energy has yet to achieve broad market acceptance and depends in part on continued support in the form of rebates, tax credits and other incentives from federal, state and local governments. If this support diminishes, our ability to obtain external financing on acceptable terms, or at all, could be materially adversely affected. Such funding limitations could lead to inadequate financing support for the anticipated growth in our business. Furthermore, growth in residential solar energy depends in part on macroeconomic conditions, retail prices of electricity and homeowner preferences, each of which can change quickly. Declining macroeconomic conditions, including in the job markets and residential real estate markets, could contribute to instability and uncertainty among homeowners and impact their financial wherewithal, credit scores or interest in entering into long-term contracts, even if such contracts would generate immediate and long-term savings.

Market prices of retail electricity generated by utilities or other energy sources could decline for a variety of reasons, as discussed further below. Any such declines in macroeconomic conditions or changes in homeowner preferences would adversely impact our business.

Our ability to provide our solar service offerings to homeowners on an economically viable basis depends in part on our ability to finance these systems with fund investors who seek particular tax and other benefits.

Our solar service offerings have been eligible for federal investment tax credits ("ITCs"), U.S. Treasury grants and other tax benefits. We have relied on, and will continue to rely on, tax equity investment funds, which are financing structures that monetize a substantial portion of those benefits, in order to finance our solar service offerings. If, for any reason, we were unable to continue to monetize those benefits through these arrangements, we may be unable to provide and maintain our solar service offerings for homeowners on an economically viable basis.

The availability of this tax-advantaged financing depends upon many factors, including:

- our ability to compete with other solar energy companies for the limited number of potential fund investors, each of which has limited funds and limited appetite for the tax benefits associated with these financings;
- the state of financial and credit markets;
- changes in the legal or tax risks associated with these financings; and
- non-renewal of these incentives or decreases in the associated benefits.

The federal government currently offers a 30% ITC (the "Commercial ITC") under Section 48(a) of the Internal Revenue Code of 1986, as amended (the "Code"), for the installation of certain solar power facilities prior to December 31, 2016, for taxpayers using solar property in a trade or business. The Commercial ITC was set to step down to 10% at the end of 2016. In December 2015, Congress passed legislation extending the Commercial ITC for an additional five years with a ramp down from 30% to 26% in 2020 and 22% in 2021. The Commercial ITC will remain at 10% permanently after 2021. Potential investors must remain satisfied that the funding structures that we offer will make the tax benefits associated with solar energy systems available to these investors, which depends both on the investors' assessment of the tax law and the absence of any unfavorable interpretations of that law. Adverse changes in existing law or interpretations of existing law by the Internal Revenue Service (the "IRS") and the courts could reduce the willingness of investors to invest in funds associated with these solar energy systems. Accordingly, we cannot assure you that this type of financing will continue to be available to us. New investment fund structures or other financing mechanisms may also become available, and if we are unable to take advantage of these fund structures and financing mechanisms, we may be at a competitive disadvantage. If, for any reason, we were unable to finance our solar service offerings through tax-advantaged structures or if we were unable to realize or monetize Commercial ITCs or other tax benefits, we may no longer be able to provide our solar service offerings to new homeowners on an economically viable basis, which would have a material adverse effect on our business, financial condition and results of operations.

We have historically benefited from declining costs in our industry, and our business and financial results may be harmed as a result of increases in costs associated with our solar service offerings. If we do not reduce our cost structure in the future, our ability to become profitable may be impaired.

Declining costs related to raw materials, manufacturing and the sale and installation of our solar service offerings has been a key driver in the pricing of our solar service offerings and, more broadly, homeowner adoption of solar energy. While historically the prices of solar panels and raw materials have declined, the cost of solar panels and raw materials could increase in the future due to a variety of factors, including trade barriers, export regulations, regulatory or contractual limitations, industry market requirements and changes in technology and industry standards. Any such increases could slow our growth and cause our financial results and operational metrics to suffer. For example, in the past, we and our solar partners purchased a significant portion of the solar panels used in our solar service offerings from manufacturers based in China or such panels have contained components from China. The U.S. government has imposed antidumping and countervailing duties on solar cells manufactured in China. In addition, we may face other increases in our operating expenses, including increases in wages or other labor costs, as well as marketing, sales or branding related costs. In addition, we invested heavily in building our direct-to-consumer capabilities in 2014 after our acquisition of the residential sales and installation business of Mainstream Energy Corporation, as well as its fulfillment business, AEE Solar, and its racking business, SnapNrack, which we refer to collectively as MEC. These investments included significantly increasing our installation capacity through the opening of new branches, increasing our hiring in construction and in associated management personnel, and increasing brand and sales and marketing expenses.

We may continue to make significant investments to drive growth in the future. Increases in any of these costs could adversely affect our results of operations and financial condition and harm our business and prospects. If we are unable to reduce our cost structure in the future, we may not be able to achieve profitability, which could have a material adverse effect on our business and prospects.

Electric utility statutes and regulations and changes to statutes or regulations may present technical, regulatory and economic barriers to the purchase and use of our solar service offerings that may significantly reduce demand for such offerings.

Federal, state, and local government statutes and regulations concerning electricity heavily influence the market for our solar service offerings. These statutes and regulations relate to electricity pricing, net metering, incentives, taxation, competition with utilities, and the interconnection of homeowner-owned and third party-owned solar energy systems to the electrical grid. These statutes and regulations are constantly evolving. Governments, often acting through state utility or public service commissions, change and adopt different rates for residential customers on a regular basis and these changes can have a negative impact on our ability to deliver savings to homeowners.

Utilities, their trade associations, and fossil fuel interests in the country, each of which has significantly greater economic and political resources than the residential solar industry, are currently challenging solar-related policies to reduce the competitiveness of residential solar energy. Any adverse changes in solar-related policies could have a negative impact on our business and prospects. For example, we recently ceased operations in Nevada as a result of the elimination of net metering.

We face competition from traditional energy companies as well as solar energy companies.

The solar energy industry is highly competitive and continually evolving as participants strive to distinguish themselves within their markets and compete with large utilities. We believe that our primary competitors are the established utilities that supply energy to homeowners by traditional means. We compete with these utilities primarily based on price, predictability of price, and the ease by which homeowners can switch to electricity generated by our solar service offerings. If we cannot offer compelling value to homeowners based on these factors, then our business and revenues will not grow. Utilities generally have substantially greater financial, technical, operational and other resources than we do. As a result of their greater size, these competitors may be able to devote more resources to the research, development, promotion and sale of their products or respond more quickly to evolving industry standards and changes in market conditions than we can. Furthermore, these competitors are able to devote substantially more resources and funding to regulatory and lobbying efforts.

Utilities could also offer other value-added products or services that could help them compete with us even if the cost of electricity they offer is higher than ours. In addition, a majority of utilities' sources of electricity are nonsolar, which may allow utilities to sell electricity more cheaply than us. In addition, regulated utilities are increasingly seeking approval to 'rate-base' their own residential solar businesses. Rate-basing means that utilities would receive guaranteed rates of return for their solar businesses. This is already commonplace for utility scale solar projects and commercial solar projects. While few utilities to date have received regulatory permission to rate base residential solar, our competitiveness would be significantly harmed should more utilities receive such permission because we do not receive guaranteed profits for our solar service offerings.

We also face competition from other residential solar service providers. Some of these competitors have a higher degree of brand name recognition, differing business and pricing strategies, and greater capital resources than we have and have extensive knowledge of our target markets. If we are unable to establish or maintain a consumer brand that resonates with homeowners, or competes with the pricing offered by our competitors, our sales and market share position may be adversely affected as our growth is dependent on originating new homeowners. We may also face competitive pressure from companies who offer lower priced consumer offerings than us.

We also compete with companies that are not regulated like traditional utilities but that have access to the traditional utility electricity transmission and distribution infrastructure. These energy service companies are able to offer homeowners electricity supply-only solutions that are competitive with our solar service offerings on both price and usage of solar energy technology while avoiding the long-term agreements and physical installations that our current fund-financed business model requires. This may limit our ability to attract homeowners, particularly those who wish to avoid long-term contracts or have an aesthetic or other objection to putting solar panels on their roofs.

We also face competition from purely finance-driven nonintegrated competitors that subcontract out the installation of solar energy systems, from installation businesses (including solar partners) that seek financing from external parties, from large construction companies and from electrical and roofing companies. In addition, local installers that might otherwise be viewed as potential solar partners may gain market share by being able to be first providers in new local markets. Some of these competitors may provide energy at lower costs than we do.

As the solar industry grows and evolves, we will also face new competitors who are not currently in the market, as well as existing and new competitors, including those resulting from the consolidation of existing competitors, that achieve significant developments in alternative technologies or new products such as storage solutions, loan products or other programs related to third-party ownership. Our failure to adapt to changing market conditions, to compete successfully with existing or new competitors and to adopt new or enhanced technologies could limit our growth and have a material adverse effect on our business and prospects.

Regulations and policies related to rate design could deter potential homeowners from purchasing our solar service offerings, reduce the value of the electricity we produce, and reduce the savings that our homeowners could realize from our solar service offerings.

All states regulate investor-owned utility retail electricity pricing. In addition, there are numerous publicly owned utilities and electric cooperatives that establish their own retail electricity pricing through some form of regulation or internal process. These regulations and policies could deter potential homeowners from purchasing our solar service offerings. For example, utilities are seeking rate design changes to "de-couple" rates. This form of "de-coupling" means changing rates to charge lower volume-based rates, or the rates charged for kilowatt hour of electricity purchased by a residential customer, and higher unavoidable fixed charges that a homeowner is subject to when they purchase solar energy from third parties. This form of rate design would adversely impact our business by reducing the value of the electricity our solar energy systems produce and reducing the savings homeowners receive by purchasing our solar service offerings. In addition to changes in general rates charged to all residential customers, utilities are increasingly seeking solar-specific charges (which may be fixed charges, capacity-based charges, or other rate changes). Any of these changes could materially reduce the demand for our products and could limit the number of markets in which our products are competitive with electricity provided by the utilities.

We rely on net metering and related policies to offer competitive pricing to homeowners in all of our current markets, and changes to net metering policies may significantly reduce demand for electricity from our solar service offerings.

As of December 31, 2015, a substantial majority of states have adopted net metering policies. Net metering policies provide homeowners with a one-for-one full retail credit within a monthly billing period for electricity that the solar energy system exports to the electric grid. At the end of the monthly billing period, if the homeowner has generated excess electricity within that month, the homeowner typically carries forward a credit for any excess electricity to be offset against future utility purchases. At the end of an annual billing period or calendar year, utilities either continue to carry forward a credit, or reconcile the homeowner's final annual or calendar year bill using different rates (including zero credit) for the exported electricity.

Utilities, their trade associations, and fossil fuel interests in the country are currently challenging net metering policies, and seeking to either eliminate it, cap it, or impose charges on homeowners that have adopted net metering. For example, the Hawaii Public Utilities Commission recently issued an Order that purports to eliminate net metering for all new customers. In its place, the Commission created a tariff that sets a reduced rate for the credit customers receive when they export power. All customers who have submitted net metering applications are grandfathered indefinitely under the old rules and we will continue to build those systems.

Some states, including California, currently set limits on the total percentage of a utility's customers that can adopt net metering. New Hampshire and New York also have net metering caps and other states we serve now or in the future may adopt net metering caps. If the net metering caps in these jurisdictions are reached without an expansion of net metering policies, homeowners in the future will be unable to recognize the cost savings associated with net metering they currently enjoy. If changes to net metering policies occur without grandfathering to existing homeowners, as occurred recently in Nevada, those existing homeowners could be negatively impacted which could create a default risk from those homeowners. Our ability to sell our solar service offerings may be adversely impacted by the failure to expand existing limits to net metering. The failure to adopt a net metering policy where it currently is not in place would pose a barrier to entry in those states. Additionally, the imposition of charges that only or disproportionately impact homeowners that utilize net metering would adversely impact our business.

Our business currently depends on the availability of utility rebates, tax credits and other financial incentives in addition to other tax benefits. The expiration, elimination or reduction of these rebates and incentives could adversely impact our business.

U.S. federal, state and local governmental bodies provide incentives to owners, distributors, installers and manufacturers of solar energy systems to promote solar energy. These incentives include ITCs, as discussed above, as well as other tax credits, rebates and other financial incentives, such as system performance payments and payments for solar renewable energy credits ("SRECs") associated with solar energy generation. We rely on these incentives to lower our cost of capital and to incent investors to invest in our funds, all of which enables us to lower the price we charge homeowners for our solar service offerings. However, these incentives may expire on a particular date (as discussed above with respect to ITCs), end when the allocated funding is exhausted, or be reduced or terminated without notice. The financial value of certain incentives may also decrease over time.

Our business model also relies on multiple tax exemptions offered at the state and local levels. For example, solar energy systems are generally not considered in determining values for calculation of local and state real and personal property taxes as a result of applicable property tax exemptions. If solar energy systems were not excluded, the property taxes payable by homeowners would be higher, which could offset any potential savings our solar service offerings could offer. For example, in the state of Arizona, the Arizona Department of Revenue has determined that a personal property tax exemption on solar panels does not apply to solar panels that are leased (as opposed to owned), such that leased panels in Arizona may ultimately subject the homeowner to an increase in personal property taxes and this increased personal property tax could reduce or eliminate entirely the savings that these solar panels would otherwise provide to the homeowner. Although we are involved in ongoing litigation challenging the Arizona personal property tax determination, there can be no assurances that this litigation will be resolved in a manner that is favorable to us or other solar companies. If this litigation is not resolved in a manner that is favorable to us and other solar companies, and we pass the tax cost on to our customers, it will adversely impact our ability to attract new customers in Arizona, and the savings that our current Arizona customers realize will be reduced by the additional tax imposed, which will make our solar service offerings less attractive to those customers and could increase the risk of default from those customers. In addition, we rely on certain state and local tax exemptions that apply to the sale of equipment, sale of power, or both. These state and local sales tax exemptions can be changed by the state legislature and other regulators, and such a change could adversely impact our business.

We are not currently regulated as a utility under applicable laws, but we may be subject to regulation as a utility in the future or become subject to new federal and state regulations for any additional solar service offerings we may introduce in the future.

Federal, state, and municipal laws do not currently regulate us as a utility. As a result, we are not subject to the various regulatory requirements applicable to U.S. utilities. However, any federal, state, local or otherwise applicable regulations could place significant restrictions on our ability to operate our business and execute our business plan by prohibiting or otherwise restricting our sale of electricity. These regulatory requirements could include restricting our sale of electricity, as well as regulating the price of our solar service offerings. If we were subject to the same regulatory authorities as utilities in the United States or if new regulatory bodies were established to oversee our business, then our operating costs could materially increase.

Our business depends in part on the regulatory treatment of third-party owned solar energy systems.

Our customer agreements are third-party ownership arrangements. Sales of electricity by third parties face regulatory challenges in some states and jurisdictions. These challenges pertain to issues such as whether third party-owned systems qualify for the same levels of rebates or other non-tax incentives available for homeowner-owned solar energy systems, whether third-party-owned systems are eligible at all for these incentives, and whether third-party-owned systems are eligible for net metering and the associated significant cost savings. Reductions in, or eliminations of, the current treatment of third-party arrangements could reduce demand for our solar service offerings, adversely impact our access to capital and cause us to increase the price we charge homeowners for energy.

Interconnection limits or circuit-level caps imposed by regulators may significantly reduce our ability to sell electricity from our solar service offerings in certain markets or slow interconnections, harming our growth rate and customer satisfaction scores.

Interconnection rules establish the circumstances in which rooftop solar will be connected to the electricity grid. Interconnection limits or circuit-level caps imposed by regulators may curb our growth in key markets. Utilities throughout the country have different rules and regulations regarding interconnection and some utilities cap or limit the amount of solar energy that can be interconnected to the grid. Our systems do not provide power to homeowners until they are interconnected to the grid. The vast majority of our current homeowners are connected to the grid, and we expect homeowners to continue to be connected to the grid in the future.

Interconnection regulations are based on claims from utilities regarding the amount of solar electricity that can be connected to the grid without causing grid reliability issues or requiring significant grid upgrades. These interconnection limits or circuit-level caps have slowed the pace of our installations in Hawaii and could slow our installations in other markets, harming our growth rate and customer satisfaction scores.

We may be required to make payments or contribute assets to our investors upon the occurrence of certain events, including one-time reset or true-up payments or upon the exercise of a redemption option by one of our investors.

Our fund investors typically advance capital to us based on estimates. The models we use to calculate prepayments in connection with certain of our investment funds will be updated for each investment fund at a fixed date occurring after placement in service of all solar energy systems or an agreed upon date (typically within the first year of the applicable term) to reflect certain specified conditions as they exist at such date including the ultimate system size of the equipment that was leased, how much it cost, and when it went into service. As a result of this true up, applicable payments are resized, and we may be obligated to refund the investor's prepayments or to contribute additional assets to the investment fund. Further, our estimated retained value may be reduced. In addition, certain of our fund investors have the right to require us to purchase their interests in the investment funds after a set period of time, generally at a price equal to the greater of a set purchase price or fair market value of the interests at the time of the repurchase. Any significant refunds, capital contributions or purchases that we may be required to make could adversely affect our liquidity or financial condition.

A material drop in the retail price of utility-generated electricity or electricity from other sources would harm our business, financial condition and results of operations.

We believe that a homeowner's decision to buy solar energy from us is primarily driven by a desire to lower electricity costs. Decreases in the retail prices of electricity from utilities or other energy sources would harm our ability to offer competitive pricing and could harm our business. The price of electricity from utilities could decrease as a result of:

- the construction of a significant number of new power generation plants, including nuclear, coal, natural gas or renewable energy technologies;
- the construction of additional electric transmission and distribution lines;
- a reduction in the price of natural gas or other natural resources as a result of new drilling techniques or other technological developments, a relaxation of associated regulatory standards, or broader economic or policy developments;
- energy conservation technologies and public initiatives to reduce electricity consumption; and
- development of new energy technologies that provide less expensive energy.

A reduction in utility electricity prices would make the purchase of our solar service offerings less attractive. If the retail price of energy available from utilities were to decrease due to any of these or other reasons, we would be at a competitive disadvantage. As a result, we may be unable to attract new homeowners and our growth would be limited.

It is difficult to evaluate our business and prospects due to our limited operating history.

Until 2014, we focused our efforts primarily on the sales, financing, and monitoring of solar energy systems for residential customers, with installation provided by our solar partners. In February 2014, we acquired MEC. We have limited experience managing the fulfillment and racking lines of the MEC business, and we may not be successful in maintaining or growing the revenue from these businesses. Further, we have limited experience, in comparison to our solar partner model, in our direct-to-consumer business, and as a result, we may fail to grow as quickly or achieve the revenue scale targeted in connection with such model. We may also be unsuccessful in expanding our customer base through installation of our solar service offerings within our current markets or in new markets we may enter. Additionally, we cannot assure you that we will be successful in generating substantial revenue from our current solar service offerings or from any additional solar service offerings we may introduce in the future. Our limited operating history, combined with the rapidly evolving and competitive nature of our industry, may not provide an adequate basis for you to evaluate our results of operations and business prospects. In addition, we only have limited insight into emerging trends, such as alternative energy sources, commodity prices in the overall energy market, and legal and regulatory changes that impact the solar industry, any of which could adversely impact our business, prospects and results of operations.

We have incurred losses and may be unable to achieve or sustain profitability in the future.

We have incurred net losses in the past, and we had an accumulated deficit of $87.2 million as of December 31, 2015. We will continue to incur net losses as we increase our spending to finance the expansion of our operations, expand our installation, engineering, administrative, sales and marketing staffs, increase spending on our brand awareness and other sales and marketing initiatives, and implement internal systems and infrastructure to support our growth. We do not know whether our revenue will grow rapidly enough to absorb these costs and our limited operating history makes it difficult to assess the extent of these expenses or their impact on our results of operations. Our ability to achieve profitability depends on a number of factors, including but not limited to:

- growing our customer base;
- finding investors willing to invest in our investment funds on favorable terms;

- maintaining or further lowering our cost of capital;
- reducing the cost of components for our solar service offerings;
- growing and maintaining our channel partner network;
- growing our direct-to-consumer business to scale; and
- reducing our operating costs by lowering our customer acquisition costs and optimizing our design and installation processes and supply chain logistics.

Even if we do achieve profitability, we may be unable to sustain or increase our profitability in the future.

Our results of operations may fluctuate from quarter to quarter, which could make our future performance difficult to predict and could cause our results of operations for a particular period to fall below expectations, resulting in a decline in the price of our common stock.

Our quarterly results of operations are difficult to predict and may fluctuate significantly in the future. We have experienced seasonal and quarterly fluctuations in the past and expect these fluctuations to continue. However, given that we are an early-stage company operating in a rapidly changing industry, those fluctuations may be masked by our recent growth rates and thus may not be readily apparent from our historical results of operations. As such, our past quarterly results of operations may not be good indicators of future performance.

In addition to the other risks described in this "Risk Factors" section, as well as the factors discussed in "Management's Discussion and Analysis of Financial Condition and Results of Operations" section, the following factors could cause our results of operations and key performance indicators to fluctuate:

- the expiration or initiation of any governmental tax rebates or incentives;
- significant fluctuations in homeowner demand for our solar service offerings or fluctuations in the geographic concentration of installations of solar energy systems;
- changes in financial markets, which could restrict our ability to access available financing sources;
- seasonal or weather conditions that impact sales, energy production and system installations;
- the amount and timing of operating expenses related to the maintenance and expansion of our business, operations and infrastructure;
- announcements by us or our competitors of new products or services, significant acquisitions, strategic partnerships, joint ventures or capital-raising activities or commitments;
- changes in our pricing policies or terms or those of our competitors, including utilities;
- changes in regulatory policy related to solar energy generation;
- the loss of one or more key partners or the failure of key partners to perform as anticipated;
- actual or anticipated developments in our competitors' businesses or the competitive landscape;
- actual or anticipated changes in our growth rate;
- general economic, industry and market conditions; and
- changes to our cancellation rate.

In the past, we have experienced seasonal fluctuations in sales and installations, particularly in the fourth quarter. This has been the result of decreased sales through the holiday season and weather-related installation delays. In addition, energy production is greater in the second and third quarters of the year, causing variability in operating lease revenues throughout the year. Our incentives revenue is also highly variable due to associated revenue recognition rules, as discussed in greater detail in "Management's Discussion and Analysis of Financial Condition and Results of Operations." Seasonal and other factors may also contribute to variability in our sales of solar energy systems and product sales. For these or other reasons, the results of any prior quarterly or annual periods should not be relied upon as indications of our future performance. In addition, our actual revenue or key operating metrics in future quarters may fall short of the expectations of investors and financial analysts, which could have a material adverse effect on the trading price of our common stock.

If we fail to manage our recent and future growth effectively, we may be unable to execute our business plan, maintain high levels of customer service or adequately address competitive challenges.

We have experienced significant growth in recent periods, and we intend to continue to expand our business significantly within existing markets and in a number of new locations in the future. This growth has placed, and any future growth may place, a significant strain on our management, operational and financial infrastructure. In particular, we will be required to expand, train and manage our growing employee base and solar partners. Our management will also be required to maintain and expand our relationships with homeowners, suppliers and other third parties and attract new homeowners and suppliers, as well as to manage multiple geographic locations.

In addition, our current and planned operations, personnel, systems and procedures might be inadequate to support our future growth and may require us to make additional unanticipated investment in our infrastructure, including additional costs for the expansion of our employee base and our solar partners as well as marketing and branding costs. For example, our headcount has grown to approximately 3,380 as of December 31, 2015. Our success and ability to further scale our business will depend, in part, on our ability to manage these changes in a cost-effective and efficient manner. If we cannot manage our growth, we may be unable to take advantage of market opportunities, execute our business strategies or respond to competitive pressures. This could also result in declines in quality or homeowner satisfaction, increased costs, difficulties in introducing new solar service offerings or other operational difficulties. Any failure to effectively manage growth could adversely impact our business and reputation.

Servicing our debt requires a significant amount of cash to comply with certain covenants and satisfy payment obligations, and we may not have sufficient cash flow from our business to pay our substantial debt and may be forced to take other actions to satisfy our obligations under our indebtedness, which may not be successful.

We have substantial amounts of debt, including the working capital facility and the non-recourse debt facilities entered into by our subsidiaries, as discussed in more detail in the section titled "Management's Discussion and Analysis of Financial Condition and Results of Operations" and our financial statements. Our ability to make scheduled payments of the principal of, to pay interest on or to refinance our indebtedness depends on our future performance, which is subject to economic, financial, competitive and other factors beyond our control. Our business may not continue to generate cash flow from operations in the future sufficient to service our debt and make necessary capital expenditures to operate our business. If we are unable to generate such cash flow, we may be required to adopt one or more alternatives, such as selling assets, restructuring debt or obtaining additional equity capital on terms that may be onerous or highly dilutive. Our ability to refinance our indebtedness will depend on the capital markets and our financial condition at such time. We may not be able to engage in any of these activities or engage in these activities on desirable terms, which could result in a default on our debt obligations.

We expect to incur substantially more debt in the future, which could intensify the risks to our business.

We and our subsidiaries expect to incur additional debt in the future, subject to the restrictions contained in our debt instruments. Our existing debt arrangements restrict our ability to incur additional indebtedness, including secured indebtedness, and we may be subject to similar restrictions under the terms of future debt arrangements. These restrictions could inhibit our ability to pursue our business strategies. Increases in our existing debt obligations would further heighten the debt related risk discussed above.

Furthermore, there is no assurance that we will be able to enter into new debt instruments on acceptable terms. If we were unable to satisfy financial covenants and other terms under existing or new instruments or obtain waivers or forbearance from our lenders or if we were unable to obtain refinancing or new financings for our working capital, equipment and other needs on acceptable terms if and when needed, our business would be adversely affected.

The production and installation of solar energy systems depends heavily on suitable meteorological conditions. If meteorological conditions are unexpectedly unfavorable, the electricity production from our solar service offerings may be below our expectations, and our ability to timely deploy new systems may be adversely impacted.

The energy produced and revenue and cash flows generated by a solar energy system depend on suitable solar and weather conditions, both of which are beyond our control. Furthermore, components of our systems, such as panels and inverters, could be damaged by severe weather or natural catastrophes, such as hailstorms, tornadoes or earthquakes. In these circumstances, we generally would be obligated to bear the expense of repairing the damaged solar energy systems that we own. Sustained unfavorable weather also could unexpectedly delay the installation of our solar energy systems, leading to increased expenses and decreased revenue and cash flows in the relevant periods. Weather patterns could change, making it harder to predict the average annual amount of sunlight striking each location where our systems are installed. This could make our solar service offerings less economical overall or make individual systems less economical. Any of these events or conditions could harm our business, financial condition and results of operations.

Our business is concentrated in certain markets, putting us at risk of region specific disruptions.

As of December 31, 2015, the majority of our customers were in California. Accordingly, our business and results of operations are particularly susceptible to adverse economic, regulatory, political, weather and other conditions in this market and in other markets that may become similarly concentrated. In addition, our corporate and sales headquarters are located in San Francisco, California, an area that is at a heightened risk of earthquakes. We may not have adequate insurance, including business interruption insurance, to compensate us for losses that may occur from any such significant events, including damage to our solar energy systems. A significant natural disaster, such as an earthquake, could have a material adverse impact on our business, results of operations and financial condition. In addition, acts of terrorism or malicious computer viruses could cause disruptions in our or our solar partners' businesses or the economy as a whole. To the extent that these disruptions result in delays or cancellations of installations or the deployment of our solar service offerings, our business, results of operations and financial condition would be adversely affected.

Loan financing developments could adversely impact our business.

The third-party ownership structure, which we bring to market through our solar service offerings, continues to be the predominant form of system ownership in the residential solar market in many states. However, there is a possibility of a shift from this trend to an outright purchase of the system by the homeowner (i.e., a homeowner purchases the solar energy system outright instead of leasing the system from us and paying us for the solar power produced by those systems for a 20-year initial term) with the development of loan financing products. Increases in third-party loan financing products or outright purchases could result in the demand for long-term customer agreements to decline, which would require us to shift our product focus to respond to the market trend and could have an adverse effect on our business. In 2014 and 2015, the majority of our customers chose our solar service offerings as opposed to buying a solar energy system outright. Our financial model is impacted by the volume of homeowners who choose our solar service offerings, and an increase in the number of customers who choose to purchase solar energy systems (whether for cash or through third-party financing) may harm our business and financial results.

The federal government currently offers a 30% investment tax credit under Section 25D of the Internal Revenue Code ("Individual ITC"), for the installation of certain solar power facilitates owned by individuals. The Individual ITC was set to expire at the end of 2016. In December 2015, Congress passed legislation extending the Individual ITC for an additional five years with a ramp down from 30% to 26% in 2020 and to 22% in 2021. The Individual ITC is set to expire after 2021.

Our growth depends in part on the success of our relationships with third parties, including our solar partners.

A key component of our growth strategy is to develop or expand our relationships with third parties. For example, we are investing resources in establishing strategic relationships with market players across a variety of industries, including large retailers, to generate new customers. These programs may not roll out as quickly as planned or produce the results we anticipated. A significant portion of our business depends on attracting and retaining new and existing solar partners. Negotiating relationships with our solar partners, investing in due diligence efforts with potential solar partners, training such third parties and contractors, and monitoring them for compliance with our standards require significant time and resources and may present greater risks and challenges than expanding a direct sales or installation team. If we are unsuccessful in establishing or maintaining our relationships with these third parties, our ability to grow our business and address our market opportunity could be impaired. Even if we are able to establish and maintain these relationships, we may not be able to execute on our goal of leveraging these relationships to meaningfully expand our business, brand recognition and customer base. This would limit our growth potential and our opportunities to generate significant additional revenue or cash flows.

We and our solar partners depend on a limited number of suppliers of solar panels and other system components to adequately meet anticipated demand for our solar service offerings. Any shortage, delay or component price change from these suppliers, or the acquisition of any of these suppliers by a competitor, could result in sales and installation delays, cancellations and loss of market share.

We and our solar partners purchase solar panels, inverters and other system components from a limited number of suppliers, making us susceptible to quality issues, shortages and price changes. If we or our solar partners fail to develop, maintain and expand our relationships with these or other suppliers, we may be unable to adequately meet anticipated demand for our solar service offerings, or we may only be able to offer our systems at higher costs or after delays. If one or more of the suppliers that we or our solar partners rely upon to meet anticipated demand ceases or reduces production, we may be unable to quickly identify alternate suppliers or to qualify alternative products on commercially reasonable terms, and we may be unable to satisfy this demand. The acquisition of a supplier by one of our competitors could limit our access to such components and require significant redesigns of our solar energy systems or installation procedures and have a material adverse effect on our business.

In particular, there are a limited number of suppliers of inverters, which are components that convert electricity generated by solar panels into electricity that can be used to power the home. For example, once we design a system for use with a particular inverter, if that type of inverter is not readily available at an anticipated price, we may incur additional delay and expense to redesign the system. Further, the inverters on our solar energy systems generally carry only 10-year warranties. If there is an inverter equipment shortage in a year when a substantial number of inverters on our systems need to be replaced, we may not be able to replace the inverters to maintain proper system functioning or may be forced to do so at higher than anticipated prices, either of which would adversely impact our business.

There have also been periods of industry-wide shortage of key components, including solar panels, in times of rapid industry growth. For example, new or unexpected changes in rooftop fire codes or building codes may require new or different system components to satisfy compliance with such newly effective codes or regulations, which may not be readily available for distribution to us or our suppliers. The manufacturing infrastructure for some of these components has a long lead time, requires significant capital investment and relies on the continued availability of key commodity materials, potentially resulting in an inability to meet demand for these components and, as a result, could negatively impact our ability to install systems in a timely manner. Further, any decline in the exchange rate of the U.S. dollar compared to the functional currency of our component suppliers could increase our component prices. Any of these shortages, delays or price changes could limit our growth, cause cancellations or adversely affect our operating margins, and result in loss of market share and damage to our brand.

As the primary entity that contracts with homeowners, we are subject to risks associated with construction, cost overruns, delays, regulatory compliance and other contingencies, any of which could have a material adverse effect on our business and results of operations.

We are a licensed contractor in certain communities that we service, and we are ultimately responsible as the contracting party for every solar energy system installation. We may be liable, either directly or through our solar partners, to homeowners for any damage we cause to them, their home, belongings or property during the installation of our systems. For example, we, either directly or through our solar partners, frequently penetrate homeowners' roofs during the installation process and may incur liability for the failure to adequately weatherproof such penetrations following the completion of construction. In addition, because the solar energy systems we or our solar partners deploy are high voltage energy systems, we may incur liability for any failure to comply with electrical standards and manufacturer recommendations.

Further, we or our solar partners may face construction delays or cost overruns, which may adversely affect our or our solar partners' ability to ramp up the volume of installation in accordance with our plans. Such delays or overruns may occur as a result of a variety of factors, such as labor shortages, defects in materials and workmanship, adverse weather conditions, transportation constraints, construction change orders, site changes, labor issues and other unforeseen difficulties, any of which could lead to increased cancellation rates, reputational harm and other adverse effects.

In addition, the installation of solar energy systems, energy-storage systems and other energy-related products requiring building modifications are subject to oversight and regulation in accordance with national, state and local laws and ordinances relating to building, fire and electrical codes, safety, environmental protection, utility interconnection and metering, and related matters. We also rely on certain of our employees to maintain professional licenses in many of the jurisdictions in which we operate, and our failure to employ properly licensed personnel could adversely affect our licensing status in those jurisdictions. It is difficult and costly to track the requirements of every individual authority having jurisdiction over our installations and to design solar energy systems to comply with these varying standards. Any new government regulations or utility policies pertaining to our systems may result in significant additional expenses to us and our homeowners and, as a result, could cause a significant reduction in demand for our solar service offerings.

While we have a variety of stringent quality standards that we apply in the selection of our solar partners, we do not control our suppliers and solar partners or their business practices. Accordingly, we cannot guarantee that they follow our standards or ethical business practices, such as fair wage practices and compliance with environmental, safety and other local laws. A lack of demonstrated compliance could lead us to seek alternative suppliers or contractors, which could increase our costs and result in delayed delivery or installation of our products, product shortages or other disruptions of our operations. Violation of labor or other laws by our suppliers and solar partners or the divergence of a supplier's or solar partners' labor or other practices from those generally accepted as ethical in the United States or other markets in which we do business could also attract negative publicity for us and harm our business, brand and reputation in the market.

We typically bear the risk of loss and the cost of maintenance, repair and removal on solar energy systems that are owned or leased by our investment funds.

We typically bear the risk of loss and are generally obligated to cover the cost of maintenance, repair and removal for any solar energy system that we sell or lease to our investment funds. At the time we sell or lease a solar energy system to an investment fund, we enter into a maintenance services agreement where we agree to operate and maintain the system for a fixed fee that is calculated to cover our future expected maintenance costs. If our solar energy systems require an above-average amount of repairs or if the cost of repairing systems were higher than our estimate, we would need to perform such repairs without additional compensation. If our solar energy systems, a majority of which are located in California, are damaged as the result of a natural disaster beyond our control, losses could exceed or be excluded from, our insurance policy limits, and we could incur unforeseen costs that could harm our business and financial condition. We may also incur significant costs for taking other actions in preparation for, or in reaction to, such events. We purchase property insurance with industry standard coverage and limits approved by an investor's third-party insurance advisors to hedge against such risk, but such coverage may not cover our losses.

Disruptions to our solar production metering solution could negatively impact our revenues and increase our expenses.

Our ability to invoice homeowners for the energy produced by our solar energy systems and monitor solar energy production for various purposes depends on the operation of our metering solution. We could incur significant expense and disruption to our operations in connection with failures of our metering solution, including meter hardware failures and failure of the cellular technology that we use to communicate with those meters. Many of our meters operate on either the 2G or 3G cellular data networks, which are expected to sunset before the term of our contract with homeowners. Upgrading our metering solution may cause us to incur a significant expense. Additionally, our meters communicate data through proprietary software, which we license from our metering partners. Should we be unable to continue to license, on agreeable terms, the software necessary to communicate with our meters, it could cause a significant disruption in our business and operations.

Problems with product quality or performance may cause us to incur warranty expenses and performance guarantee expenses, may lower the residual value of our solar energy systems and may damage our market reputation and cause our financial results to decline.

Homeowners who buy energy from us under leases or power purchase agreements are covered by production guaranties and roof penetration warranties. As the owners of the solar energy systems, we or our investment funds receive a warranty from the inverter and solar panel manufacturers, and, for those solar energy systems that we do not install directly, we receive workmanship and material warranties as well as roof penetration warranties from our solar partners. For example, we recently had to replace a significant number of defective inverters, the cost of which was borne by the manufacturer. However, our customers were without solar service for a period of time while the work was done, which impacted customer satisfaction. Furthermore, one or more of our third-party manufacturers or solar partners could cease operations and no longer honor these warranties, leaving us to fulfill these potential obligations to homeowners. Further, we provide a performance guarantee with certain solar service offerings pursuant to which we compensate homeowners on an annual basis if their system does not meet the electricity production guarantees set forth in their agreement with us. Homeowners who buy energy from us under leases or power purchase agreements are covered by production guarantees equal to the length of the term of these agreements, typically 20 years.

Because of our limited operating history, we have been required to make assumptions and apply judgments regarding a number of factors, including our anticipated rate of warranty claims and the durability, performance and reliability of our solar energy systems. Our assumptions could prove to be materially different from the actual performance of our systems, causing us to incur substantial expense to repair or replace defective solar energy systems in the future or to compensate homeowners for systems that do not meet their production guarantees. Product failures or operational deficiencies also would reduce our revenue from power purchase or lease agreements because they are dependent on system production. Any widespread product failures or operating deficiencies may damage our market reputation and adversely impact our financial results.

Product liability claims against us could result in adverse publicity and potentially significant monetary damages.

If our solar service offerings, including our racking systems or other products, injured someone, we would be exposed to product liability claims. Because solar energy systems and many of our other current and anticipated products are electricity-producing devices, it is possible that consumers or their property could be injured or damaged by our products, whether by product malfunctions, defects, improper installation or other causes. We rely on third-party manufacturing warranties, warranties provided by our solar partners and our general liability insurance to cover product liability claims and have not obtained separate product liability insurance. Any product liability claim we face could be expensive to defend and divert management's attention. The successful assertion of product liability claims against us could result in potentially significant monetary damages that could require us to make significant payments, as well as subject us to adverse publicity, damage our reputation and competitive position and adversely affect sales of our systems and other products. In addition, product liability claims, injuries, defects or other problems experienced by other companies in the residential solar industry could lead to unfavorable market conditions to the industry as a whole, and may have an adverse effect on our ability to attract homeowners, thus affecting our growth and financial performance.

The residual value of our solar energy systems at the end of the associated term of the lease or power purchase agreement may be lower than projected, which may adversely affect our financial performance and valuation.

We depreciate the costs of our solar energy systems over 20 years to a residual value. At the end of the initial 20-year term, customers may choose to purchase their solar energy systems, ask to remove the system at our cost or renew their customer agreements. Homeowners may choose to not renew or purchase for any reason, such as pricing, decreased energy consumption, relocation of residence or switching to a competitor product.

Furthermore, it is difficult to predict how future environmental regulations may affect the costs associated with the removal, disposal or recycling of our solar energy systems. If the value in trade or renewal revenue is less than we expect, after giving effect to any associated removal and redeployment costs, we may be required to recognize all or some of the remaining unamortized costs. This could materially impair our future results of operations.

We have guaranteed a minimum return to be received by an investor in one of our investment funds, which could adversely affect our business and financial condition if we were required to make any payments as a result of this guarantee.

We have guaranteed payments to the investor in one of our investment funds in the case that the investor does not achieve a specified minimum internal rate of return in this fund, which rate is assessed annually. The amounts of potential future payments under this guarantee depend on the amounts and timing of future distributions to the investor from funds and the tax benefits that accrue to the investor from the fund's activities. Because of uncertainties associated with estimating the timing and amounts of distributions to the investor, we cannot determine the potential maximum future payments that we could have to make under this guarantee. To date, we have not been required to make any payments under this guarantee. We may agree to similar terms with other third-party fund investors in the future. Any significant payments that we may be required to make under such guarantees, now or in the future, could adversely affect our financial condition.

Damage to our brand and reputation or failure to expand our brand would harm our business and results of operations.

We depend significantly on our brand and reputation for high-quality solar service offerings, engineering and customer service to attract homeowners and grow our business. If we fail to continue to deliver our solar service offerings within the planned timelines, if our solar service offerings do not perform as anticipated or if we damage any homeowners' properties or cancel projects, our brand and reputation could be significantly impaired. We also depend greatly on referrals from homeowners for our growth. Therefore, our inability to meet or exceed homeowners' expectations would harm our reputation and growth through referrals. Further, we have focused particular attention on expeditiously growing our direct sales force and our solar partners, leading us in some instances to hire personnel or partner with third parties who we may later determine do not fit our company culture. If we cannot manage our hiring and training processes to avoid potential issues related to expanding our sales team or solar partners and maintain appropriate customer service levels, our business and reputation may be harmed and our ability to attract homeowners would suffer. In addition, if we were unable to achieve a similar level of brand recognition as our competitors, some of which currently have a broader brand footprint as a result of a larger direct sales force, more resources and longer operational history, we could lose recognition in the marketplace among prospective customers, suppliers and partners, which could affect our growth and financial performance. Our growth strategy involves marketing and branding initiatives that will involve incurring significant expenses in advance of corresponding revenues. We cannot assure you that such marketing and branding expenses will result in the successful expansion of our brand recognition or increase our revenues.

A failure to hire and retain a sufficient number of employees and service providers in key functions would constrain our growth and our ability to timely complete homeowners' projects and successfully manage homeowner accounts.

To support our growth, we need to hire, train, deploy, manage and retain a substantial number of skilled employees, engineers, installers, electricians, sales and project finance specialists. Competition for qualified personnel in our industry is increasing, particularly for skilled personnel involved in the installation of solar energy systems. We may be unable to attract or retain qualified and skilled installation personnel or installation companies to be our solar partners, which would have an adverse effect on our business. We and our solar partners also compete with the homebuilding and construction industries for skilled labor. As these industries grow and seek to hire additional workers, our cost of labor may increase. The unionization of the industry's labor force could also increase our labor costs. Shortages of skilled labor could significantly delay a project or otherwise increase our costs. Because our profit on a particular installation is based in part on assumptions as to the cost of such project, cost overruns, delays or other execution issues may cause us to not achieve our expected margins or cover our costs for that project. In addition, because we are headquartered in the San Francisco Bay Area, we compete for a limited pool of technical and engineering resources that requires us to pay wages that are competitive with relatively high regional standards for employees in these fields. Further, we need to continue to expand upon the training of our customer service team to provide high-end account management and service to homeowners before, during and following the point of installation of our solar energy systems. Identifying and recruiting qualified personnel and training them requires significant time, expense and attention. It can take several months before a new customer service person is fully trained and productive at the standards that we have established. If we are unable to hire, develop and retain talented customer service personnel, we may not be able to realize the expected benefits of this investment or grow our business.

In addition, to support the growth and success of our direct-to-consumer channel, we need to recruit, retain and motivate a large number of sales personnel on a continuing basis. We compete with many other companies for qualified sales personnel, and it could take many months before a new salesperson is fully trained on our solar service offerings. If we are unable to hire, develop and retain qualified sales personnel or if they are unable to achieve desired productivity levels, we may not be able to compete effectively.

If we or our solar partners cannot meet our hiring, retention and efficiency goals, we may be unable to complete homeowners' projects on time or manage homeowner accounts in an acceptable manner or at all. Any significant failures in this regard would materially impair our growth, reputation, business and financial results. If we are required to pay higher compensation than we anticipate, these greater expenses may also adversely impact our financial results and the growth of our business.

The loss of one or more members of our senior management or key employees may adversely affect our ability to implement our strategy.

We depend on our experienced management team, and the loss of one or more key executives could have a negative impact on our business. In particular, we are dependent on the services of our chief executive officer and co-founder, Lynn Jurich, and our Chairman and co-founder, Edward Fenster. We also depend on our ability to retain and motivate key employees and attract qualified new employees. Neither our founders nor our key employees are bound by employment agreements for any specific term, and we may be unable to replace key members of our management team and key employees in the event we lose their services. Integrating new employees into our management team could prove disruptive to our operations, require substantial resources and management attention and ultimately prove unsuccessful. An inability to attract and retain sufficient managerial personnel who have critical industry experience and relationships could limit or delay our strategic efforts, which could have a material adverse effect on our business, financial condition and results of operations.

We may not realize the anticipated benefits of past or future acquisitions, and integration of these acquisitions may disrupt our business and management.

We acquired MEC in February 2014 and CEE in April 2015. We may in the future acquire additional companies, project pipelines, products, or technologies or enter into joint ventures or other strategic initiatives. We may not realize the anticipated benefits of past or future acquisitions, and any acquisition has numerous risks that are not within our control. These risks include the following, among others:

- difficulty in assimilating the operations and personnel of the acquired company, especially given our unique culture;
- difficulty in effectively integrating the acquired technologies or products with our current products and technologies;
- difficulty in maintaining controls, procedures, and policies during the transition and integration;
- disruption of our ongoing business and distraction of our management and employees from other opportunities and challenges due to integration issues;
- difficulty integrating the acquired company's accounting, management information, and other administrative systems;
- inability to retain key technical and managerial personnel of the acquired business;
- inability to retain key customers, vendors, and other business partners of the acquired business;
- inability to achieve the financial and strategic goals for the acquired and combined businesses;
- incurring acquisition-related costs or amortization costs for acquired intangible assets that could impact our results of operations;
- significant post-acquisition investments which may lower the actual benefits realized through the acquisition;
- potential failure of the due diligence processes to identify significant issues with product quality, legal and financial liabilities, among other things;

- potential inability to assert that internal controls over financial reporting are effective; and
- potential inability to obtain, or obtain in a timely manner, approvals from governmental authorities, which could delay or prevent such acquisitions.

Our failure to address these risks, or other problems encountered in connection with our past or future acquisitions, could cause us to fail to realize the anticipated benefits of these acquisitions or investments, cause us to incur unanticipated liabilities, and harm our business generally. Future acquisitions could also result in dilutive issuances of our equity securities, the incurrence of debt, contingent liabilities, amortization expenses, incremental expenses or the write-off of goodwill, any of which could harm our financial condition or results of operations.

Mergers and acquisitions of companies are inherently risky, may not produce the anticipated benefits and could adversely affect our business, financial condition, or results of operations.

If we are unsuccessful in developing and maintaining our proprietary technology, including our BrightPath software, our ability to attract and retain solar partners could be impaired, our competitive position could be harmed and our revenue could be reduced.

Our future growth depends on our ability to continue to develop and maintain our proprietary technology that supports our solar service offerings, including our design and proposal software, BrightPath. In addition, we rely, and expect to continue to rely, on licensing agreements with certain third parties for aerial images that allow us to efficiently and effectively analyze a homeowner's rooftop for solar energy system specifications. In the event that our current or future products require features that we have not developed or licensed, or we lose the benefit of an existing license, we will be required to develop or obtain such technology through purchase, license or other arrangements. If the required technology is not available on commercially reasonable terms, or at all, we may incur additional expenses in an effort to internally develop the required technology. In addition, our BrightPath software was developed, in part, with U.S. federal government funding. When new technologies are developed with U.S. government funding, the government obtains certain rights in any resulting patents, including a nonexclusive license authorizing the government to use the invention for non-commercial purposes. These rights may permit the government to disclose our confidential information to third parties and to exercise "march-in" rights to use or allow third parties to use our patented technology. We are also subject to certain reporting and other obligations to the U.S. government in connection with funding for BrightPath. If we were unable to maintain our existing proprietary technology, our ability to attract and retain solar partners could be impaired, our competitive position could be harmed and our revenue could be reduced.

Our business may be harmed if we fail to properly protect our intellectual property, and we may also be required to defend against claims or indemnify others against claims that our intellectual property infringes on the intellectual property rights of third parties.

We believe that the success of our business depends in part on our proprietary technology, including our software, information, processes and know-how. We rely on copyright, trade secret and patent protections to secure our intellectual property rights. Although we may incur substantial costs in protecting our technology, we cannot be certain that we have adequately protected or will be able to adequately protect it, that our competitors will not be able to utilize our existing technology or develop similar technology independently, that the claims allowed with respect to any patents held by us will be broad enough to protect our technology or that foreign intellectual property laws will adequately protect our intellectual property rights. Moreover, we cannot be certain that our patents provide us with a competitive advantage. Despite our precautions, it may be possible for third parties to obtain and use our intellectual property without our consent. Unauthorized use of our intellectual property by third parties, and the expenses incurred in protecting our intellectual property rights, may adversely affect our business. In the future, some of our products could be alleged to infringe existing patents or other intellectual property of third parties, and we cannot be certain that we will prevail in any intellectual property dispute. In addition, any future litigation required to enforce our patents, to protect our trade secrets or know-how or to defend us or indemnify others against claimed infringement of the rights of third parties could harm our business, financial condition and results of operations.

The Office of the Inspector General of the U.S. Department of Treasury has issued subpoenas to a number of significant participants in the rooftop solar energy installation industry, including us. The subpoena we received requires us to deliver certain documents in our possession relating to our participation in the U.S. Treasury grant program. These documents have been delivered to the Office of the Inspector General of the U.S. Department of Treasury, which is investigating the administration and implementation of the U.S. Treasury grant program.

In July 2012, we and other companies that are significant participants in both the solar industry and the cash grant program under Section 1603 of the American Recovery and Reinvestment Act of 2009 received subpoenas from the U.S. Department of Treasury's Office of the Inspector General. Our subpoena requested, among other things, documents that relate to our applications for U.S. Treasury grants and communications with certain other solar service companies or certain firms that appraise solar energy property for U.S. Treasury grant application purposes. The Inspector General is working with the Civil Division of the U.S. Department of Justice to investigate the administration and implementation of the U.S. Treasury grant program, including possible misrepresentations concerning the fair market value of the solar power systems submitted for grant under that program made in grant applications by companies in the solar industry, including us. We produced documents and testimony as requested by the Inspector General, and we intend to continue to cooperate fully with the Inspector General and the Department of Justice. We are not able to predict how long this review will be on-going. If, at the conclusion of the investigation, the Inspector General concludes that misrepresentations were made, the Department of Justice could decide to bring a civil action to recover amounts it believes were improperly paid to us. If it were successful in asserting this action, we could be required to pay damages and penalties for any funds received based on such misrepresentations (which, in turn, could require us to make indemnity payments to certain of our fund investors). Such consequences could have a material adverse effect on our business, liquidity, financial condition and prospects. Additionally, the period of time necessary to resolve the investigation is uncertain, and this matter could require significant management and financial resources that could otherwise be devoted to the operation of our business.

If the Internal Revenue Service or the U.S. Treasury Department makes determinations that the fair market value of our solar energy systems is materially lower than what we have claimed, we may have to pay significant amounts to our fund investors and our business, financial condition and prospects may be materially and adversely affected.

We and our fund investors claim the Commercial ITC or the U.S. Treasury grant in amounts based on the fair market value of our solar energy systems. We have obtained independent appraisals to determine the fair market values we report for claiming Commercial ITCs and U.S. Treasury grants. The IRS and the U.S. Treasury Department review these fair market values. With respect to U.S. Treasury grants, the U.S. Treasury Department reviews the reported fair market value in determining the amount initially awarded, and the IRS and the U.S. Treasury Department may also subsequently audit the fair market value and determine that amounts previously awarded must be repaid to the U.S. Treasury Department or that excess awards constitute taxable income for U.S. federal income tax purposes. With respect to Commercial ITCs, the IRS may review the fair market value on audit and determine that the tax credits previously claimed must be reduced. If the fair market value is determined in these circumstances to be less than we reported, we may owe our fund investors an amount equal to this difference, plus any costs and expenses associated with a challenge to that valuation. We could also be subject to tax liabilities, including interest and penalties. If the IRS or the U.S. Treasury Department further disagrees now or in the future with the amounts we reported regarding the fair market value of our solar energy systems, or if we receive an adverse outcome with respect to the Department of Treasury Inspector General investigation, it could have a material adverse effect on our business, financial condition and prospects. For example, a hypothetical five percent downward adjustment in the fair market value of the solar energy systems for which we have been awarded approximately $269.0 million in U.S. Department of Treasury grants since the beginning of the U.S. Treasury grant program through December 31, 2014, would obligate us to repay approximately $14 million to our fund investors. Three of our investment funds are currently being audited by the IRS.

We are subject to legal proceedings, regulatory inquiries and litigation, and we may be named in additional legal proceedings, become involved in regulatory inquiries or be subject to litigation in the future, all of which are costly, distracting to our core business and could result in an unfavorable outcome, or a material adverse effect on our business, financial condition, results of operations, or the trading price for our securities.

We are involved in legal proceedings and receive inquiries from government and regulatory agencies, including the pending Treasury investigation discussed above. In the event that we are involved in significant disputes or are the subject of a formal action by a regulatory agency, we could be exposed to costly and time consuming legal proceedings that could result in any number of outcomes. Although outcomes of such actions vary, any current or future claims or regulatory actions initiated by or against us, whether successful or not, could result in expensive costs, costly damage awards or settlement amounts, injunctive relief, increased costs of business, fines or orders to change certain business practices, significant dedication of management time, diversion of significant operational resources, or otherwise harm our business.

If we are not successful in our legal proceedings and litigation, we may be required to pay significant monetary damages, which could hurt our results of operations. Lawsuits are time-consuming and expensive to resolve and divert management's time and attention. Although we carry general liability insurance, our insurance may not cover potential claims or may not be adequate to indemnify us for all liability that may be imposed. We cannot predict how the courts will rule in any potential lawsuit against us. Decisions in favor of parties that bring lawsuits against us could subject us to significant liability for damages, adversely affect our results of operations and harm our reputation.

A failure to comply with laws and regulations relating to our interactions with current or prospective residential customers could result in negative publicity, claims, investigations, and litigation, and adversely affect our financial performance.

Our business involves transactions with homeowners. We must comply with numerous federal, state and local laws and regulations that govern matters relating to our interactions with homeowners, including those pertaining to privacy and data security, consumer financial and credit transactions, home improvement contracts, warranties and direct-to-home solicitation. These laws and regulations are dynamic and subject to potentially differing interpretations, and various federal, state and local legislative and regulatory bodies may expand current laws or regulations, or enact new laws and regulations, regarding these matters. Changes in these laws or regulations or their interpretation could dramatically affect how we do business, acquire customers, and manage and use information we collect from and about current and prospective customers and the costs associated therewith. We strive to comply with all applicable laws and regulations relating to our interactions with residential customers. It is possible, however, that these requirements may be interpreted and applied in a manner that is inconsistent from one jurisdiction to another and may conflict with other rules or our practices. Our noncompliance with any such law or regulations could also expose us to claims, proceedings, litigation and investigations by private parties and regulatory authorities, as well as substantial fines and negative publicity, each of which may materially and adversely affect our business. We have incurred, and will continue to incur, significant expenses to comply with such laws and regulations, and increased regulation of matters relating to our interactions with residential customers could require us to modify our operations and incur significant additional expenses, which could have an adverse effect on our business, financial condition and results of operations.

Compliance with occupational safety and health requirements and best practices can be costly, and noncompliance with such requirements may result in potentially significant penalties, operational delays and adverse publicity.

The installation of solar energy systems requires our employees and employees of our solar partners to work with complicated and potentially dangerous electrical systems. The evaluation and installation of our energy-related products require these employees to work in locations that may contain potentially dangerous levels of asbestos, lead or mold or other substances. We also maintain large fleets of vehicles that these employees use in the course of their work. There is substantial risk of serious injury or death if proper safety procedures are not followed. Our operations are subject to regulation under the U.S. Occupational Safety and Health Act ("OSHA") and equivalent state laws. Changes to OSHA requirements, or stricter interpretation or enforcement of existing laws or regulations, could result in increased costs. If we fail to comply with applicable OSHA regulations, even if no work-related serious injury or death occurs, we may be subject to civil or criminal enforcement and be required to pay substantial penalties, incur significant capital expenditures, or suspend or limit operations. Any accidents, citations, violations, injuries or failure to comply with industry best practices may subject us to adverse publicity, damage our reputation and competitive position and adversely affect our business.

Rising interest rates will adversely impact our business.

Rising interest rates will increase our cost of capital. Our future success depends on our ability to raise capital from fund investors and obtain secured lending to help finance the deployment of our solar service offerings. Part of our business strategy is to seek to reduce our cost of capital through these arrangements to improve our margins, offset future reductions in government incentives and maintain the price competitiveness of our solar service offerings. Rising interest rates may have an adverse impact on our ability to offer attractive pricing on our solar service offerings to homeowners.

The majority of our cash flows to date have been from solar service offerings under customer agreements that have been monetized under various investment fund structures. One of the components of this monetization is the present value of the payment streams from homeowners who enter into these customer agreements. If the rate of return required by capital providers, including debt providers, rises as a result of a rise in interest rates, it will reduce the present value of the homeowner payment stream and consequently reduce the total value derived from this monetization. Any measures that we could take to mitigate the impact of rising interest rates on our ability to secure third-party financing could ultimately have an adverse impact on the value proposition that we offer homeowners.

We are exposed to the credit risk of homeowners and payment delinquencies on our accounts receivables.

Our customer agreements are typically for 20 years and require the homeowner to make monthly payments to us. Accordingly, we are subject to the credit risk of homeowners. As of December 31, 2015, the average FICO score of our customers under a lease or power purchase agreement was approximately 760, but this may decline to the extent FICO score requirements under future investment funds are relaxed. While to date homeowner defaults have been immaterial, we expect that the risk of homeowner defaults may increase as we grow our business. Due to the immaterial amount of homeowner defaults to date, our reserve for this exposure is minimal, and our future exposure may exceed the amount of such reserves. If we experience increased homeowner credit defaults, our revenues and our ability to raise new investment funds could be adversely affected. If economic conditions worsen, certain of our homeowners may face liquidity concerns and may be unable to satisfy their payment obligations to us on a timely basis or at all, which could have a material adverse effect on our financial condition and results of operations.

The requirements of being a public company may strain our resources, divert management's attention and affect our ability to attract and retain qualified board members and officers.

We are subject to the reporting requirements of the Exchange Act, the listing requirements of the NASDAQ Stock Market and other applicable securities rules and regulations. Compliance with these rules and regulations has increased our legal and financial compliance costs, made some activities more difficult, time-consuming or costly and increased demand on our systems and resources. The Exchange Act requires, among other things, that we file annual, quarterly and current reports with respect to our business and results of operations and maintain effective disclosure controls and procedures and internal control over financial reporting. To maintain and improve our disclosure controls and procedures and internal control over financial reporting to meet this standard, significant resources and management oversight may be required. As a result, management's attention may be diverted from other business concerns, which could harm our business and results of operations. Although we have already hired additional employees to comply with these requirements, we may need to hire more employees in the future, which will increase our costs and expenses.

We use "open source" software in our solutions, which may require that we release the source code of certain software subject to open source licenses or subject us to possible litigation or other actions that could adversely affect our business.

We utilize software that is licensed under so-called "open source," "free" or other similar licenses. Open source software is made available to the general public on an "as-is" basis under the terms of a non-negotiable license. We currently combine our proprietary software with open source software but not in a manner that we believe requires the release of the source code of our proprietary software to the public. However, our use of open source software may entail greater risks than use of third-party commercial software. Open source licensors generally do not provide warranties or other contractual protections regarding infringement claims or the quality of the code. In addition, if we combine our proprietary software with open source software in a certain manner, we could, under certain open source licenses, be required to release the source code of our proprietary software to the public. This would allow our competitors to create similar offerings with lower development effort and time.

We may also face claims alleging noncompliance with open source license terms or infringement or misappropriation of proprietary software. These claims could result in litigation, require us to purchase a costly license or require us to devote additional research and development resources to change our software, any of which would have a negative effect on our business and results of operations. In addition, if the license terms for open source software that we use change, we may be forced to re-engineer our solutions, incur additional costs or discontinue the use of these solutions if re-engineering cannot be accomplished on a timely basis. Although we monitor our use of open source software to avoid subjecting our offerings to unintended conditions, few courts have interpreted open source licenses, and there is a risk that these licenses could be construed in a way that could impose unanticipated conditions or restrictions on our ability to use our proprietary software. We cannot guarantee that we have incorporated or will incorporate open source software in our software in a manner that will not subject us to liability or in a manner that is consistent with our current policies and procedures.

Any unauthorized disclosure or theft of personal information we gather, store and use could harm our reputation and subject us to claims or litigation.

We receive, store and use personal information of homeowners, including names, addresses, e-mail addresses, credit information and other housing and energy use information. Unauthorized disclosure of such personal information, whether through breach of our systems by an unauthorized party, employee theft or misuse, or otherwise, could harm our business. If we were subject to an inadvertent disclosure of such personal information, or if a third party were to gain unauthorized access to homeowners' personal information we possess, we could be subject to claims or litigation arising from damages suffered by homeowners. In addition, we could incur significant costs in complying with the multitude of federal, state and local laws regarding the unauthorized disclosure of personal information. Finally, any perceived or actual unauthorized disclosure of such information could harm our reputation, substantially impair our ability to attract and retain homeowners and have an adverse impact on our business.

Our management will not be required to evaluate the effectiveness of our internal control over financial reporting until the end of the fiscal year for which our second Annual Report is due. If we are unable to establish and maintain effective internal control over financial reporting, investors may lose confidence in the accuracy of our financial reports.

In connection with the audits of our consolidated financial statements for the years ended December 31, 2013 and 2012, we identified material weaknesses in our internal control over financial reporting relating to certain aspects of our financial statement close process and our accounting for income taxes. A material weakness is a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of a company's annual or interim financial statements will not be prevented or detected on a timely basis. These material weaknesses resulted from an aggregation of deficiencies.

In the 2013 consolidated financial statements, we incorrectly accounted for our deferred tax liabilities, prepaid tax asset and the related amortization as it related to income taxes incurred on intercompany transactions. The foregoing resulted in the restatement of our 2012 consolidated financial statements. Subsequent to the quarter ended March 31, 2015, we also identified and corrected an immaterial error related to the accounting for taxes on intercompany transactions. We continue to remediate our internal controls related to the accounting for income taxes.

We are required to establish and maintain internal control over financial reporting and to report any material weaknesses in such internal controls. Section 404 of the Sarbanes-Oxley Act requires that we evaluate and determine the effectiveness of our internal control over financial reporting. Beginning with our second Annual Report following our initial public offering, we will be required to provide a management report on internal control over financial reporting. When we are no longer an emerging growth company, our management report on internal control over financial reporting will need to be attested to by our independent registered public accounting firm. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that misstatements due to error or fraud will not occur or that all control issues and instances of fraud will be detected.

We may fail to establish and maintain effective internal control over financial reporting, in which case we may not detect errors on a timely basis and our financial statements may be materially misstated. In addition, we cannot guarantee that our internal control over financial reporting will prevent or detect all errors and fraud. The risk of errors is increased in light of the complexity of our business and investment funds. For example, we must deal with significant complexity in accounting for our fund structures and the resulting allocation of net income (loss) between our stockholders and noncontrolling interests under the hypothetical liquidation book value ("HLBV") method as well as the income tax consequences of these fund structures. As we enter into additional investment funds, which may have contractual provisions different from those of our existing funds, the analysis as to whether we consolidate these funds, the calculation under the HLBV method, and the analysis of the tax impact could become increasingly complicated. This additional complexity could require us to hire additional resources and increase the chance that we experience errors in the future.

If we fail to establish and maintain effective internal control over financial reporting, investors may lose confidence in the accuracy and completeness of our financial reports, which could cause the price of our common stock to decline. In addition, we could become subject to investigations by the NASDAQ Stock Market, the SEC or other regulatory authorities, which could require additional management attention and which could adversely affect our business.

Our ability to use our net operating loss carryforwards and certain other tax attributes may be limited.

As of December 31, 2015, we had U.S. federal net operating loss carryforwards of approximately $595.0 million and state net operating loss carryforwards of approximately $546.6 million, which begin expiring in varying amounts in 2028 and 2020, respectively, if unused. Under Sections 382 and 383 of the Code if a corporation undergoes an "ownership change," the corporation's ability to use its pre-change net operating loss carryforwards and other pre-change tax attributes, such as research tax credits, to offset its post-change income and taxes may be limited. In general, an "ownership change" occurs if there is a cumulative change in our ownership by "5% shareholders" that exceeds 50 percentage points over a rolling three-year period. Similar rules may apply under state tax laws. Any such limitations on our ability to use our net operating loss carryforwards and other tax assets could adversely impact our business, financial condition and results of operations.

Risks Related to Ownership of Our Common Stock

Our executive officers, directors and principal stockholders continue to have substantial control over us, which will limit your ability to influence the outcome of important matters, including a change in control.

Each of our executive officers, directors and each of our stockholders who beneficially own 5% or more of our outstanding common stock and their affiliates, in the aggregate, beneficially own approximately 43.8% of the outstanding shares of our common stock, based on the number of shares outstanding as of December 31, 2015. As a result, these stockholders, if acting together, will be able to influence or control matters requiring approval by our stockholders, including the election of directors and the approval of mergers, acquisitions or other extraordinary transactions. They may also have interests that differ from yours and may vote in a way with which you disagree and which may be adverse to your interests. This concentrated control may have the effect of delaying or preventing a change in control of our company, could deprive our stockholders of an opportunity to receive a premium for their capital stock and might ultimately affect the market price of our common stock.

The market price of our common stock has been and may continue to be volatile, and you could lose all or part of your investment.

The trading price of our common stock has been volatile since our initial public offering, and is likely to continue to be volatile. Factors that could cause fluctuations in the market price of our common stock include the following:

- price and volume fluctuations in the overall stock market from time to time;
- volatility in the market prices and trading volumes of companies in our industry or companies that investors consider comparable;
- changes in operating performance and stock market valuations of other companies generally, or those in our industry in particular;
- sales of shares of our common stock by us or our stockholders;
- failure of securities analysts to maintain coverage of us, changes in financial estimates by securities analysts who follow us, or our failure to meet these estimates or the expectations of investors;
- the financial projections we may provide to the public, any changes in those projections or our failure to meet those projections;
- announcements by us or our competitors of new products or services;
- the public's reaction to our press releases, other public announcements and filings with the SEC;

- rumors and market speculation involving us or other companies in our industry;
- actual or anticipated changes in our results of operations;
- changes in tax and other incentives that we rely upon in order to raise tax equity investment funds;
- changes in the regulatory environment and utility policies and pricing, including those that could reduce the savings we are able to offer to customers;
- actual or anticipated developments in our business, our competitors' businesses or the competitive landscape generally;
- litigation involving us, our industry or both, or investigations by regulators into our operations or those of our competitors;
- announced or completed acquisitions of businesses or technologies by us or our competitors;
- new laws or regulations or new interpretations of existing laws or regulations applicable to our business;
- changes in accounting standards, policies, guidelines, interpretations or principles;
- any significant change in our management; and
- general economic conditions and slow or negative growth of our markets.

In addition, in the past, following periods of volatility in the overall market and the market price of a particular company's securities, securities class action litigation has often been instituted against these companies. This litigation, if instituted against us, could result in substantial costs and a diversion of our management's attention and resources.

The large number of shares of our capital stock eligible for public sale or subject to rights requiring us to register them for public sale could depress the market price of our common stock.

The market price of our common stock could decline as a result of sales of a large number of shares of our common stock in the market after our initial public offering, and the perception that these sales could occur may also depress the market price of our common stock.

As of December 31, 2015, stockholders owning an aggregate of up to 65,396,429 shares of our common stock can require us to register shares of our capital stock owned by them for public sale in the United States. In addition, we filed a registration statement to register shares of our capital stock reserved for future issuance under our equity compensation plans. Subject to the satisfaction of applicable exercise periods and applicable volume and restrictions that apply to affiliates, the shares of our capital stock issued upon exercise of outstanding options to purchase shares of our common stock became available for immediate resale in the United States in the open market.

Future sales of our common stock may make it more difficult for us to sell equity securities in the future at a time and at a price that we deem appropriate. These sales also could cause the market price of our common stock to decline and make it more difficult for you to sell shares of our common stock.

Anti-takeover provisions contained in our amended and restated certificate of incorporation and amended and restated bylaws, as well as provisions of Delaware law, could impair a takeover attempt.

Our amended and restated certificate of incorporation, amended and restated bylaws and Delaware law contain provisions which could have the effect of rendering more difficult, delaying, or preventing an acquisition deemed undesirable by our board of directors and therefore depress the trading price of our common stock. Among other things, our amended and restated certificate of incorporation and amended and restated bylaws include provisions:

- creating a classified board of directors whose members serve staggered three-year terms;
- authorizing "blank check" preferred stock, which could be issued by our board of directors without stockholder approval and may contain voting, liquidation, dividend and other rights superior to our common stock;
- limiting the liability of, and providing indemnification to, our directors and officers;
- limiting the ability of our stockholders to call and bring business before special meetings;
- requiring advance notice of stockholder proposals for business to be conducted at meetings of our stockholders and for nominations of candidates for election to our board of directors; and
- controlling the procedures for the conduct and scheduling of board of directors and stockholder meetings.

These provisions, alone or together, could delay or prevent hostile takeovers and changes in control or changes in our management.

As a Delaware corporation, we are also subject to provisions of Delaware law, including Section 203 of the Delaware General Corporation law, which prevents certain stockholders holding more than 15% of our outstanding capital stock from engaging in certain business combinations without approval of the holders of at least two-thirds of our outstanding capital stock not held by such stockholder.

Any provision of our amended and restated certificate of incorporation, amended and restated bylaws or Delaware law that has the effect of delaying or preventing a change in control could limit the opportunity for our stockholders to receive a premium for their shares of our capital stock and could also affect the price that some investors are willing to pay for our common stock.

Provisions contained in our amended and restated certificate of incorporation and amended and restated bylaws limit the ability of our stockholders to call special meetings and prohibit stockholder action by written consent.

Our amended and restated certificate of incorporation provide that our stockholders may not take action by written consent. Instead, any such actions must be taken at an annual or special meeting of our stockholders. As a result, our stockholders are not able to take any action without first holding a meeting of our stockholders called in accordance with the provisions of our amended and restated bylaws, including advance notice procedures set forth in our amended and restated bylaws. Our amended and restated bylaws further provide that special meetings of our stockholders may be called only by a majority of our board of directors, the chairman of our board of directors, our Chief Executive Officer or our President. As a result, our stockholders are not allowed to call a special meeting. These provisions may delay the ability of our stockholders to force consideration of a stockholder proposal, including a proposal to remove directors.

Provisions contained in our amended and restated certificate of incorporation and amended and restated bylaws could preclude our stockholders from bringing matters before meetings of stockholders and delay changes in our board of directors.

Our amended and restated bylaws provide advance notice procedures for stockholders seeking to bring business before, or nominate candidates for election as directors at, our annual or special meetings of stockholders. In addition, our amended and restated certificate of incorporation provide that stockholders may remove directors only for cause. Any amendment of these provisions in our amended and restated bylaws or amended and restated certificate of incorporation would require approval by holders of at least 66 2/3% of our then outstanding capital stock. These provisions could preclude our stockholders from bringing matters before annual or special meetings of stockholders and delay changes in our board of directors.

Our amended and restated bylaws provide that the Court of Chancery of the State of Delaware will be the sole and exclusive forum for substantially all disputes between us and our stockholders, which could limit our stockholders' ability to obtain a favorable judicial forum for disputes with us or our directors, officers or employees.

Our amended and restated bylaws provide that, unless we consent to the selection of an alternative forum, the Court of Chancery of the State of Delaware is the sole and exclusive forum for (i) any derivative action or proceeding brought on our behalf, (ii) any action asserting a claim of breach of fiduciary duty owed by any of our directors, officers or other employees to us or to our stockholders, (iii) any action asserting a claim arising pursuant to the Delaware General Corporation Law or (iv) any action asserting a claim governed by the internal affairs doctrine. The choice of forum provision may limit a stockholder's ability to bring a claim in a judicial forum that it finds favorable for disputes with us or our directors, officers or other employees, which may discourage such lawsuits against us and our directors, officers and other employees. Alternatively, if a court were to find the choice of forum provision contained in our amended and restated bylaws to be inapplicable or unenforceable in an action, we may incur additional costs associated with resolving such action in other jurisdictions, which could harm our business, results of operations and financial condition.

If securities or industry analysts cease publishing research or reports about us, our business, our market or our competitors, or if they adversely change their recommendations regarding our common stock, the market price of our common stock and trading volume could decline.

The market for our common stock is influenced by the research and reports that securities or industry analysts publish about us, our business, our market or our competitors. If any of the analysts who cover us adversely change their recommendations regarding our common stock, or provide more favorable recommendations about our competitors, the market price of our common stock would likely decline. If any of the analysts who cover us cease coverage of our company or fail to regularly publish reports on us, we could lose visibility in the financial markets, which in turn could cause the market price of our common stock and trading volume to decline.

We do not expect to declare any dividends in the foreseeable future.

We do not anticipate declaring any cash dividends to holders of our common stock in the foreseeable future. Consequently, investors may need to rely on sales of our common stock after price appreciation, which may never occur, as the only way to realize any future gains on their investment. Investors seeking cash dividends should not purchase shares of our common stock.

Additional stock issuances could result in significant dilution to our stockholders.

We may issue additional equity securities to raise capital, make acquisitions or for a variety of other purposes. Additional issuances of our stock may be made pursuant to the exercise or conversion of new or existing convertible debt securities, warrants, stock options or other equity incentive awards to new and existing service providers. Any such issuances will result in dilution to existing holders of our stock. We rely on equity- based compensation as an important tool in recruiting and retaining employees. The amount of dilution due to equity-based compensation of our employees and other additional issuances could be substantial.

As an emerging growth company within the meaning of the Securities Act, we will utilize certain modified disclosure requirements, and we cannot be certain if these reduced requirements will make our common stock less attractive to investors.

We are an emerging growth company, and, for as long as we continue to be an emerging growth company, we may choose to take advantage of exemptions from various reporting requirements applicable to other public companies but not to "emerging growth companies." These exemptions include not being required to have our independent registered public accounting firm audit our internal control over financial reporting under Section 404 of the Sarbanes-Oxley Act, reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements, and exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and stockholder approval of any golden parachute payments not previously approved. We are utilizing, and we plan in future filings with the SEC to continue to utilize, the modified disclosure requirements available to emerging growth companies. As a result, our stockholders may not have access to certain information they may deem important. We could remain an "emerging growth company" for up to five years following the anniversary of our initial public offering, or until the earliest of (1) the last day of the first fiscal year in which our annual gross revenue reaches or exceeds $1.0 billion, (2) the date that we become a "large accelerated filer" as defined in the Exchange Act, which could occur as early as January 1, 2017 or (3) the date on which we have issued more than $1.0 billion in non-convertible debt securities during the preceding three-year period.

Item 1B. Unresolved Staff Comments.

Not applicable

Item 2. Properties.

Our corporate headquarters and executive offices are located in San Francisco, California, where we occupy approximately 56,000 square feet of office space. We also maintain 40 other locations, consisting primarily of branch offices, warehouses, sales offices and design centers in seven states.

We lease all of our facilities and we do not own any real property. We believe that our current facilities are adequate to meet our ongoing needs. If we require additional space, we believe that we will be able to obtain additional facilities on commercially reasonable terms.

Item 3. Legal Proceedings.

In July 2012, the Department of Treasury and the Department of Justice (together, the "Government") opened a civil investigation into the participation by residential solar developers in the Section 1603 grant program. The Government served subpoenas on several developers, including us, along with their investors and valuation firms, with requests for information related to the cash grant applications made by the developers. The focus of the investigation is the claimed fair market value of the solar systems the developers submitted to the Government in their grant applications. We have cooperated fully with the Government and plan to continue to do so. No claims have been brought against us.

In addition, we are a party to litigation and subject to claims in the ordinary course of business. Although the results of litigation and claims cannot be predicted with certainty, we currently believe that the final outcome of litigation and claims will not have a material adverse effect on our business. Regardless of the outcome, litigation can have an adverse impact on us because of defense and settlement costs, diversion of management resources and other factors.

Item 4. Mine Safety Disclosures.

Not applicable.

PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities.

Market Information

Our common stock began trading on the NASDAQ Global Select Market under the symbol "RUN" on August 5, 2015.

Holders of Record

As of March 8, 2016, there were approximately 211 holders of record of common stock. Certain shares are held in "street" name and, accordingly, the number of beneficial owners of such shares is not known or included in the foregoing number.

Price Range of Our Common Stock

The following table sets forth the reported high and low sales prices of our common stock since the first day of public trading on August 5, 2015 for the indicated periods, as regularly quoted on the NASDAQ Global Select Market:

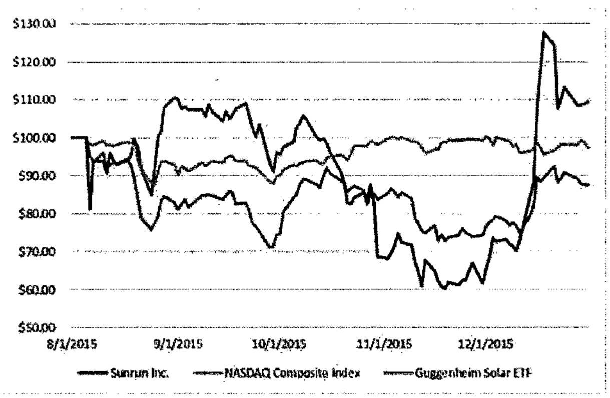
	Fiscal Year Ended December 31, 2015	
	High	Low
Third Quarter (August 5, 2015 through September 30, 2015)	$ 13.31	$ 8.23
Fourth Quarter	$ 14.95	$ 6.36

Dividend Policy

We have never declared or paid any cash dividends on our capital stock. We currently intend to retain all available funds and any future earnings for use in the operation of our business and do not expect to pay any dividends on our capital stock in the foreseeable future. Any future determination to declare dividends will be made at the discretion of our board of directors, subject to applicable laws, and will depend on a number of factors, including our financial condition, results of operations, capital requirements, contractual restrictions, general business conditions and other factors that our board of directors may deem relevant. In addition, our credit agreements contain restrictions on payments of cash dividends.

Stock Price Performance Graph

The following stock performance graph compares our total stock return with the total return for (i) the NASDAQ Composite Index and the (ii) the Guggenheim Solar ETF, which represents a peer group of solar companies, for the period from August 5, 2015 (the date our common stock commenced trading on the NASDAQ Global Select Market) through December 31, 2015. The figures represented below assume an investment of $100 in our common stock at the closing price of $10.77 on August 5, 2015 and in the NASDAQ Composite Index and the Guggenheim Solar ETF on August 5, 2015 and the reinvestment of dividends into shares of common stock. The comparisons in the table are required by the Securities and Exchange Commission, or SEC, and are not intended to forecast or be indicative of possible future performance of our common stock. This graph shall not be deemed "soliciting material" or be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or the Exchange Act, or otherwise subject to the liabilities under that section, and shall not be deemed to be incorporated by reference into any of our filings under the Securities Act of 1933, as amended, or the Securities Act, whether made before or after the date hereof and irrespective of any general incorporation language in any such filing.



	Ticker	August 5, 2015	December 31, 2015
Sunrun Inc.	RUN	$ 100.00	$ 109.29
NASDAQ Composite Index	^IXIC	$ 100.00	$ 97.42
Guggenheim Solar ETF	TAN	$ 100.00	$ 87.61

Recent Sales of Unregistered Securities

In August 2015, immediately prior to the closing of our initial public offering, we issued approximately 1.7 million shares of common stock and executed a letter of intent to issue approximately 1.3 million warrants to purchase common stock subject to contingencies being met to the then holders of Series D and E preferred stock as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the closing of our initial public offering and waive any potential anti-dilution adjustments resulting from the issuance of shares of common stock in our initial public offering. The warrants were issued on September 30, 2015 and are exercisable for three years from the date of grant with an exercise price of $22.50 per share.

No underwriters were involved in the foregoing issuance or sales of securities. The issuances of the securities described above were deemed to be exempt from registration under the Securities Act in reliance on Section 4(a)(2) of the Securities Act as transactions by an issuer not involving any public offering. The recipients of the securities represented their intentions to acquire the securities for investment only and not with a view to or for sale in connection with any distribution thereof. All recipients had adequate access, through their relationships with us, to information about us. The sales of these securities were made without any general solicitation or advertising.

Item 6. Selected Consolidated Financial Data.

You should read the following selected consolidated financial data below in conjunction with *Management's Discussion and Analysis of Financial Condition and Results of Operations* and the consolidated financial statements, related notes and other financial information included elsewhere in this Annual Report on Form 10-K. the selected consolidated financial data in this section are not intended to replace the consolidated financial statements and are qualified in their entirety by the consolidated financial statements and related notes included elsewhere in this Annual Report on Form 10-K.

The selected consolidated statements of operations data for the years ended December 31, 2015, 2014 and 2013, and the selected consolidated balance sheet data as of December 31, 2015 and 2014 are derived from our audited consolidated financial statements included elsewhere in this Form 10-K. Our historical results are not necessarily indicative of the results that may be expected in the future and interim results are not necessarily indicative of results to be expected for the full year.

	Year Ended December 31.		
	2015	2014	2013
Revenue:			
Operating leases and incentives	$ 118,004	$ 84,006	$ 54,740
Solar energy systems and product sales	186,602	114,551	—
Total revenue	304,606	198,557	54,740
Operating expenses:			
Cost of operating leases and incentives	111,784	72,898	43,088
Cost of solar energy systems and product sales	168,751	100,802	—
Sales and marketing	145,477	78,723	22,395
Research and development	9,657	8,386	9,984
General and administrative	84,442	68,098	33,242
Amortization of intangible assets	3,695	2,269	—
Total operating expenses	523,806	331,176	108,709
Loss from operations	(219,200)	(132,619)	(53,969)
Interest expense, net	33,236	27,521	11,752
Loss on early extinguishment of debt	431	4,350	—
Other expenses	1,338	3,043	365
Loss before income taxes	(254,205)	(167,533)	(66,086)
Income tax benefit	(5,299)	(10,043)	(591)
Net loss	(248,906)	(157,490)	(65,495)
Net loss attributable to noncontrolling interests and redeemable noncontrolling interests	(220,660)	(86,638)	(64,294)
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Deemed dividend to convertible preferred stockholders (1)	(24,890)	—	—
Net loss available to common stockholders	$ (53,136)	$ (70,852)	$ (1,201)
Net loss per share available to common shareholders—basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)
Weighted average shares used to compute net loss per share available to common stockholders—basic and diluted	55,091	22,795	9,780

(1) We calculate net income (loss) per share (EPS) available to common stockholders using the two-class method. The two-class method allocates net income that otherwise would have been available to common stockholders to holders of participating securities. We recognized a $24.9 million deemed dividend to Series D and E preferred stockholders as a result of an inducement to convert the Series D and E preferred stock into common stock immediately prior to the closing of our initial public offering. This deemed dividend was added to net loss attributable to common stockholders to determine the amount available to the common stockholders.

	As of December 31,	
	2015	2014
Consolidated Balance Sheet Data:		
Cash	$ 203,864	$ 152,154
Solar energy systems, net	1,992,021	1,484,251
Total assets	2,738,146	1,932,584
Long-term debt, current portion	2,085	2,602
Solar asset-backed notes, current portion	3,323	—
Line of credit	194,975	48,597
Long-term debt, net of current portion	232,378	188,052
Solar asset-backed notes, net of current portion	105,557	—
Redeemable noncontrolling interests	147,139	135,948
Total equity	659,560	416,619

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations.

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with our consolidated financial statements and related notes thereto included elsewhere in this Annual Report on Form 10-K. This discussion contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those discussed below. Factors that could cause or contribute to such differences include those identified below and those discussed in the section titled "Risk Factors" included elsewhere in this Annual Report on Form 10-K.

We provide clean, solar energy to homeowners at a significant savings compared to traditional utility energy. We have been selling solar energy to residential customers through a variety of offerings since we were founded in 2007. We, either directly or through one of our solar partners, install a solar energy system on a customer's home and either sell the system to the homeowner or, as is more often the case, sell the energy generated by the system to the homeowner pursuant to a lease or power purchase agreement ("PPA") with no or low upfront costs. We refer to these leases and PPAs as "Customer Agreements." Following installation, a system is interconnected to the local utility grid. The home's energy usage is provided by the solar energy system, with any additional energy needs provided by the local utility. Through the use of a bi-directional utility meter, any excess solar energy that is not immediately used by the homeowner is exported to the utility grid, and the homeowner receives a credit for the excess energy from their utility to offset future usage of utility-generated energy.

Until 2014, we provided our solar service offerings primarily through our solar partner channel and relied on our solar partners to originate customers for our solar service offerings and procure and install the solar energy systems on our customers' homes. In February 2014, we purchased the residential sales and installation business of Mainstream Energy Corporation, as well as its fulfillment business, AEE Solar, and its racking business, SnapNrack. We refer to these businesses collectively as "MEC." Following the MEC acquisition, we began offering our solar service offerings both directly to the homeowner and through our solar partners, which include sales and installation partners, and strategic partners, which include retail partners. In addition, following the acquisition, we began to sell solar energy systems directly to customers for cash. We also sell solar energy panels and other products to resellers through AEE Solar and SnapNrack. As of December 31, 2015, we offered our solar service offerings to customers in 15 states, plus the District of Columbia, and sold solar energy panels and other products to resellers throughout the United States. The majority of our cumulative systems deployed are in California. The acquisition of MEC provided us with direct-to-consumer installation capabilities in the areas we previously serviced only through our partner channel. We did not expand our solar service offerings to any new state as a result of the acquisition of MEC.

We compete mainly with traditional utilities. In the markets we serve, our strategy is to price the energy we sell below prevailing retail electricity rates. As a result, the price our customers pay to buy energy from us through our solar service offerings varies depending on the state where the customer lives and the local traditional utility that otherwise provides electricity to the customer as well as the prices other solar energy companies charge in that region. Even within the same neighborhood, site-specific characteristics drive meaningful variability in the revenue and cost profiles of each home. Using our proprietary technology, we target homes with advantageous revenue and cost characteristics, which means we are often able to offer pricing that allows customers to save more on their energy bill while maintaining our ability to meet our targeted returns. For example, with the insights provided by our technology, we can offer competitive pricing to customers with homes that have favorable characteristics, such as roofs that allow for easy installation, high electricity consumption, or low shading, effectively passing through the cost savings we are able to achieve on these installations to the homeowner.

Our ability to offer Customer Agreements depends in part on our ability to finance the purchase and installation of the solar energy systems by monetizing the resulting customer cash flows and related investment tax credits ("ITCs"), accelerated tax depreciation and other incentives from governments and local utilities. We monetize these incentives under tax equity investment funds which are generally structured as non-recourse project financings. From inception to March 8, 2016, we have established 24 investment funds, which represent financing for an estimated $4.0 billion in value of solar energy systems on a cumulative basis. We intend to establish additional investment funds and may also use debt, equity and other financing strategies to fund our growth.

Recent Developments

In January 2016, certain of our subsidiaries entered into secured credit facilities with a syndicate of banks for up to $250.0 million in committed facilities. The facilities include a $220.0 million aggregate facility ("Aggregate Facility"), $23.0 million term loan ("Term Loan") and a $7.0 million letter of credit facility. The Aggregate Facility and letter of credit bear an interest rate of LIBOR + 250 basis points for the initial three-year revolving availability period, stepping up to LIBOR + 275 basis points in the following two-year period. The Term Loan bears an interest rate of LIBOR + 500 basis points (with a LIBOR floor of 100 basis points) in the first three years, stepping up to LIBOR plus 650 basis points in the following two-year period. The principal and accrued interest on any outstanding loans mature on December 31, 2020.

The facilities are non-recourse to Sunrun and are secured by net cash flows of certain subsidiaries from power purchase agreements and leases, less certain operating, maintenance and other expenses which are available to the borrowers after distributions to tax equity investors. The facilities contain customary covenants including the requirement to maintain certain financial measurements and provide lender reporting. The credit facilities also contain certain provisions in the event of default which entitle lenders to take certain actions including acceleration of amounts due under the facilities.

In March 2016, one of our subsidiaries entered into a $24.5 million secured, non-recourse loan agreement. The loan will be repaid through cashflows from a lease pass-through arrangement we previously entered into. The loan matures in September 2022 and has an interest rate of LIBOR + 2.25%. The loan agreement contains customary covenants including the requirement to maintain certain financial measurements and provide lender reporting. The loan also contains certain provisions in the event of default which entitles the lender to take certain actions including acceleration of amounts due under the loan.

At the end of 2015, we began to slow our operations in Nevada as the result of proposed regulatory changes, including elimination of net metering. In early 2016, we ceased our operations in Nevada in response to the issuance of the final rules by the Nevada Public Utilities Commission.

Investment Funds

Our Customer Agreements provide for recurring customer payments, typically over 20 years, and the related solar energy systems are generally eligible for ITCs, accelerated tax depreciation and other government or utility incentives. Our financing strategy is to monetize these benefits at a low weighted-average cost of capital. This low cost of capital enables us to offer attractive pricing to our customers for the energy generated by the solar energy system on their homes. Historically, we have monetized a portion of the value created by our customer agreements and the related solar energy systems through investment funds. These assets are attractive to fund investors due to the long-term, recurring nature of the cash flows generated by our Customer Agreements, the high credit scores of our customers, the fact that energy is a non-discretionary good and our low loss rates. In addition, fund investors can receive attractive after-tax returns from our investment funds due to their ability to utilize ITCs, accelerated depreciation and certain government or utility incentives associated with the funds' ownership of solar energy systems.

From inception to March 8, 2016, we have formed 24 investment funds. Of these 24 funds, 19 are currently active and are described below. We have established different types of investment funds to implement our asset monetization strategy. Depending on the nature of the investment fund, cash may be contributed to the investment fund by the investor upfront or in stages based on milestones associated with the design, construction or interconnection status of the solar energy systems. The cash contributed by the fund investor is used by the investment fund to purchase solar energy systems. The investment funds either own or enter into a master lease with a Sunrun subsidiary for the solar energy systems, Customer Agreements and associated incentives. We receive on-going cash distributions from the investment funds representing a portion of the monthly customer payments received. We use the upfront cash, as well as on-going distributions to cover our costs associated with purchasing and installing the solar energy systems. In addition, we also use debt, equity and other financing strategies to fund our operations. The allocation of the economic benefits between us and the fund investor and the corresponding accounting treatment varies depending on the structure of the investment fund.

We currently utilize three legal structures in our investment funds, which we refer to as: (i) lease pass-throughs, (ii) partnership flips and (iii) joint venture ("JV") inverted leases. We reflect lease pass-through arrangements on our consolidated balance sheet as a lease pass-through financing obligation. We record the investor's interest in partnership flips or JV inverted leases (which we define collectively as "consolidated joint ventures") as noncontrolling interests or redeemable noncontrolling interests. These consolidated joint ventures are usually redeemable at our option and, in certain cases, at the investor's option. If redemption is at our option or the consolidated joint ventures are not redeemable, we record the investor's interest as a noncontrolling interest and account for the interest using the hypothetical liquidation at book value ("HLBV") method. If the investor has the option to put their interest to us, we record the investor's interest as redeemable noncontrolling interest at the greater of the HLBV and the redemption value.

Lease Pass-Through

Lease Pass-Through. In this investment fund structure, we and the fund investor form two entities which facilitate the pass-through of the ITC or U.S. Treasury grants to the fund investors. In this structure we contribute solar energy systems to an "owner" entity in exchange for interests in the owner entity, and the fund investors contribute cash to a "tenant" entity in exchange for interests in the tenant entity.

Under our lease pass-through structure, in accordance with the provisions of Financial Accounting Standards Board ("FASB"), Accounting Standards Codification Topic 810 ("ASC 810") *Consolidation*, we have determined that we are the primary beneficiary of the owner entity, and accordingly, we consolidate that entity. We have also determined that we are not the primary beneficiary of the tenant entity, and accordingly, we do not consolidate that entity.

In this investment fund structure, the investors make a series of large up-front payments as well as, in some instances, subsequent smaller quarterly lease payments through their respective tenant entity to the corresponding owner entity in exchange for the assignment of cash flows from customer agreements and certain other benefits associated with the customer agreements and related solar energy systems. We account for the payments from investors as borrowings by recording the proceeds received as lease pass-through financing obligations. The financing obligation is reduced by recurring customer payments received under the customer agreements assigned to the funds and, if applicable, any U.S. Treasury grants, the fair value of the ITCs monetized and proceeds from the contracted resale of assigned solar renewable energy credits ("SRECs"), as they are received by the investor over the term of the assignment agreement, which is approximately 20 years. We account for these investment funds in our consolidated financial statements as if we are the lessor in the arrangement with the customer, and we record on our consolidated financial statements activities arising from the customer agreements and any related U.S. Treasury grants, ITCs, incentive rebates and SREC sales. The interest charge on our lease pass-through financing obligations is imputed at the inception of the fund based on the effective interest rate in the arrangement giving rise to the obligation and is updated prospectively as appropriate.

In certain arrangements, we agree to defer a portion of the up-front payments by arranging a loan between an indirectly wholly owned subsidiary of the Company to a subsidiary of the investor's tenant entity. There is a legal right to offset the loan against the financing obligation if an event of default has occurred. Therefore, the lease pass-through related to these types of arrangements is recorded net of the loan.

Consolidated Joint Ventures

Partnership Flips. Under partnership flip structures, we and our fund investors contribute cash into a partnership entity. The partnership uses the cash to acquire solar energy systems developed by us and sells or leases the energy produced under customer agreements. Each fund investor receives a rate of return, typically on an after-tax basis, which varies by investment fund. Prior to the fund investor receiving its contractual rate of return or for a time period specified in the contractual arrangements, the fund investor receives the majority of the value attributable to customer payments and accelerated tax depreciation, and substantially all of the ITCs. After the fund investor receives its contractual rate of return or after the specified time period, we receive substantially all of the value attributable to the remaining customer payments and other incentives.

Under our partnership flip structures, we have determined that we control the variable interest entity ("VIE"), and accordingly we consolidate the entity and record the investor's interest as either noncontrolling interests or redeemable noncontrolling interests in our consolidated balance sheets.

Inverted Leases. Under our inverted lease structure, we and the fund investor set up a multi-tiered investment vehicle that is comprised of two partnership entities which facilitate the pass through of the tax benefits to the fund investors. In this structure we contribute solar energy systems to an "owner" partnership entity in exchange for interests in the owner partnership and the fund investors contribute cash to a "tenant" partnership in exchange for interests in the tenant partnership, which in turn makes an investment in the owner partnership entity in exchange for interests in the owner partnership. The owner partnership uses the cash contributions received from the tenant partnership to purchase systems from us and/or fund installation of such systems. The owner partnership leases the contributed solar energy systems to the tenant partnership under a master lease, and the tenant partnership pays the owner partnership rent for those systems both upfront and on an ongoing basis. The tenant partnership sells energy from the solar energy systems to customers pursuant to the terms of the applicable customer agreements. Customer payments made to the tenant partnership are used to pay expenses (including fees to us), make master lease rent payments and pay preferred return distributions to the fund investor. The owner partnership distributes cash to us and the tenant partnership. As the tenant partnership is an investor in the owner partnership, this allows the fund investors to receive a portion of the accelerated tax depreciation and operating losses associated with the ownership of the assets. In this format, in part owing to the allocation of depreciation benefits to the investor, the investor's pre-tax return is much lower than the investor's after-tax return. Under our existing JV inverted lease structure, a substantial portion of the value generated by the solar energy systems is provided to the fund investor for a specified period of time, which is generally based upon the period of time corresponding to the expiry of the recapture period associated with the ITCs. After that point in time, we receive substantially all of the value attributable to the long-term recurring customer payments and the other incentives.

Under our JV inverted lease structure, we have determined that we control each VIE, and accordingly we consolidate the entity and book the investor's interest as a noncontrolling interest or redeemable noncontrolling interest. For all of our JV inverted leases, the redeemable noncontrolling interest is carried on our balance sheet at the greater of the redemption value or the amount calculated under the HLBV method. The HLBV method estimates the amount that, if the fund's assets were hypothetically sold at their book value, the investor would be entitled to receive according to the liquidation waterfall in the partnership agreement. Generally, the terms of each agreement allocate the value of ITCs earned or grants received by the fund investor to us. Any remaining proceeds are allocated on a pro rata basis to the fund investor and us in accordance with their ownership percentages. We also have one JV inverted lease fund whereby we have a pro rata interest in the entity and we account for the noncontrolling interest's share of income on a pro rata basis. Accordingly, the noncontrolling interest of this fund is carried on our balance sheet at the cumulative amount of capital contributions, reduced by cumulative distributions paid to the investor, as well as the pro rata share of their income. For further information, see the section entitled "Components of Statements of Operations —Net Loss attributable to Common Stockholders."

For further information regarding our investment funds, including the associated risks, see "Risk Factors—Our ability to provide our solar service offerings to homeowners on an economically viable basis depends in part on our ability to finance these systems with fund investors who seek particular tax and other benefits" and Note 15, *Noncontrolling Interests and Redeemable Noncontrolling Interests*, to our consolidated financial statements appearing elsewhere in this Annual Report on Form 10-K.

Key Operating Metrics

We regularly review a number of metrics, including the following key operating metrics, to evaluate our business, measure our performance, identify trends affecting our business, formulate financial projections and make strategic decisions. Some of our key operating metrics are estimates that are based on our management's beliefs and assumptions and on information currently available to management. Although we believe that we have a reasonable basis for each of these estimates, we caution you that these estimates are based on a combination of assumptions that may prove to be inaccurate over time. Such inaccuracies could be material to our actual results when compared to our calculations. Please see the section titled "Risk Factors" in this Annual Report on Form 10-K. Furthermore, other companies may calculate these metrics differently than we do now or in the future, which would reduce their usefulness as a comparative measure.

- *Megawatts Booked* represents the aggregate megawatt production capacity of our solar energy systems sold to customers or subject to an executed customer agreement, net of cancellations.
- *Megawatts Deployed* represents the aggregate megawatt production capacity of our solar energy systems, whether sold directly to customers or subject to customer agreements, for which we have (i) confirmation that the systems are installed on the roof, subject to final inspection or (ii) in the case of certain system installations by our partners, accrued at least 80% of the expected project cost.
- *Estimated Nominal Contracted Payments Remaining* equals the sum of the remaining cash payments that customers are expected to pay over the initial terms of their agreements (not including the value of any renewal or system purchase at the end of the initial agreement term), including estimated uncollected prepayments, for systems contracted as of the measurement date.

- *Estimated Retained Value* represents the cash flows (discounted at 6%) we expect to receive pursuant to customer agreements during the initial agreement term, excluding substantially all value from solar renewable energy credits ("SRECs") prior to July 1, 2015. It also includes a discounted estimate of the value of the purchase or renewal of the agreement at the end of the initial term. Estimated retained value excludes estimated distributions to investors in consolidated joint ventures and estimated operating, maintenance and administrative expenses for systems contracted as of the measurement date. We do not deduct amounts we are obligated to pass through to investors in lease pass-throughs. Estimated retained value under energy contract represents the net cash flows during the initial 20-year term of our customer agreements. Estimated retained value of purchase or renewal is the forecasted net present value we would receive upon or following the expiration of the initial contract term.
- *Estimated Retained Value Per Watt* is calculated by dividing the estimated retained value as of the measurement date by the aggregate nameplate capacity of solar energy systems under customer agreements as of such date.

	For the Year Ended December 31,	
	2015	2014
MW booked (during the period)	273.8	162.9 (1)
MW deployed (during the period)	202.9	129.6 (1)

	As of December 31,	
	2015	2014
Cumulative megawatts deployed (end of period)	596.3	393.4

	As of December 31,	
	2015	2014
	(in thousands, except per watt values)	
Estimated nominal contracted payments remaining	$ 2,404,428	$ 1,596,615
Estimated retained value under energy contract	1,029,311	642,735
Estimated retained value of purchase or renewal	487,397	357,329
Estimated retained value	$ 1,516,708	$ 1,000,064
Estimated retained value per watt	$ 2.33	$ 2.40

(1) Includes 14.7 MWs associated with purchase of asset portfolio in the second quarter of 2014.

Components of Statements of Operations

Revenue

We generate revenue from (1) operating leases and incentives and (2) solar energy systems and product sales commencing in 2014 as a result of the MEC acquisition. Product sales also include lead generation sales commencing in 2015 as a result of the acquisition of Clean Energy Experts, LLC or CEE acquisition.

Operating Leases and Incentives

Operating leases and incentives revenue is primarily comprised of revenue from our customer agreements, solar energy system rebate incentives and sales of SRECs generated by our solar energy systems to third parties, as well as revenue associated with ITCs assigned to investment funds that are classified as lease pass-through arrangements.

We classify and account for our customer agreements as operating leases. We recognize revenue from these agreements either on a straight-line basis over the term of the agreements (in the case of leases) or as we generate and sell energy to customers (in the case of PPAs). The term of these agreements is typically 20 years.

We consider the proceeds from solar energy system rebate incentives to be minimum lease payments under our customer agreements and recognize such payments as revenue over the contract term on a straight-line basis.

We also apply for and receive SRECs and sell them to third parties in certain jurisdictions for energy generated by our solar energy systems. We recognize revenue related to the sale of SRECs to the extent the cumulative value of delivered SRECs per contract exceeds any possible liquidated damages for non-delivery, if any.

Finally, under our investment funds that are classified as lease pass-through arrangements, we allocate a portion of the cash consideration received from the investors to the estimated fair value of the ITCs assigned to such investment funds. The ITCs are subject to recapture under the Internal Revenue Code ("Code") if the underlying solar energy system either ceases to be a qualifying property or undergoes a change in ownership within five years of its placed-in-service date. The recapture amount decreases on the anniversary of the permission to operate ("PTO") date. We recognize ITC revenue as the recapture provisions lapse, with one-fifth of the estimated fair value of the assigned ITC recognized on each anniversary of the solar energy systems' PTO date over the following five years.

Our quarterly operating leases and incentives revenue has been and will continue to be impacted by seasonality. Energy production is greater in the second and third quarters than in the first and fourth quarters, causing variability in revenue recognized under PPAs. There are also seasonal fluctuations in sales and installations, particularly in the fourth quarter, resulting from decreased sales through the holiday season and weather-related installation delays. In addition, as described above, ITC revenue associated with lease pass-through arrangements is recognized once annually on the anniversary of the PTO date and a high percentage of our existing ITCs have PTO dates that occur in the second quarter.

Solar Energy Systems and Product Sales

Solar energy systems sales are comprised of revenue from the sale of solar energy systems directly to homeowners. We generally recognize revenue from solar energy systems sold to homeowners when we install the solar energy system and it passes inspection by the authority having jurisdiction, provided all other revenue recognition criteria have been met.

Product sales revenue consists of revenue from the sale of solar panels, inverters, racking systems, other solar-related equipment to resellers and customer leads to third parties, including our partners and other solar providers. Product sales revenue is recognized at the time title is transferred, generally upon shipment. Customer lead revenue is recognized at the time the lead is delivered.

Our quarterly solar energy systems and product sales revenue has and will continue to fluctuate due to a variety of factors, including timing of installation and seasonal factors described above, as well as other factors that may cause homeowners to opt to purchase solar energy systems rather than leasing them.

Operating Expenses

Operating expenses are classified by the related activity and assigned department of our personnel. Personnel costs include salaries, bonuses, benefits and stock-based compensation. Corporate overhead costs include information technology and facilities costs that are allocated based upon the estimated use by personnel in the related classification below.

Cost of Operating Leases and Incentives

Operating leases and incentives cost of revenue is primarily comprised of (1) the depreciation of solar energy systems, as reduced by amortization of U.S. Treasury grant income, (2) amortization of initial direct costs ("IDCs"), (3) lease operations, monitoring and maintenance costs including associated personnel costs, and (4) allocated corporate overhead costs.

Cost of Solar Energy Systems and Product Sales

Solar energy systems cost of revenue and non-lead generation product sales cost of revenue primarily consists of direct and indirect material and personnel costs for solar energy systems installations and product sales. Other costs include engineering and design costs, estimated warranty costs, freight costs, allocated corporate overhead costs, vehicle depreciation costs and personnel costs associated with supply chain, logistics, operations management, safety and quality control. Cost of revenue for lead generations consists of costs related to direct-response advertising activities associated with generating customer leads.

Sales and Marketing

Sales and marketing expenses include personnel costs as well as advertising, promotional and other marketing related expenses. Sales and marketing expenses also include referral fees, allocated corporate overhead costs, travel and professional services.

Research and Development

Research and development expenses include personnel costs, allocated corporate overhead costs, and other costs related to the development of our BrightPath software suite as well as our racking equipment.

General and Administrative

General and administrative expenses include personnel costs related to accounting, finance, structured finance services, legal, executive staff and human resources. General and administrative expenses also include professional services and allocated corporate overhead costs as well as certain fees paid to fund investors.

Amortization of Intangible Assets

We acquired intangible assets in connection with the acquisition of MEC and CEE. Such intangible assets are being amortized over their estimated useful lives, which range from four months to 10 years.

Non-operating Expenses

Interest Expense, net

Interest expense, net primarily consists of the interest charges associated with long term borrowing and lease pass-through financing obligations. Our revolving line of credit and syndicated term loans are subject to variable interest rates. Our notes payable, bank term loans and solar asset-backed notes bear fixed interest rates. The interest charge on our lease pass-through financing obligations is imputed at the inception of the related transaction based on the effective interest rate in the arrangement giving rise to the obligation and updated prospectively as appropriate. Interest expense also includes the amortization of deferred financing costs associated with such borrowings, partially offset by a nominal amount of interest income generated from our cash holdings in interest-bearing accounts. In the future we may incur additional indebtedness to fund our operations, and our interest expense would correspondingly increase.

Loss on Early Extinguishment of Debt

Loss on early extinguishment of debt consists of loss from early extinguishment of certain non-bank term loans in 2015 and 2014.

Other Expenses

Other expenses consist principally of our portion of the net loss in our investment in The Alliance for Solar Choice ("TASC"), which was accounted for under the equity method of accounting.

Income Tax Expense

We are subject to taxation in the United States, where all of our business is conducted. Our effective tax rates differ from the statutory rate primarily due to noncontrolling and redeemable noncontrolling interest adjustments and prepaid tax expense on intercompany gains.

As of December 31, 2015, we had approximately $595.0 million of federal and $546.6 million of state net operating loss carryforwards ("NOLs"), available to offset future taxable income, if any, which expire in varying amounts beginning in 2028 and 2020 for federal and state purposes, respectively, if unused. It is possible that we will not generate taxable income in time to use these NOLs before their expiration.

Net Loss Attributable to Common Stockholders

As discussed above under "—Investment Funds," 14 of our 19 active investment funds are consolidated joint ventures. We determine the net loss attributable to common stockholders by deducting from net loss the net loss attributable to noncontrolling interests and redeemable noncontrolling interests in these funds. The net loss attributable to noncontrolling interests and redeemable noncontrolling interests represents the fund investors' allocable share in the results of operations of these investment funds. For these funds, we have determined that the provisions in the contractual arrangements represent substantive profit sharing arrangements, where the allocations to the partners sometimes differ from the stated ownership percentages. We have further determined that, for these arrangements, the appropriate methodology for attributing income and loss to the noncontrolling interests and redeemable noncontrolling interests each period is a balance sheet approach using the HLBV method.

Under the HLBV method, the amounts of income and loss attributed to the noncontrolling interests and redeemable noncontrolling interests in the consolidated statements of operations reflect changes in the amounts the fund investors would hypothetically receive at each balance sheet date under the liquidation provisions of the contractual provisions of these funds, assuming the net assets of the respective investment funds were liquidated at the carrying value determined in accordance with generally accepted accounting principles in the United States ("GAAP"). The fund investors' interest in the results of operations of these investment funds is initially determined by calculating the difference in the noncontrolling interests and redeemable noncontrolling interests' claim under the HLBV method at the start and end of each reporting period, after taking into account any contributions and distributions between the fund and the fund investors and subject to the redemption provisions in certain funds. The redeemable noncontrolling interests balance is the greater of the carrying value calculated under the HLBV method or the redemption value. Because the investor contributes cash into the fund to purchase solar energy systems at fair market value which exceeds their carrying value, the noncontrolling interest balance is reduced upon application of the HLBV method. As such, the HLBV method generally allocates more loss to the noncontrolling interest in the first several years after fund formation. After the solar systems have been purchased by the fund, the noncontrolling interest's contributions decrease substantially. As ongoing distributions are received by the noncontrolling interest, their losses under the HLBV method tend to reverse. While the application of HLBV is performed consistently, the results of that application and its impact on the income or loss allocated between us and the noncontrolling interests and redeemable noncontrolling interests depend on the respective funds' specific contractual liquidation provisions. The HLBV results are generally affected by the tax attributes allocated to the fund investors including tax bonus depreciation and ITCs or U.S. Treasury grants in lieu of the ITCs, the amount of preferred returns that have been paid to the fund investors by the investment funds, and the allocation of tax income or losses in a liquidation scenario.

The contractual liquidation provisions of our consolidated joint ventures (which include our partnership flips and JV inverted leases) provide that the allocation percentages between us and the investor change, or "flip," under certain circumstances, such as upon the achievement of the fund investor's targeted rate of return, the passage of time, or the expiration of the recapture period associated with ITCs. Prior to the point at which the allocation percentage flips, the investor is entitled to receive a majority of the value generated by the solar energy systems. At the flip point, we become entitled to receive most of the value. The difference between our current partnership flip structures and JV inverted lease structures that drives a significant impact on our results from the application of the HLBV method is how the flip point is determined.

For investment funds that have a partnership flip structure, the flip point is tied to the achievement of the fund investor's targeted rate of return. The receipt of tax benefits by the fund investor count towards the achievement of such target, which reduces the amount distributable to the fund investor in a hypothetical liquidation under these funds' contractual liquidation provisions. This results in a net loss attributable to the fund investor over the periods in which these tax benefits are received as a result of our application of the HLBV method.

For investment funds that have a JV inverted lease structure, the flip point is typically tied to the expiration of the recapture period associated with ITCs. An investor in a fund with a JV inverted lease fund structure will receive tax benefits similar to an investor in a fund that has adopted a partnership structure. However, unlike the partnership flip structure, the receipt of tax benefits by the fund investor does not impact the amount distributable to the fund investor in a hypothetical liquidation under these funds' contractual liquidation provisions. At the flip point, the fund investor's claims on the net assets of the investment fund generally decreases. This results in a net loss attributable to the fund investor in the period when the flip occurs as a result of our application of the HLBV method. As discussed above under "—Investment Funds," we also have one JV inverted lease whereby we have a pro rata interest in the entity, and we account for the noncontrolling interest's share of income on a pro rata basis.

These differences are a result of the specific contractual provisions for each of our existing funds and are not necessarily indicative of terms for our future partnership flip or JV inverted lease structures. Future investment funds may contain different features than those that we currently employ, and as a result, the application of the HLBV method and resulting allocation of net income or loss may be different from our existing funds.

Critical Accounting Policies and Estimates

Our discussion and analysis of our financial condition and results of operations are based upon our financial statements, which have been prepared in accordance with GAAP. GAAP requires us to make estimates and assumptions that affect the reported amounts of assets, liabilities, revenue, expenses, and related disclosures. We base our estimates on historical experience and on various other assumptions that we believe to be reasonable under the circumstances. In many instances, we could have reasonably used different accounting estimates, and in other instances, changes in the accounting estimates are reasonably likely to occur from period-to-period. Actual results could differ significantly from our estimates. Our future financial statements will be affected to the extent that our actual results materially differ from these estimates. For further information on all of our significant accounting policies, see Note 2, *Summary of Significant Accounting Policies*, to our consolidated financial statements included elsewhere in this Annual Report.

We believe that assumptions and estimates associated with our principles of consolidation, revenue recognition, impairment of long-lived assets, goodwill impairment analysis, stock-based compensation expense and common stock valuation, provision for income taxes and valuation of noncontrolling interests and redeemable noncontrolling interests have the greatest impact on our consolidated financial statements. Therefore, we consider these to be our critical accounting policies and estimates.

Principles of Consolidation

Our consolidated financial statements include our accounts and those of our subsidiaries in which we have a controlling financial interest. The typical condition for a controlling financial interest is holding a majority of the voting interests of an entity. However, a controlling financial interest may also exist in entities, such as VIEs, through arrangements that do not involve controlling financial interests. We consolidate any VIE of which we are the primary beneficiary, which is defined as the party that has (1) the power to direct the activities of a VIE that most significantly impact the VIE's economic performance and (2) the obligation to absorb losses or receive benefits of the VIE that could potentially be significant to the VIE. We evaluate our relationships with our VIEs on an ongoing basis to determine whether we continue to be the primary beneficiary. Our financial statements reflect the assets and liabilities of VIEs that we consolidate. All intercompany transactions and balances have been eliminated in consolidation. For further information regarding consolidation of our investment funds, see Investment Funds above.

Revenue Recognition

We sell the energy that our solar energy systems produce through long-term customer agreements. We also derive a portion of our revenue from solar energy system rebate incentives, sales of SRECs generated from our solar energy systems and ITCs assigned to investment funds that are classified as lease pass-through arrangements.

Following the acquisition of MEC in February 2014, we began selling solar energy systems to homeowners, as well as related products, such as solar panels, inverters, racking systems and other solar-related equipment, to resellers. Following the acquisition of CEE in April 2015, we began selling customer leads to third parties, including our partners and other solar providers.

We recognize revenue when (i) persuasive evidence of an arrangement exists, (ii) delivery has occurred or services have been rendered, (iii) the sales price is fixed and determinable, and (iv) collection of the related receivable is reasonably assured.

Operating Leases and Incentives Revenue. Operating leases and incentives revenue represent both ongoing and advance payments received under the terms of the customer agreements, which typically have terms of 20 years. Revenue from advance payments including prepayment options is deferred and begins to be recognized when PTO is given by the local utility company or on the date daily operation commences if utility approval is not required, provided all other revenue criteria are met.

We have determined that our customer agreements should be accounted for as operating leases after evaluating the following lease classification criteria: (i) whether there is a transfer of ownership or bargain purchase option at the end of the lease, (ii) whether the lease term is greater than 75% of the estimated economic life, or (iii) whether the present value of minimum lease payments exceeds 90% of the fair value at lease inception.

In the majority of our customer agreements, we charge a fixed fee per kilowatt hour based on the amount of electricity the solar energy system actually produces, with an annual fixed percentage price escalation to address the impact of inflation and utility rate increases over the period of the contract. In these cases, we consider the customer payments to be contingent lease payments which are excluded from minimum lease payments used for purposes of assessing the lease classification criteria above. Accordingly, we recognize these electricity payments as earned, provided all other revenue recognition criteria discussed above are met.

We also offer customer agreements whereby the customers' monthly payment is a pre-determined amount calculated based on the expected solar energy generation and includes an annual fixed percentage price escalation (to address the impact of inflation and utility rate increases) over the period of the contracts, which are typically 20 years. We record operating lease revenue from minimum lease payments on a straight-line basis over the life of the lease term, provided all other revenue recognition criteria are met.

We also apply for and receive upfront rebates and incentives offered by certain state and local governments and local utility companies on behalf of our customers for solar facilities installed on certain of our customers' premises. We consider these rebates to be minimum lease payments which are generally recognized on a straight-line basis over the life of the lease term. The difference between the payments received and the revenue recognized is recorded as deferred revenue on the consolidated balance sheet.

SREC revenue arises from the sale of environmental credits generated by solar energy systems. If the solar energy systems do not generate the amount of electricity required to earn SRECs sold forward or if for any reason the electricity generated does not produce SRECs for a particular state, we may be required to make up the shortfall of SRECs through purchases on the open market or make payments of liquidated damages. We recognize revenue related to the sale of SRECs to the extent the cumulative value of delivered SRECs per contract exceeds any possible liquidated damages for non-delivery, if any.

For lease pass-through structures, we monetize the ITCs associated with the systems subject to customer agreements by assigning them to the investor together with the future associated customer payments. A portion of the cash consideration received from the investor is allocated to the estimated fair value of the assigned ITCs. The estimated fair value of the ITCs is determined by applying the expected internal rate of return to the investor to the gross amount of the ITCs that may be claimed by the investor.

The ITCs are subject to recapture under the Code if the underlying solar energy systems either ceases to be a qualifying property or undergoes a change in ownership within five years of its placed in service date. The recapture amount decreases by one-fifth on the anniversary of the placed in service date, which begins upon PTO. As we have an obligation to ensure the solar energy system is in service and operational for a term of five years to avoid any recapture of the ITCs, we recognize revenue as the recapture provisions lapse provided the other revenue recognition criteria have been met. The monetized ITCs are initially recorded as deferred revenue on the consolidated balance sheet, and subsequently, one-fifth of the monetized ITCs will be recognized as operating leases and incentives revenue in the consolidated statement of operations on each anniversary of the solar energy system's PTO date over the following five years.

Solar Energy Systems and Product Sales. For solar energy systems sold to customers, we recognize revenue, net of any applicable governmental sales taxes, when we install the solar facilities and it passes inspection by the responsible city department, provided all other revenue recognition criteria are met. The installation projects of our solar energy systems are typically completed in a short period of time. Prior to our acquisition of MEC in February 2014, we did not directly sell solar energy systems to homeowners.

Product sales revenue is recognized at the time the goods are shipped or when title is transferred. Shipping and handling fees charged to customers are included in net sales. Shipping and handling costs incurred are included in cost of sales. Taxes assessed by government authorities that are directly imposed on revenue producing transactions are excluded from product sales revenue. Prior to our acquisition of MEC in February 2014, we did not sell solar-related products to resellers. Customer lead revenue, included in product sales, is recognized at the time the lead is delivered. Prior to the acquisition of CEE in April 2015, we did not sell customer leads to third parties.

Impairment of Long-Lived Assets

The carrying amounts of our long-lived assets, including solar energy systems and definite-lived intangible assets, are periodically reviewed for impairment whenever events or changes in circumstances indicate that the carrying value of these assets may not be recoverable or that the useful life is shorter than originally estimated. Factors that we consider in deciding when to perform an impairment review would include significant negative industry or economic trends, and significant changes or planned changes in our use of the assets. Recoverability of these assets is measured by comparison of the carrying amount of each asset to the future undiscounted cash flows the asset is expected to generate over its remaining life. If the asset is considered to be impaired, the amount of any impairment is measured as the difference between the carrying value and the fair value of the impaired asset. If the useful life is shorter than originally estimated, we amortize the remaining carrying value over the new shorter useful life. No impairment of long-lived assets has been recorded for the years ended December 31, 2015, 2014 and 2013.

Goodwill Impairment Analysis

Goodwill represents the excess of the purchase price of an acquired business over the fair value of the net tangible and identifiable intangible assets acquired. Our goodwill balance is a result of the acquisition of MEC in February 2014 and CEE in April 2015. We have determined that we operate as one reporting unit, and our goodwill is recorded at the enterprise level. We perform our annual impairment test of goodwill on October 1 of each year or whenever events or circumstances change or occur that would indicate that goodwill might be impaired. When assessing goodwill for impairment, we use qualitative and, if necessary, quantitative methods. We also consider our enterprise value and, if necessary, our discounted cash flow model, which involves assumptions and estimates, including our future financial performance, weighted-average cost of capital and interpretation of currently enacted tax laws. Circumstances that could indicate impairment and require us to perform an impairment test include a significant decline in our financial results, a significant decline in our enterprise value relative to our net book value, an unanticipated change in competition or our market share and a significant change in our strategic plans. We did not note any indicators of impairment in the qualitative assessment that would require a quantitative analysis in 2015. We did not have any goodwill prior to 2014, and no impairment charges have been recorded to date.

Stock-Based Compensation

We grant stock options to our employees, including our executive officers and members of our board of directors, and recognize employee stock-based compensation expense based on the fair value of stock options at grant date. We estimate the fair value of stock options using the Black-Scholes option-pricing model. This model requires us to use certain estimates and assumptions such as: (i) the fair value of our common stock, which is estimated using the methodology as discussed below in *Common Stock Valuation*; (ii) the expected volatility of our common stock, which is based on the volatility data of a group of publicly traded peer companies in our industry; (iii) the expected terms of our stock options, which are based on the historical average vesting terms and contractual lives of our stock options; (iv) the expected dividend yield, which is 0%, as we have not paid and do not anticipate paying dividends on our common stock; and (v) the risk-free interest rates, which are based on the U.S. Treasury yield curves in effect at the grant date with maturities equal to the expected terms of the options granted. Our stock options have a contractual term of 10 years and generally vest over four years, with 25% vesting after one year and the remainder vesting monthly thereafter over 36 months. If any of the assumptions used in the Black-Scholes model changes significantly, stock-based compensation for future awards may differ materially compared with the awards granted previously.

The following table summarizes the assumptions relating to our stock options granted in 2015, 2014 and 2013:

	Year Ended December 31,		
	2015	2014	2013
Risk-free interest rate	1.55%-1.95%	1.68%-2.01%	0.82%-2.06%
Volatility	36.30%-39.63%	37.41%-46.68%	54.36%-55.80%
Expected term (in years)	5.50-6.23	5.34-6.08	5.54-6.08
Expected dividend yield	0.00%	0.00%	0.00%

We record stock-based compensation expense net of estimated forfeitures so that expense is recorded for only those stock-based awards that we expect to vest. We estimate forfeitures based on our historical forfeiture of equity awards adjusted to reflect future changes in facts and circumstances, if any. We will revise our estimated forfeiture rate if actual forfeitures differ from our initial estimates. We record stock-based compensation expense for stock options on a straight-line basis over the vesting term.

We also granted restricted stock units ("RSUs") to certain non-employee service providers. Certain RSUs granted to non-employees vest upon the satisfaction of both a performance-based condition and service condition. We start recognizing non-employee stock-based compensation expense on RSUs subject to performance-based conditions and service conditions when the performance conditions are met.

We will continue to use judgment in evaluating the expected term, expected volatility and forfeiture rate related to our stock-based compensation on a prospective basis. As we continue to accumulate additional data related to our common stock, we may have refinements to the estimates of our expected volatility, expected terms and forfeiture rates, which could materially impact our future stock-based compensation expense as it relates to the future grants of our stock-based awards.

Provision for Income Taxes

We account for income taxes under an asset and liability approach. Deferred income taxes reflect the impact of temporary differences between assets and liabilities recognized for financial reporting purposes and the amounts recognized for income tax reporting purposes, net operating loss carryforwards and other tax credits measured by applying currently enacted tax laws. A valuation allowance is provided when necessary to reduce deferred tax assets to an amount that is more likely than not to be realized. There is no valuation allowance as of December 31, 2015 as we expect to utilize the deferred tax assets over approximately 20 years.

We sell solar energy systems to the investment funds. As the investment funds are consolidated by us, the gain on the sale of the solar energy systems is not recognized in the consolidated financial statements. However, this gain is recognized for tax reporting purposes. Since these transactions are intercompany sales for book purposes, any tax expense incurred related to these intercompany sales is deferred and recorded as a prepaid tax asset and there is no recognition of a deferred tax asset. The prepaid tax asset is amortized over the estimated useful life of the underlying solar energy systems which has been estimated to be 20 years.

We determine whether a tax position is more likely than not to be sustained upon examination, including resolution of any related appeals or litigation processes, based on the technical merits of the position. We use a two-step approach to recognizing and measuring uncertain tax positions. The first step is to evaluate the tax position for recognition by determining if the weight of available evidence indicates that it is more likely than not that the position will be sustained upon tax authority examination, including resolution of related appeals or litigation processes, if any. The second step is to measure the tax benefit as the largest amount that is more than 50% likely of being realized upon ultimate settlement.

Our policy is to include interest and penalties related to unrecognized tax benefits, if any, within the provision for taxes in the consolidated statements of operations.

Noncontrolling Interests and Redeemable Noncontrolling Interests

Our noncontrolling interests and redeemable noncontrolling interests represent fund investors' interests in the net assets of certain investment funds, which we consolidate, that we have entered into in order to finance the costs of solar energy facilities under operating leases. We have determined that the provisions in the contractual arrangements of the investment funds represent substantive profit-sharing arrangements, which gives rise to the noncontrolling interests and redeemable noncontrolling interests. We have further determined that for all but one of these arrangements, the appropriate methodology for attributing income and loss to the noncontrolling interests and redeemable noncontrolling interests each period is a balance sheet approach using the HLBV method.

Attributing income and loss to the noncontrolling interests and redeemable noncontrolling interests under the HLBV method requires the use of significant assumptions to calculate the amounts that fund investors would receive upon a hypothetical liquidation. Changes in these assumptions can have a significant impact on the amount that fund investors would receive upon a hypothetical liquidation.

We classify certain noncontrolling interests with redemption features that are not solely within our control outside of permanent equity on our consolidated balance sheets. Redeemable noncontrolling interests are reported using the greater of their carrying value at each reporting date as determined by the HLBV method or their estimated redemption value in each reporting period. Estimating the redemption value of the redeemable noncontrolling interests requires the use of significant assumptions and estimates such as projected future cash flows at the time the redemption feature can be exercised. Changes in these assumptions and estimates can have a significant impact on the calculation of the redemption value.

Results of Operations

The results of operations presented below should be reviewed in conjunction with the consolidated financial statements and notes thereto included elsewhere in this Annual Report on Form 10-K.

	Year Ended December 31,		
	2015	2014	2013
Revenue:			
Operating leases and incentives	$ 118,004	$ 84,006	$ 54,740
Solar energy systems and product sales	186,602	114,551	—
Total revenue	304,606	198,557	54,740
Operating expenses:			
Cost of operating leases and incentives	111,784	72,898	43,088
Cost of solar energy systems and product sales	168,751	100,802	—
Sales and marketing	145,477	78,723	22,395
Research and development	9,657	8,386	9,984
General and administrative	84,442	68,098	33,242
Amortization of intangible assets	3,695	2,269	—
Total operating expenses	523,806	331,176	108,709
Loss from operations	(219,200)	(132,619)	(53,969)
Interest expense, net	33,236	27,521	11,752
Loss on early extinguishment of debt	431	4,350	—
Other expenses	1,338	3,043	365
Loss before income taxes	(254,205)	(167,533)	(66,086)
Income tax benefit	(5,299)	(10,043)	(591)
Net loss	(248,906)	(157,490)	(65,495)
Net loss attributable to noncontrolling interests and redeemable noncontrolling interests	(220,660)	(86,638)	(64,294)
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Deemed dividend to convertible preferred stockholders (1)	(24,890)	—	—
Net loss available to common stockholders	$ (53,136)	$ (70,852)	$ (1,201)
Net loss per share available to common shareholders—basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)
Weighted average shares used to compute net loss per share available to common stockholders—basic and diluted	55,091	22,795	9,780

(1) We calculate net income (loss) per share (EPS) available to common stockholders using the two-class method. The two-class method allocates net income that otherwise would have been available to common stockholders to holders of participating securities. We recognized a $24.9 million deemed dividend to Series D and E preferred stockholders as a result of an inducement to convert the Series D and E preferred stock into common stock immediately prior to the closing of our initial public offering. This deemed dividend was added to net loss attributable to common stockholders to determine the amount available to the common stockholders.

Comparison of the Years Ended December 31, 2015 and 2014

Revenue

	Year Ended December 31,		Change	
	2015	2014	$	%
		(in thousands)		
Operating leases	$ 86,332	$ 63,962	$ 22,370	35%
Incentives	31,672	20,044	11,628	58%
Operating leases and incentives	118,004	84,006	33,998	40%
Solar energy systems	50,191	23,687	26,504	112%
Products	136,411	90,864	45,547	50%
Solar energy systems and product sales	186,602	114,551	72,051	63%
Total revenue	$ 304,606	$ 198,557	$ 106,049	53%

Operating lease revenue increased by $22.4 million related to an increase in solar assets under Customer Agreements being placed in service in the period from December 31, 2014 through December 31, 2015 and due to a full year of revenue recognized in 2015 for systems placed in service in 2014 versus only a portion recognized in 2014. Revenue from incentives increased by $11.6 million primarily due to an increase in ITC revenue, which relates to solar systems in lease pass-through funds being placed in service in the prior year as we recognize revenue from the monetization of these ITCs annually over five years on each anniversary of a solar energy system's permission-to-operate date.

Revenue from solar energy systems sales increased by $26.5 million compared to the prior year period due to higher sales volume from overall growth following our increased investment in sales and marketing. Product sales increased by $45.5 million compared to the prior period primarily due to increased volume of solar-related products revenue due to overall growth discussed above and due to the CEE acquisition in April 2015.

Operating Expenses

	Year Ended December 31,		Change	
	2015	2014	$	%
		(in thousands)		
Cost of operating lease and incentives	$ 111,784	$ 72,898	$ 38,886	53%
Cost of solar energy systems and product sales	168,751	100,802	67,949	67%
Sales and marketing	145,477	78,723	66,754	85%
Research and development	9,657	8,386	1,271	15%
General and administrative expense	84,442	68,098	16,344	24%
Amortization of intangible assets	3,695	2,269	1,426	63%
Total operating expenses	$ 523,806	$ 331,176	$ 192,630	58%

Cost of Operating Leases and Incentives. The $38.9 million increase in cost of operating leases and incentives was primarily due to the increase in solar energy systems placed in service in the period from December 31, 2014 through December 31, 2015, plus a full year of expenses recognized for systems placed in service in 2014 versus only a portion recognized in 2014, which resulted in an increase in depreciation and amortization of solar energy system equipment costs and initial direct costs, as well as non-capitalizable costs associated with building and maintaining solar energy systems subject to Customer Agreements.

Cost of Solar Energy Systems and Product Sales. The $67.9 million increase in cost of solar energy systems and product sales represents an increase in the direct and indirect material and personnel costs of solar energy systems sold directly to customers as well as solar panels, inverters and other solar-related products sold to resellers, including the costs associated with the customer lead sales.

Sales and Marketing Expense. The $66.8 million increase in sales and marketing expense was attributable to the expansion of our direct-to-consumer channel as well as our continued efforts to grow our business by entering new markets, increasing hiring of sales and marketing personnel and internal lead generation through advertising and other channels.

Research and Development. The $1.3 million increase in research and development expenses primarily resulted from an increase in fees paid to external consultants in connection with ongoing development of our pricing and quoting platforms.

General and Administrative Expense. The $16.3 million increase in general and administrative expenses primarily related to hiring of personnel and increased consulting and legal fees as a result of our acquisition of CEE in 2015 and to support the growth of our business.

Amortization of Intangible Assets. The $1.4 million increase in amortization expense resulted from the amortization of intangible assets acquired from the CEE acquisition in April 2015.

Non-Operating Expenses

	Year Ended December 31,		Change	
	2015	2014	$	%
		(in thousands)		
Interest expense, net	$ 33,236	$ 27,521	$ 5,715	21%
Loss on early extinguishment of debt	431	4,350	(3,919)	(90)%
Other expenses	1,338	3,043	(1,705)	(56)%
Total interest and other expenses, net	$ 35,005	$ 34,914	$ 91	0%

Interest Expense, net. The increase in interest expense, net of $5.7 million was related to an increase in imputed interest on additional lease pass-through obligations entered into in 2015 and additional interest expense related to additional borrowings entered into in late 2014 and in 2015.

Other Expenses. The decrease in other expenses of $1.7 million primarily relates to the change in fair value of warrant derivatives which were issued to former Series D and E preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the closing of our initial public offering, partially offset by an increase in losses from our investment in The Alliance for Solar Choice ("TASC") in 2015.

Income Tax Benefit

	Year Ended December 31,		Change	
	2015	2014	$	%
		(in thousands)		
Income tax benefit	$ (5,299)	$ (10,043)	$ 4,744	(47)%

The tax expense at the statutory rate of 34.0% for the year ended December 31, 2015 was reduced by the allocation of the losses to noncontrolling interests and redeemable noncontrolling interests of 29.5% and by other miscellaneous items of 2.4%. The statutory rate tax of 34.0% for the year ended December 31, 2014 was reduced by the allocation of losses to noncontrolling interests and redeemable noncontrolling interests of 17.6%, by the tax impact of intercompany transactions of 9.4% and by other miscellaneous items of 1.0%.

Net Loss Attributable to Noncontrolling Interests and Redeemable Noncontrolling Interests

	Year Ended December 31,		Change	
	2015	2014	$	%
		(in thousands)		
Net loss attributable to noncontrolling interests and redeemable noncontrolling interests	$ (220,660)	$ (86,638)	$ (134,022)	155%

The increase in net loss attributable to noncontrolling interests and redeemable noncontrolling interests was primarily a result of the addition of three investment funds since December 31, 2014, as well as the HLBV method used in determining the amount of net loss attributable to noncontrolling interests and redeemable noncontrolling interests, which generally allocates more loss to the noncontrolling interest in the first several years after fund formation.

Comparison of the Years Ended December 31, 2014 and 2013

Revenue

	Year Ended December 31,		Change	
	2014	2013	$	%
		(in thousands)		
Operating leases	$ 63,962	$ 44,249	$ 19,713	45%
Incentives	20,044	10,491	9,553	91%
Operating leases and incentives	84,006	54,740	29,266	53%
Solar energy systems	23,687	—	23,687	100%
Products	90,864	—	90,864	100%
Solar energy systems and product sales	114,551	—	114,551	100%
Total revenue	$ 198,557	$ 54,740	$ 143,817	263%

Operating lease revenue increased by $19.7 million related to an increase in solar assets under Customer Agreements being placed in service from December 31, 2013 through December 31, 2014 and due to a full year of revenue recognized in 2014 for systems placed in service in 2013 versus only a portion recognized in 2013. Revenue from incentives increased by $9.5 million primarily due to an increase in ITC revenue. Revenue from incentives in 2014 includes $5.6 million in ITC revenue due to lapsing of the first year of the ITC recapture period associated with solar energy systems placed in service in 2013 under lease pass-through arrangements. We did not recognize ITC revenue in 2013 as the first year of the ITC recapture period associated with solar energy systems placed in service in 2013 had not elapsed until 2014. Additionally, revenue from incentives increased $3.9 million in 2014 due to increased rebate and SREC revenue as a result of the increase in cumulative megawatts deployed under operating leases discussed above.

The $114.6 million increase in revenue from solar energy systems and product sales was a result of the acquisition of MEC in 2014. We did not sell solar energy systems directly to homeowners or sell products to solar energy installers and distributors prior to this acquisition.

Operating Expenses

	Year Ended December 31,		Change	
	2014	2013	$	%
		(in thousands)		
Cost of operating lease and incentives	$ 72,898	$ 43,088	$ 29,810	69%
Cost of solar energy systems and product sales	100,802	—	100,802	100%
Sales and marketing	78,723	22,395	56,328	252%
Research and development	8,386	9,984	(1,598)	(16)%
General and administrative expense	68,098	33,242	34,856	105%
Amortization of intangible assets	2,269	—	2,269	100%
Total operating expenses	$ 331,176	$ 108,709	$ 222,467	205%

Cost of Operating Leases and Incentives. The $29.8 million increase in cost of operating leases and incentives was primarily due to the increase in solar energy systems placed in service in the period from December 31, 2013 through December 31, 2014, plus a full year of expenses recognized for systems placed in service in 2013 versus only a portion recognized in 2013, which resulted in an increase in depreciation and amortization of solar energy system equipment costs and initial direct costs, as well as non-capitalizable costs associated with building and maintaining solar energy systems subject to Customer Agreements we incurred subsequent to the acquisition of MEC.

Cost of Solar Energy Systems and Product Sales. The cost of solar energy systems and product sales of $100.8 million in 2014 represents the direct and indirect material and personnel costs of solar energy systems sold directly to customers as well as solar panels, inverters and other solar-related products sold to resellers. We did not sell solar energy systems directly to our customers, nor did we directly or indirectly sell solar panels and other related products to resellers prior to our acquisition of MEC in 2014. Instead, prior to the acquisition of MEC, we relied on solar partners to originate customers for our solar service offerings and procure and install the solar energy systems on our customers' homes on our behalf. As a result of the acquisition, we began offering customer agreements and installing solar energy systems both directly to the customer and selling solar energy systems for cash through our direct-to-consumer channel.

Sales and Marketing Expense. The $56.3 million increase in sales and marketing expense was attributable to the expansion of our direct-to-consumer channel as a result of our acquisition of MEC in February 2014, as well as our continued efforts to grow our business by entering new markets, increasing internal lead generation through advertising and other channels, and increased hiring of sales and marketing personnel.

Research and Development. The $1.6 million decrease in research and development expenses primarily resulted from a shift in 2014 toward activities that qualified for capitalization as internally developed software rather than a decrease in research and development activity. We expect to continue to make significant investments in research and development.

General and Administrative Expense. The $34.9 million increase in general and administrative expenses primarily resulted from increased personnel costs as a result of our acquisition of MEC in 2014 as well as an increase in professional service and legal fees driven primarily from our efforts in preparing to become a public company, as well as general corporate costs associated with supporting overall growth and formation of five additional investment funds in 2014.

Non-Operating Expenses

	Year Ended December 31,		Change	
	2014	2013	$	%
	(in thousands)			
Interest expense, net	$ 27,521	$ 11,752	$ 15,769	134%
Loss on early extinguishment of debt	4,350	—	4,350	100%
Other expenses	3,043	365	2,678	734%
Total interest and other expenses, net	$ 34,914	$ 12,117	$ 22,797	188%

Interest Expense, net. The increase in interest expense, net of $15.8 million was related to a full year of interest on borrowings entered into in 2013 as well as imputed interest on additional lease pass-through obligations entered into in 2014.

Other Expense. The increase in other expenses of $2.7 million primarily represents our loss from our investment in TASC in 2014.

Income Tax Benefit

	Year Ended December 31,		Change	
	2014	2013	$	%
	(in thousands)			
Income tax benefit	$ (10,043)	$ (591)	$ (9,452)	1599%

The statutory rate tax of 34.0% for the year ended December 31, 2014 was reduced by the allocation of losses to noncontrolling interests and redeemable noncontrolling interests of 17.6%, by the tax impact of intercompany transactions of 9.4% and by other miscellaneous items of 1.0%. The statutory rate tax of 34.0% for the year ended December 31, 2013 was reduced by the allocation of losses to noncontrolling interests and redeemable noncontrolling interests of 34.1%, offset by an increase in other miscellaneous items of 1.0%.

Net Loss Attributable to Noncontrolling Interests and Redeemable Noncontrolling Interests

	Year Ended December 31,		Change	
	2014	2013	$	%
	(in thousands)			
Net loss attributable to noncontrolling interests and redeemable noncontrolling interests	$ (86,638)	$ (64,294)	$ (22,344)	35%

The increase in net loss attributable to noncontrolling interests and redeemable noncontrolling interests was primarily a result of the addition of three investment funds between December 31, 2013 and December 31, 2014, as well as the HLBV method used in determining the amount of net loss attributable to noncontrolling interests and redeemable noncontrolling interests, which generally allocates more loss to the noncontrolling interest in the first several years after fund formation.

Quarterly Results of Operations

The following table represents our unaudited consolidated statement of operations for each of the quarters indicated. Our consolidated statement of operations for each of these quarters have been prepared on a basis consistent within our audited financial statements included elsewhere in this Annual Report on Form 10-K and, in the opinion of management, include all adjustments necessary for the fair presentation of our consolidated results of operations for these quarters. You should read this information together with our annual consolidated financial statements and the related notes included elsewhere in this Annual Report on Form 10-K. Our quarterly results of operations are not necessarily indicative of our results for any future period.

	Three Months Ended							
	December 31, 2015	September 30, 2015	June 30, 2015	March 31, 2015	December 31, 2014	September 30, 2014	June 30, 2014	March 31, 2014
Revenue:								
Operating leases and incentives	$ 29,588	$ 31,650	$ 34,458	$ 22,308	$ 20,966	$ 21,612	$ 22,987	$ 18,441
Solar energy systems and product sales	70,051	50,950	38,232	27,369	39,173	34,464	28,952	11,962
Total revenue	99,639	82,600	72,690	49,677	60,139	56,076	51,939	30,403
Operating expenses:								
Cost of operating leases and incentives	34,617	28,723	27,067	21,377	21,531	19,112	17,359	14,896
Cost of solar energy systems and product sales	62,329	46,468	34,624	25,330	34,759	30,235	25,333	10,475
Sales and marketing	41,193	45,382	33,976	24,926	25,516	23,445	17,173	12,589
Research and development	2,638	2,240	2,492	2,287	2,424	2,036	1,999	1,927
General and administrative	22,973	21,486	19,677	20,306	17,711	17,700	20,037	12,650
Amortization of intangible assets	1,051	1,051	1,051	542	576	575	655	463
Total operating expenses	164,801	145,350	118,887	94,768	102,517	93,103	82,556	53,000
Loss from operations	(65,162)	(62,750)	(46,197)	(45,091)	(42,378)	(37,027)	(30,617)	(22,597)
Interest expense, net	9,198	8,475	8,433	7,130	7,764	7,433	6,662	5,662
Loss on early extinguishment of debt	—	—	431	—	4,350	—	—	—
Other expenses	(67)	87	1,019	299	540	657	1,386	460
Loss before income taxes	(74,293)	(71,312)	(56,080)	(52,520)	(55,032)	(45,117)	(38,665)	(28,719)
Income tax expense (benefit)	13	903	(6,215)	—	—	—	(5,917)	(4,126)
Net loss	(74,306)	(72,215)	(49,865)	(52,520)	(55,032)	(45,117)	(32,748)	(24,593)
Net loss attributable to noncontrolling interests and redeemable noncontrolling interests	(59,283)	(69,447)	(57,405)	(34,525)	(28,346)	(29,903)	(15,517)	(12,872)
Net loss attributable to common stockholders	$ (15,023)	$ (2,768)	$ 7,540	$ (17,995)	$ (26,686)	$ (15,214)	$ (17,231)	$ (11,721)
Net income allocated to participating securities	—	—	(7,540)		—	—	—	—
Deemed dividend to convertible preferred stockholders	—	(24,890)	—		—	—	—	—
Net loss available to common stockholders	$ (15,023)	$ (27,658)	$ —	$ (17,995)	$ (26,686)	$ (15,214)	$ (17,231)	$ (11,721)
Net loss per share available to common shareholders—basic and diluted	$ (0.15)	$ (0.41)	$ —	$ (0.23)	$ (1.10)	$ (0.64)	$ (0.72)	$ (0.62)
Weighted average shares used to compute net loss per share available to common stockholders—basic and diluted	101,034	67,732	26,215	79,268	24,173	23,943	23,827	19,021

Liquidity and Capital Resources

As of December 31, 2015, we had cash of $203.9 million, which consisted principally of cash held in checking and savings accounts with financial institutions. We finance our operations mainly through a variety of financing fund arrangements that we have formed with fund investors, sales of preferred and common stock, borrowings, cash generated from our operations and more recently, issuance of solar asset-backed notes in July 2015 and our initial public offering of our common stock in August 2015. Additionally, in January 2016, we entered into secured credit facilities agreements with a syndicate of banks for up to $250.0 million in committed facilities. Our principal uses of cash are funding our business, including the costs of acquisition and installation of solar energy systems, satisfaction of our obligations under our debt instruments and other working capital requirements. Our business model requires substantial outside financing arrangements to grow the business and facilitate the deployment of additional solar energy systems. The solar energy systems that are operational are expected to generate a positive return rate over the term of the Customer Agreement, typically 20 years. However, in order to grow, we are dependent on financing from outside parties. If financing is not available to us on acceptable terms if and when needed, we may be required to reduce planned spending, which could have a material adverse effect on our operations. While there can be no assurances, we anticipate raising additional required capital from new and existing investors. We believe our cash, investment fund commitments and available borrowings as further described below will be sufficient to meet our anticipated cash needs for at least the next 12 months. The following table summarizes our cash flows for the periods indicated:

	Year Ended December 31,		
	2015	2014	2013
	(in thousands)		
Consolidated cash flow data:			
Net cash provided by (used in) operating activities	$ (105,266)	$ (7,928)	$ 23,374
Net cash used in investing activities	(627,489)	(463,968)	(325,754)
Net cash provided by financing activities	784,465	524,351	312,294
	$ 51,710	$ 52,455	$ 9,914

Operating Activities

During 2015, we used $105.3 million in net cash in operating activities. The primary driver of our operating cash inflow consists of payments received from customers. During 2015, we had an increase in deferred revenue of approximately $47.7 million relating to upfront lease payments received from customers and solar energy system incentive rebate payments received from various state and local utilities. This increase was offset by our operating cash outflows of $159.3 million from our net loss excluding non-cash and non-operating items. Net changes in working capital, other than deferred revenue, resulted in an inflow of cash of $6.3 million.

During 2014, we used $7.9 million in net cash from operations. During 2014, we had an increase in deferred revenue of approximately $97.4 million relating to upfront lease payments received from customers and solar energy system incentive rebate payments received from various state and local utilities and prepayment for future deliveries of SRECs. The increase generated from deferred revenue was offset by our operating cash outflows of $103.6 million from our net loss excluding non-cash and non-operating items. Net changes in working capital, other than deferred revenue, resulted in an outflow of cash of $1.7 million.

During 2013, we generated $23.4 million in net cash from operations. During 2013, we had an increase in deferred revenue of $57.1 million relating to upfront lease payments received from customers and solar energy system incentive rebate payments received from various state and local governments. We had operating cash outflows of $31.7 million from our net loss excluding non-cash and non-operating items. Net changes in working capital, other than deferred revenue, resulted in an outflow of cash of $2.0 million.

Investing Activities

During 2015, we used $627.5 million in cash in investing activities. Of this amount, we used $594.9 million to acquire and install solar energy systems and components under our long-term Customer Agreements. We used $19.6 million to acquire the CEE business. We used $13.0 million for the acquisition of vehicles, office equipment, leasehold improvements and furniture.

During 2014, we used $464.0 million in cash in investing activities. Of this amount, we used $412.3 million to acquire and install solar energy systems and components under our long-term customer agreements. We also used $15.3 million for the acquisition of vehicles, office equipment, leasehold improvements and furniture and spent approximately $36.4 million in cash for the acquisitions of businesses, which included the backlog purchased in connection with a new installer partner relationship, as well as the MEC acquisition.

During 2013, we used $325.8 million in investing activities. Of this amount, we used $322.0 million in cash to acquire and install solar energy systems under operating leases with our customers. We also used $3.7 million in cash for the acquisition of vehicles, office equipment, leasehold improvements and furniture.

Financing Activities

During 2015, we generated $784.5 million from financing activities. We received $287.2 million in net proceeds from fund investors and $280.6 million in proceeds from debt issuances net of debt issuance costs and repayments, including the issuance and repayment of asset-backed notes. We received $222.1 million in proceeds from our initial public offering, net of offering costs. We also received $4.7 million from state grants, net of recapture, and $3.6 million from the exercise of employee stock options. Restricted cash increased by $8.8 million. We made repayments of $4.9 million on capital lease obligations.

During 2014, we generated $524.4 million in cash from financing activities. Of this amount, we received $311.7 million in net proceeds from fund investors. We also raised $143.4 million, net of transaction costs, from the issuance of convertible preferred stock. We received $64.7 million in proceeds net of debt issuance costs and repayments. We also received $2.7 million from the exercise of employee stock options and $1.6 million from state grants in 2014. Restricted cash decreased by $1.4 million. We made repayments of $1.1 million on capital lease obligations.

During 2013, we generated $312.3 million in cash from financing activities. Of this amount, we received $166.3 million in net proceeds from fund investors. We also received $142.2 million, net of debt issuance costs and repayments, from long-term borrowings. We also received $1.1 million from the exercise of employee stock options and $29.3 million from U.S. Treasury grants. We paid $22.0 million to acquire the noncontrolling interests in three investment funds. Lastly, we increased restricted cash by $4.6 million in 2013.

Debt, Equity, and Financing Fund Commitments

Debt Instruments

For a discussion of the terms and conditions of debt instruments and changes thereof in the period, refer to Note 11, *Indebtedness,* to our consolidated financial statements included elsewhere in this Annual Report on Form 10-K.

Equity Instruments

Conversion of preferred stock and issuance of additional shares and warrants.

In July 2015, we entered into a letter of intent to issue 1,250,764 warrants to purchase common stock subject to contingencies being met to the former Series D and E preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the closing of our initial public offering and waive any potential anti-dilution adjustments resulting from the issuance of shares of common stock in our initial public offering. The warrants were issued on September 30, 2015. The warrants are exercisable for three years from the date of grant and have an exercise price of $22.50 per share. The warrants are recorded at fair value as derivative liabilities and reported in other liabilities in the Company's consolidated balance sheet.

Immediately prior to closing of our initial public offering, all 54,840,767 shares of our outstanding preferred stock were automatically converted into shares of common stock.

Initial public offering. On August 10, 2015, we closed our initial public offering in which 17,900,000 shares of common stock were sold at a public offering price of $14.00 per share, resulting in net proceeds of approximately $221.3 million, after deducting underwriting discounts and commissions and $7.5 million in offering expenses payable by us, and excluding the proceeds received by the selling stockholders who sold an aggregate of 417,732 shares of the total 17,900,000 shares sold in the initial public offering.

Investment Fund Commitments

As of December 31, 2015, we had undrawn committed capital of approximately $392.0 million which may only be used to purchase and install solar energy systems. We intend to establish new investment funds in the future, and we may also use debt, equity or other financing strategies to finance our business.

Contractual Obligations and Other Commitments

The following table summarizes our contractual obligations as of December 31, 2015:

	Payments Due by Period				
	Less Than 1 Year	1 to 3 Years	3 to 5 Years	More Than 5 Years	Total
			(in thousands)		
Contractual Obligations:					
Debt obligations (including future interest)	$ 29,567	$ 279,359	$ 43,543	$ 292,751	$ 645,220
Distributions payable to noncontrolling interests and redeemable noncontrolling interests	8,144	—	—	—	8,144
Purchase of photovoltaic modules	86,039	—	—	—	86,039
Capital lease obligations (including accrued interest)	9,727	12,765	3,018	200	25,710
Operating lease obligations	7,019	12,575	3,400	53	23,047
Total contractual obligations	$ 140,496	$ 304,699	$ 49,961	$ 293,004	$ 788,160

Off-Balance Sheet Arrangements

We include in our consolidated financial statements all assets and liabilities and results of operations of investment fund arrangements that we have entered into. We do not have any off-balance sheet arrangements.

Recent Accounting Pronouncements

See Note 2, *Summary of Significant Accounting Policies*, to our consolidated financial statement included elsewhere in this Annual Report on Form 10-K

Item 7A. Quantitative and Qualitative Disclosures About Market Risk.

We are exposed to certain market risks in the ordinary course of our business. Our primary exposure includes changes in interest rates because certain borrowings bear interest at floating rates based on LIBOR plus a specified margin. We sometimes manage our interest rate exposure on floating-rate debt by entering into derivative instruments to hedge all or a portion of our interest rate exposure in certain debt facilities. We do not enter into any derivative instruments for trading or speculative purposes. Changes in economic conditions could result in higher interest rates, thereby increasing our interest expense and operating expenses and reducing funds available for capital investments, operations and other purposes. A hypothetical 10% increase in our interest rates on our variable rate debt facilities would have increased our interest expense by $0.6 million and $1.0 million for the year ended December 31, 2015 and 2014, respectively.

Item 8. Financial Statements and Supplementary Data.

INDEX TO CONSOLIDATED FINANCIAL STATEMENTS

Report of Independent Registered Public Accounting Firm

The Board of Directors and Stockholders of Sunrun Inc.

We have audited the accompanying consolidated balance sheets of Sunrun Inc. as of December 31, 2015 and 2014, and the related consolidated statements of operations, comprehensive loss, redeemable noncontrolling interests and equity, and cash flows for each of the three years in the period ended December 31, 2015. These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with the standards of the Public Company Accounting Oversight Board (United States). Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. We were not engaged to perform an audit of the Company's internal control over financial reporting. Our audits included consideration of internal control over financial reporting as a basis for designing audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion. An audit also includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the consolidated financial position of Sunrun Inc. at December 31, 2015 and 2014, and the consolidated results of its operations and its cash flows for each of the three years in the period ended December 31, 2015, in conformity with U.S. generally accepted accounting principles.

/s/ Ernst & Young LLP
San Francisco, California
March 10, 2016

Sunrun Inc.
Consolidated Balance Sheets
(In Thousands, Except Share Par Values)

	As of December 31, 2015	As of December 31, 2014
Assets		
Current assets:		
Cash	$ 203,864	$ 152,154
Restricted cash	9,203	2,534
Accounts receivable (net of allowances for doubtful accounts of $1,641 and $703 as of December 31, 2015 and December 31, 2014, respectively)	60,275	43,189
State tax credits receivable	9,198	5,183
Inventories	71,258	23,914
Prepaid expenses and other current assets	6,696	9,560
Total current assets	360,494	236,534
Restricted cash	8,094	6,012
Solar energy systems, net	1,992,021	1,484,251
Property and equipment, net	44,866	22,195
Intangible assets, net	22,705	13,111
Goodwill	87,543	51,786
Prepaid tax asset	190,146	109,381
Other assets	32,277	9,314
Total assets(1)	$ 2,738,146	$ 1,932,584
Liabilities and total equity		
Current liabilities:		
Accounts payable	$ 104,133	$ 51,166
Distributions payable to noncontrolling interests and redeemable noncontrolling interests	8,144	6,764
Accrued expenses and other liabilities	49,146	25,445
Deferred revenue, current portion	59,726	44,398
Deferred grants, current portion	13,949	13,754
Capital lease obligation, current portion	8,951	1,593
Long-term debt, current portion	2,085	2,602
Solar asset-backed notes, current portion	3,323	—
Lease pass-through financing obligation, current portion	3,710	5,161
Total current liabilities	253,167	150,883
Deferred revenue, net of current portion	559,066	467,726
Deferred grants, net of current portion	220,784	226,801
Capital lease obligation, net of current portion	15,042	5,761
Line of credit	194,975	48,597
Long-term debt, net of current portion	232,378	188,052
Solar asset-backed notes, net of current portion	105,557	—
Lease pass-through financing obligation, net of current portion	153,188	180,224
Other liabilities	7,144	2,424
Deferred tax liabilities	190,146	109,549
Total liabilities(1)	1,931,447	1,380,017
Commitments and contingencies (Note 21)		
Redeemable noncontrolling interests	147,139	135,948
Stockholders' equity:		
Convertible preferred stock, $0.0001 par value—authorized, 0 and 57,028 shares as of December 31, 2015 and 2014 respectively; issued and outstanding, 0 and 54,841 shares as of December 31, 2015 and 2014, respectively; aggregate liquidation value of $0 and $305,883 as of December 31, 2015 and 2014, respectively	—	5
Preferred stock, $0.0001 par value—authorized, 200,000 and 0 shares as of December 31, 2015 and 2014, respectively; issued and outstanding, 0 shares as of December 31, 2015 and 2014	—	—
Common stock, $0.0001 par value—authorized, 2,000,000 and 119,547 shares as of December 31, 2015 and 2014, respectively; issued and outstanding, 101,282 and 24,249 shares as of December 31, 2015 and 2014, respectively	10	2
Additional paid-in capital	642,229	383,860
Accumulated other comprehensive loss	(921)	—
Accumulated deficit	(87,249)	(59,003)
Total stockholders' equity	554,069	324,864
Noncontrolling interests	105,491	91,755
Total equity	659,560	416,619
Total liabilities, redeemable noncontrolling interests and total equity	$ 2,738,146	$ 1,932,584

(1) The Company's consolidated assets as of December 31, 2015 and 2014 include $1,363,615 and $986,878, respectively, in assets of variable interest entities, or VIEs, that can only be used to settle obligations of the VIEs. Solar energy systems, net, as of December 31, 2015 and 2014 were $1,305,420 and $942,655, respectively; cash as of December 31, 2015 and 2014 were $44,407 and $29,099, respectively; restricted cash as of December 31, 2015 and 2014 were $757 and $593, respectively; accounts receivable, net as of December 31, 2015 and 2014 were $12,965 and $14,351; respectively; prepaid expenses and other current assets as of December 31, 2015 and 2014 were $66 and $180, respectively. The Company's consolidated liabilities as of December 31, 2015 and 2014 include $540,464 and $474,348, respectively, in liabilities of VIEs whose creditors have no recourse to the Company. These liabilities include accounts payable as of December 31, 2015 and 2014 of $11,025 and $9,057, respectively; distributions payable to noncontrolling interests and redeemable noncontrolling interests as of December 31, 2015 and 2014 of $8,063 and $6,426, respectively; accrued expenses and other liabilities as of December 31, 2015 and 2014 of $175 and $340, respectively; deferred revenue as of December 31, 2015 and 2014 of $374,736 and $301,792, respectively; deferred grants as of December 31, 2015 and 2014 of $115,726 and $123,351, respectively; and long-term debt as of December 31, 2015 and 2014 of $30,739 and $33,382, respectively.

The accompanying notes are an integral part of these consolidated financial statements.

Sunrun Inc.
Consolidated Statements of Operations
(In Thousands, Except Per Share Amounts)

	Year Ended December 31,		
	2015	2014	2013
Revenue:			
Operating leases and incentives	$ 118,004	$ 84,006	$ 54,740
Solar energy systems and product sales	186,602	114,551	—
Total revenue	304,606	198,557	54,740
Operating expenses:			
Cost of operating leases and incentives	111,784	72,898	43,088
Cost of solar energy systems and product sales	168,751	100,802	—
Sales and marketing	145,477	78,723	22,395
Research and development	9,657	8,386	9,984
General and administrative	84,442	68,098	33,242
Amortization of intangible assets	3,695	2,269	—
Total operating expenses	523,806	331,176	108,709
Loss from operations	(219,200)	(132,619)	(53,969)
Interest expense, net	33,236	27,521	11,752
Loss on early extinguishment of debt	431	4,350	—
Other expenses	1,338	3,043	365
Loss before income taxes	(254,205)	(167,533)	(66,086)
Income tax benefit	(5,299)	(10,043)	(591)
Net loss	(248,906)	(157,490)	(65,495)
Net loss attributable to noncontrolling interests and redeemable noncontrolling interests	(220,660)	(86,638)	(64,294)
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Deemed dividend to convertible preferred stockholders	(24,890)	—	—
Net loss available to common stockholders	$ (53,136)	$ (70,852)	$ (1,201)
Net loss per share available to common shareholders—basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)
Weighted average shares used to compute net loss per share available to common stockholders—basic and diluted	55,091	22,795	9,780

The accompanying notes are an integral part of these consolidated financial statements.

Sunrun Inc.
Consolidated Statements of Comprehensive Loss
(In Thousands)

	Year Ended December 31,		
	2015	2014	2013
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Other comprehensive income:			
Unrealized loss on derivatives, net of tax benefit for the year ended December 31, 2015	(2,442)	—	—
Less interest expense on derivatives recognized into earnings	(1,521)	—	—
Comprehensive loss	$ (29,167)	$ (70,852)	$ (1,201)

Sunrun Inc.
Consolidated Statements of Redeemable Noncontrolling Interests and Stockholders' Equity
(In Thousands)

	Redeemable Noncontrolling Interests	Preferred Stock		Common Stock		Additional Paid-In Capital	Accumulated Other Comprehensive Loss	Accumulated Deficit	Total Shareholders' Equity	Noncontrolling Interests	Total Equity
		Shares	Amount	Shares	Amount						
Balance - January 1, 2013	$ 95,941	43,998	$ 4	9,450	$ 1	$ 152,134	$ —	$ 13,050	$ 165,189	$ 57,472	$ 222,661
Exercise of stock options	—	—	—	962	—	1,119	—	—	1,119	—	1,119
Stock-based compensation	—	—	—	—	—	2,655	—	—	2,655	—	2,655
Acquisition of noncontrolling interests	(16,906)	—	—	—	—	(5,118)	—	—	(5,118)	—	(5,118)
Income tax effect of acquisition of noncontrolling interests	—	—	—	—	—	2,339	—	—	2,339	—	2,339
Contributions from noncontrolling interests and redeemable noncontrolling interests	73,189	—	—	—	—	—	—	—	—	92,142	92,142
Distributions to noncontrolling interests and redeemable noncontrolling interests	(8,973)	—	—	—	—	—	—	—	—	(61,178)	(61,178)
Net loss	(33,586)	—	—	—	—	—	—	(1,201)	(1,201)	(30,708)	(31,909)
Balance - December 31, 2013	$ 109,665	43,998	$ 4	10,412	$ 1	$ 153,129	$ —	$ 11,849	$ 164,983	$ 57,728	$ 222,711
Conversion of Preferred Stock	—	(36)	—	36	—	—	—	—	—	—	—
Issuance of Series E convertible preferred stock, net of issuance costs of $7,108	—	10,879	1	—	—	143,392	—	—	143,393	—	143,393
Issuance of shares for an acquisition	—	—	—	12,763	1	75,280	—	—	75,281	—	75,281
Exercise of stock options	—	—	—	1,038	—	2,707	—	—	2,707	—	2,707
Stock-based compensation	—	—	—	—	—	9,352	—	—	9,352	—	9,352
Contributions from noncontrolling interests and redeemable noncontrolling interests	88,837	—	—	—	—	—	—	—	—	80,653	80,653
Distributions to noncontrolling interests and redeemable noncontrolling interests	(11,619)	—	—	—	—	—	—	—	—	(10,923)	(10,923)
Net loss	(50,935)	—	—	—	—	—	—	(70,852)	(70,852)	(35,703)	(106,555)
Balance - December 31, 2014	$ 135,948	54,841	$ 5	24,249	$ 2	$ 383,860	$ —	$ (59,003)	$ 324,864	$ 91,755	$ 416,619
Exercise of stock options	—	—	—	1,210	—	3,548	—	—	3,548	—	3,548
Issuance of restricted stock units, net of tax withholdings	—	—	—	182	—	(103)			(103)		(103)
Stock based compensation	—	—	—	—	—	16,002	—	—	16,002	—	16,002
Contributions from noncontrolling interests and redeemable noncontrolling interests	128,466	—	—	—	—	—	—	—	—	147,238	147,238
Distributions to noncontrolling interests and redeemable noncontrolling interests	(12,924)	—	—	—	—	—	—	—	—	(17,193)	(17,193)
Issuance of shares due to business acquisition	—	—	—	1,650	—	19,148	—	—	19,148	—	19,148
Inducement shares issued to Series D and E preferred stockholders	—	—	—	1,668	1	23,348	—	—	23,349	—	23,349
Deemed dividend to Series D and E convertible preferred stockholders	—	—	—		—	(24,890)	—	—	(24,890)	—	(24,890)
Conversion of convertible preferred stock to common stock	—	(54,841)	(5)	54,841	5	—	—	—	—	—	—
Issuance of common stock in connection with underwritten public offering, net of issuance costs	—	—	—	17,482	2	221,316	—	—	221,318	—	221,318
Net loss	(104,351)	—	—	—	—	—	—	(28,246)	(28,246)	(116,309)	(144,555)
Unrealized gain (loss) on derivative	—	—	—	—	—	—	(921)	—	(921)	—	(921)
	$ 147,139	—	$ —	101,282	$ 10	$ 642,229	$ (921)	$ (87,249)	$ 554,069	$ 105,491	$ 659,560

The accompanying notes are an integral part of these consolidated financial statements.

Sunrun Inc.
Consolidated Statements of Cash Flows
(In Thousands)

	Year Ended December 31, 2015	2014	2013
Operating activities:			
Net loss	$ (248,906)	$ (157,490)	$ (65,495)
Adjustments to reconcile net loss to net cash provided by (used in) operating activities:			
Noncash losses	3,516	4,350	—
Depreciation and amortization, net of amortization of deferred grants	71,373	49,541	30,192
Bad debt expense	1,998	546	172
Interest on lease pass-through financing	11,959	10,204	6,437
Noncash tax benefit	(5,299)	(10,043)	(591)
Noncash interest expense	6,997	2,384	1,551
Stock-based compensation expense	15,823	9,218	2,655
Reduction in lease pass—through financing obligations	(16,780)	(12,323)	(9,573)
Changes in operating assets and liabilities:			
Accounts receivable	(15,517)	(14,075)	(954)
Inventories	(47,344)	(3,788)	—
Prepaid and other assets	(884)	(1,920)	(2,176)
Accounts payable	50,946	11,063	1,351
Accrued expenses and other liabilities	19,168	7,010	2,734
Deferred revenue	47,684	97,395	57,071
Net cash provided by (used in) operating activities	(105,266)	(7,928)	23,374
Investing activities:			
Payments for the costs of solar energy systems, leased and to be leased	(594,887)	(412,267)	(322,034)
Purchases of property and equipment	(13,027)	(15,317)	(3,720)
Acquisitions of businesses, net of cash acquired	(19,575)	(36,384)	—
Net cash used in investing activities	(627,489)	(463,968)	(325,754)
Financing activities:			
Proceeds from grants and state tax credits, net of recapture	4,685	1,579	29,321
Proceeds from issuance of debt	544,385	192,750	148,282
Repayment of debt	(357,878)	(120,054)	(612)
Payment of debt fees	(14,798)	(7,939)	(5,493)
Proceeds from solar asset-backed notes	111,000	—	—
Repayment of solar asset-backed notes	(2,120)	—	—
Proceeds from issuance of convertible preferred stock, net of issuance costs	—	143,393	—
Proceeds from lease pass-through financing obligations	129,121	174,159	64,888
Repayment of lease pass-through financing obligations	(88,918)	—	—
Contributions received from noncontrolling interests and redeemable noncontrolling interests	275,704	169,490	165,331
Distributions paid to noncontrolling interests and redeemable noncontrolling interests	(28,737)	(31,967)	(63,907)
Acquisition of noncontrolling interests	—	(21)	(22,024)
Proceeds from exercises of stock options	3,548	2,707	1,119
Proceeds from initial public offering, net of offering costs	222,078	—	—
Payment of capital lease obligation	(4,854)	(1,181)	—
Change in restricted cash	(8,751)	1,435	(4,611)
Net cash provided by financing activities	784,465	524,351	312,294
Net increase in cash	51,710	52,455	9,914
Cash, beginning of period	152,154	99,699	89,785
Cash, end of period	$ 203,864	$ 152,154	$ 99,699
Supplemental disclosures of cash flow information			
Cash paid for interest	$ 11,954	$ 11,101	$ 3,657
Supplemental disclosures of noncash investing and financing activities			
Costs of solar energy systems and property and equipment included in accounts payable and accrued expenses	$ 15,850	$ 14,074	$ 14,469
Distributions payable to noncontrolling interests and redeemable noncontrolling interests	$ 8,144	$ 6,764	$ 16,189
Vehicles acquired under capital leases	$ 21,556	$ 5,666	$ —
Noncash purchase consideration on acquisition of business	$ 18,718	$ 76,964	$ —
Deemed dividend on Series D and E preferred shares	$ 24,890	$ —	$ —
Offering costs prepaid in prior year	$ 760	$ —	$ —

The accompanying notes are an integral part of these consolidated financial statements.

Sunrun Inc.
Notes to Consolidated Financial Statements

Note 1. Organization

Sunrun Inc. ("Sunrun" or the "Company") was originally formed in 2007 as a California limited liability company, and was converted into a Delaware corporation in 2008. The Company is engaged in the design, development, installation sale, ownership, and maintenance of residential solar energy systems ("Projects") in the United States.

Sunrun acquires customers directly and through relationships with various solar and strategic partners ("Partners"). The Projects are constructed either by Sunrun or by Sunrun's Partners and are owned by the Company. Sunrun's customers enter into a power purchase agreement ("PPA") or a lease (each, a "Customer Agreement") which typically has a term of 20 years. Sunrun monitors, maintains and insures the Projects. As a result of the acquisition of Mainstream Energy Corporation, its fulfillment business AEE Solar and its racking business SnapNrack (collectively, "MEC") completed in February 2014, the Company also sells solar energy systems and products to customers.

The Company has formed various subsidiaries ("Funds") to finance the development of Projects. These Funds, structured as limited liability companies, obtain financing from outside investors and purchase or lease Projects from Sunrun under master purchase or master lease agreements. The Company currently utilizes three legal structures in its investment Funds, which are referred to as: (i) lease pass-throughs, (ii) partnership-flips and (iii) joint venture ("JV") inverted leases.

Sunrun acquired Clean Energy Experts, LLC ("CEE"), a consumer demand and solar lead generation company, in April 2015, to support the growth of the business, including reducing costs of obtaining customer leads externally. As a result of acquisition, the Company also sells a portion of solar leads generated to customers.

The Company completed its initial public offering in August 2015 and its common stock is listed on the NASDAQ Global Select Market under the symbol "RUN".

Note 2. Summary of Significant Accounting Policies

Basis of Presentation and Principles of Consolidation

The consolidated financial statements have been prepared in conformity with U.S. generally accepted accounting principles ("GAAP") and reflect the accounts and operations of the Company and those of its subsidiaries, including Funds, in which the Company has a controlling financial interest. The typical condition for a controlling financial interest ownership is holding a majority of the voting interests of an entity. However, a controlling financial interest may also exist in entities, such as variable interest entities ("VIEs"), through arrangements that do not involve controlling financial interests. In accordance with the provisions of Financial Accounting Standards Board ("FASB") Accounting Standards Codification Topic 810 ("ASC 810") Consolidation, the Company consolidates any VIE of which it is the primary beneficiary. The primary beneficiary, as defined in ASC 810, is the party that has (1) the power to direct the activities of a VIE that most significantly impact the VIE's economic performance and (2) the obligation to absorb the losses of the VIE or the right to receive benefits from the VIE that could potentially be significant to the VIE. The Company evaluates its relationships with its VIEs on an ongoing basis to determine whether it continues to be the primary beneficiary. The consolidated financial statements reflect the assets and liabilities of VIEs that are consolidated. All intercompany transactions and balances have been eliminated in consolidation.

Reclassifications

Certain prior period amounts have been reclassified to conform to current period presentation.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Use of Estimates

The preparation of the consolidated financial statements requires management to make estimates and assumptions that affect the amounts reported in the consolidated financial statements and accompanying notes. The Company regularly makes significant estimates and assumptions, including, but not limited to, the estimates that affect the collectability of accounts receivable, the valuation of inventories, the useful lives and estimated residual values of solar energy systems, the useful lives of property and equipment, the valuation and useful lives of intangible assets, the fair value of assets acquired and liabilities assumed in business combinations, the effective interest rate used to amortize lease pass-through financing obligations, the valuation of stock-based compensation, the valuation of the Company's common stock, the determination of valuation allowances associated with deferred tax assets, fair value of debt instruments disclosed and the redemption value of redeemable noncontrolling interests. The Company bases its estimates on historical experience and on various other assumptions believed to be reasonable. Actual results may differ from such estimates.

Segment Information

The Company has one operating segment with one business activity, providing solar energy services and products to customers. The Company's chief operating decision maker ("CODM") is its Chief Executive Officer, who manages operations on a consolidated basis for purposes of allocating resources. When evaluating performance and allocating resources, the CODM reviews financial information presented on a consolidated basis.

Revenues from external customers for each group of similar products and services are as follows (in thousands):

	Year Ended December 31,		
	2015	2014	2013
Operating leases	$ 86,332	$ 63,962	$ 44,249
Incentives	31,672	20,044	10,491
Operating leases and incentives	118,004	84,006	54,740
Solar energy systems	50,191	23,687	—
Products	136,411	90,864	—
Solar energy systems and product sales	186,602	114,551	—
Total revenue	$ 304,606	$ 198,557	$ 54,740

Cash

Cash consists of bank deposits held in checking and savings accounts. The Company considers all highly liquid investments purchased with an original maturity of three months or less to be cash equivalents. The Company has exposure to credit risk to the extent cash balances exceed amounts covered by federal deposit insurance. The Company believes that its credit risk is not significant.

Restricted Cash

Restricted cash represents balances collateralizing standby letters of credit, amounts related to replacement of solar energy systems and obligations under certain financing transactions.

Accounts Receivable

Accounts receivable consist of amounts due from customers as well as state and utility rebates due from government agencies and utility companies. Under arrangements with customers, the customers typically assign incentive rebates to the Company.

Accounts receivable are recorded at net realizable value. The Company maintains allowances for the applicable portion of receivables when collection becomes doubtful. The Company estimates anticipated losses from doubtful accounts based upon the expected collectability of all accounts receivables, which takes into account the number of days past due, collection history, identification of specific customer exposure, and current economic trends. Once a receivable is deemed to be uncollectible, it is written off. In 2015, 2014 and 2013, the Company recorded provision for bad debt expense of $2.0 million, $0.5 million and $0.2 million, respectively, and wrote-off uncollectible receivables of $1.1 million, $0.1 million and $0.0 million, respectively.

Accounts receivable, net consists of the following (in thousands):

	December 31,	
	2015	2014
Customer receivables	$ 46,169	$ 24,477
Customer deposits	10,150	11,135
Other receivables	4,376	5,936
Rebates receivable	1,221	2,344
Allowance for doubtful accounts	(1,641)	(703)
Total	$ 60,275	$ 43,189

State Tax Credits Receivable

State tax credits receivable are recognized upon submission of the state income tax return.

Inventories

Inventories are stated at the lower of cost or market on a first-in, first-out basis. Inventories consist of raw materials such as photovoltaic panels, inverters and mounting hardware as well as miscellaneous electrical components that are sold as-is by the distribution operations and used in installations and work-in-process. Work-in-process primarily relates to solar energy systems that will be sold to customers, which are partially installed and have yet to pass inspection by the responsible city or utility department. For solar energy systems where the Company performs the installation, the Company commences transferring component parts from inventories to construction in progress, a component of solar energy systems, once a lease contract with a lease customer has been executed and the component parts have been assigned to a specific project. Additional costs incurred including labor and overhead are recorded within construction in progress.

The Company periodically reviews inventories for unusable and obsolete items based on assumptions about future demand and market conditions. Based on this evaluation, provisions are made to write inventories down to their market value.

Solar Energy Systems, net

The Company records solar energy systems leased to customers and solar energy systems that are under installation as solar energy systems, net on its consolidated balance sheet. Solar energy systems, net is comprised of system equipment costs and initial direct costs related to solar energy systems, less accumulated depreciation and amortization. Depreciation on solar energy systems is calculated on a straight-line basis to their estimated residual values over the estimated useful lives of the systems to the Company, which is the expected holding period of typically 20 years, coinciding with the initial lease term

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

of the Company's Customer Agreements. The Company has determined that it is more likely that the customer will elect to purchase the solar energy system at the end of the initial lease period rather than renew their customer agreement, due to the cost of purchasing the solar energy system being significantly lower than it was at the initiation of the customer agreement, in order to reduce electricity costs, as well as increase the value and marketing attributes of their home. If a customer elects to renew their lease at the end of the initial lease term, the residual value will be depreciated over a revised estimated remaining useful life to the Company. The Company periodically reviews its estimates of residual value and its estimated useful life and recognizes changes in estimates by prospectively adjusting depreciation expense. Inverters are depreciated over their estimated useful life of 10 years.

Solar energy systems under installation will be depreciated as solar energy systems leased to customers when the respective systems are completed and interconnected.

Initial direct costs from the origination of Customer Agreements are capitalized and amortized over the initial term of the related Customer Agreement and are included within solar energy systems, net in the consolidated balance sheets. Amortization of these costs is recorded in cost of operating leases and incentives in the accompanying consolidated statements of operations.

Property and Equipment, net

Property and equipment, net consists of leasehold improvements, furniture, computer hardware and software, machinery and equipment, and automobiles. All property and equipment are stated at historical cost net of accumulated depreciation. Repairs and maintenance are expensed as incurred.

Property and equipment is depreciated on a straight-line basis over the following periods:

Leasehold improvements	Lesser of estimated useful life of the asset or lease term, which is typically 2 to 6 years
Furniture	5 years
Computer hardware and software	3 years
Machinery and equipment	5-7 years
Automobiles	4-5 years

Capitalization of Software Costs

For costs incurred in the development of internal use software, the Company capitalizes costs incurred during the application development stage. Costs related to preliminary project activities and post implementation activities are expensed as incurred. Internal use software is amortized on a straight-line basis over its estimated useful life.

Intangible Assets, net

Finite-lived intangible assets are initially recorded at fair value and presented net of accumulated amortization. Intangible assets are amortized on a straight-line basis over their estimated useful lives as follows:

Customer relationships	6-10 years
Backlog	1 year
Developed technology	5 years
Trade names	4 months to 5 years

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Impairment of Long-Lived Assets

The carrying amounts of the Company's long-lived assets, including solar energy systems and intangible assets subject to depreciation and amortization, are periodically reviewed for impairment whenever events or changes in circumstances indicate that the carrying value of these assets may not be recoverable or that the useful life is shorter than originally estimated. Factors that are considered in deciding when to perform an impairment review would include significant negative industry or economic trends and significant changes or planned changes in the use of the assets. Recoverability of these assets is measured by comparison of the carrying amount of each asset to the future undiscounted cash flows the asset is expected to generate over its remaining life. If the asset is considered to be impaired, the amount of any impairment is measured as the difference between the carrying value and the fair value of the impaired asset. If the useful life is shorter than originally estimated, the Company amortizes the remaining carrying value over the new shorter useful life. No impairment of long-lived assets has been recorded for the years ended December 31, 2015, 2014 and 2013.

Business Combinations

Acquisitions of entities and certain solar projects with the associated leases that meet the definition of a business are accounted for as business combinations in accordance with ASC 805, *Business Combinations*. The Company records assets acquired and liabilities assumed based on their estimated fair values at the acquisition date. The excess of the purchase price over those fair values is recorded as goodwill. Acquisition-related expenses are expensed as incurred.

Goodwill

Goodwill represents the excess of the purchase price over the fair value of assets acquired and liabilities assumed of MEC in February 2014 and CEE in April 2015. Goodwill is reviewed for impairment at least annually or whenever events or changes in circumstances indicate that the carrying amount may be impaired. The Company has determined that it operates as one reporting unit and the Company's goodwill is recorded at the enterprise level. The Company performs its annual impairment test of goodwill on October 1 of each fiscal year or whenever events or circumstances change or occur that would indicate that goodwill might be impaired. When assessing goodwill for impairment, the Company uses qualitative and if necessary, quantitative methods in accordance with FASB ASC Topic 350 ("ASC 350"), *Goodwill*. The Company also considers its enterprise value and if necessary, discounted cash flow model, which involves assumptions and estimates, including the Company's future financial performance, weighted-average cost of capital and interpretation of currently enacted tax laws.

Circumstances that could indicate impairment and require the Company to perform a quantitative impairment test include a significant decline in the Company's financial results, a significant decline in the Company's enterprise value relative to its net book value, an unanticipated change in competition or the Company's market share and a significant change in the Company's strategic plans. The Company did not note any indicators of impairment in the qualitative assessment that would require a quantitative analysis in 2015. The Company did not have any goodwill prior to 2014, and no impairment charges have been recorded to date.

Deferred Revenue

Deferred revenue consists of amounts for which the criteria for revenue recognition have not yet been met and includes a) amounts that are collected from customers, including upfront deposits and lease prepayments; b) rebates and incentives received and receivables from utility companies and various local and state government agencies; c) amounts related to investment tax credits ("ITC") that the Company monetized in connection with its lease-pass through financing obligations; and d) amounts received related to the sales of solar renewable energy credits ("SRECs").

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Deferred revenue consists of the following (in thousands):

	December 31,	
	2015	2014
Customer payments	$ 370,754	$ 311,193
Rebates and incentives	102,827	101,318
ITCs	126,853	85,767
SRECs	18,358	13,846
Total	$ 618,792	$ 512,124

Deferred Grants

Deferred grants consist of U.S. Treasury grants and State Grants. The Company applied for a renewable energy technologies income tax credit offered by one of the states in the form of a cash payment and deferred the tax credit as a grant on the consolidated balance sheets. The Company initially recorded the grants as deferred grant income and recognizes the benefit on a straight-line basis over the estimated depreciable life of the associated assets as a reduction in cost of operating leases and incentives.

Warranty Accrual

The Company provides warranty service and replacement on the majority of all solar energy systems sold and installed. The major components are generally covered under a manufacturer's limited warranty.

In resolving claims under warranty services, the Company has the option of remedying the defect to the warranted level through repair, refurbishment, or replacement. The warranty accrual is estimated and is re-evaluated regularly by management based upon the Company's warranty policy, applicable contractual warranty obligations, an analysis of historical costs and age of installed systems and management's evaluation of current claims in process. The warranty accrual is recorded as a component of accrued expenses and other liabilities in the Company's consolidated balance sheets. Prior to the Company's acquisition of the residential business from MEC in February 2014, no warranty accrual was necessary. The Company recorded a warranty accrual of $1.1 million and $0.9 million as of December 31, 2015 and 2014, respectively.

Solar Energy Performance Guarantees

The Company guarantees to customers certain specified minimum solar energy production output for solar facilities over the initial term of the Customer Agreements. The Company monitors the solar energy systems to determine whether these specified minimum outputs are being achieved. If the Company determines that the guaranteed minimum energy output is not achieved, it records a liability for the estimated amounts payable. As of December 31, 2015 and 2014, the Company recorded liabilities of $0.3 million and $0.4 million, respectively, as accrued expenses and other liabilities in the consolidated balance sheets relating to these guarantees based on the Company's assessment of its exposure.

Derivative Financial Instruments

The Company recognizes all derivative instruments on the balance sheet at their fair value. Changes in the fair value of derivatives are recorded each period in current earnings or other comprehensive loss if a derivative is designated as part of a hedge transaction. The ineffective portion of the hedge, if any, is immediately recognized in earnings.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Beginning in 2015, the Company uses derivative financial instruments, primarily interest rate swaps, to manage its exposure to interest rate risks on its syndicated term loans, which are recognized on the balance sheet at their fair values. On the date that the Company enters into a derivative contract, the Company formally documents all relationships between the hedging instruments and the hedged items, as well as its risk management objective and strategy for undertaking each hedge transaction. Derivative instruments designated in a hedge relationship to mitigate exposure to variability in expected future cash flows, or other types of forecasted transactions, are considered cash flow hedges. Cash flow hedges are accounted for by recording the fair value of the derivative instrument on the balance sheet as either a freestanding asset or liability. Changes in the fair value of a derivative that is designated and qualifies as an effective cash flow hedge are recorded in accumulated other comprehensive loss, net of tax, until earnings are affected by the variability of cash flows of the hedged item. Any derivative gains and losses that are not effective in hedging the variability of expected cash flows of the hedged item or that do not qualify for hedge accounting treatment are recognized directly into income. At the hedge's inception and at least quarterly thereafter, a formal assessment is performed to determine whether changes in cash flows of the derivative instrument have been highly effective in offsetting changes in the cash flows of the hedged items and whether they are expected to be highly effective in the future. The Company discontinues hedge accounting prospectively when (i) it determines that the derivative is no longer effective in offsetting changes in the cash flows of a hedged item; (ii) the derivative expires or is sold, terminated, or exercised; or (iii) management determines that designating the derivative as a hedging instrument is no longer appropriate. In all situations in which hedge accounting is discontinued and the derivative remains outstanding, the derivative instrument is carried at its fair market value on the balance sheet with the changes in fair value recognized in current-period earnings. The remaining balance in accumulated other comprehensive loss associated with the derivative that has been discontinued is not recognized in the income statement unless it is probable that the forecasted transaction will not occur. Such amounts are recognized in earnings when earnings are affected by the hedged transaction.

The Company recognized warrants with former preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the Company's initial public offering as derivative liabilities. Such liabilities were valued when the financial instruments were initially issued, with the change in their respective fair values recorded as a gain or loss on revaluation within other expenses in the Company's statement of operations. The Company determines the fair value of its warrant derivative liabilities using the Black-Scholes option-pricing model.

Fair Value of Financial Instruments

The Company defines fair value as the exchange price that would be received for an asset or an exit price that would be paid to transfer a liability in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants on the measurement date. The Company uses valuation techniques to measure fair value that maximize the use of observable inputs and minimize the use of unobservable inputs. FASB establishes a three-tier fair value hierarchy for disclosure of fair value measurements as follows:

- Level 1—Inputs are unadjusted, quoted prices in active markets for identical assets or liabilities at the measurement date;
- Level 2—Inputs are observable, unadjusted quoted prices in active markets for similar assets or liabilities, unadjusted quoted prices for identical or similar assets or liabilities in markets that are not active, or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the related assets or liabilities; and
- Level 3—Inputs that are unobservable, significant to the measurement of the fair value of the assets or liabilities and are supported by little or no market data.

The Company's financial instruments include cash, receivables, accounts payable, accrued expenses, distributions payable to noncontrolling interests, derivatives, borrowings on the line of credit, long-term debt and solar asset-backed notes.

Revenue Recognition

The Company recognizes revenue when (i) persuasive evidence of an arrangement exists, (ii) delivery has occurred or services have been rendered, (iii) the sales price is fixed and determinable, and (iv) collection of the related receivable is reasonably assured.

Operating leases and incentives

Operating leases and incentives revenue is primarily comprised of revenue from customer agreements, revenue from solar energy system rebate incentives, revenue associated with ITCs assigned to investment funds that are classified as lease pass-through arrangements and revenue from the sales of SRECs generated by the Company's solar energy systems to third parties.

The Company begins to recognize revenue on Customer Agreements when permission to operate ("PTO") is given by the local utility company or on the date daily operation commences if utility approval is not required. The Company recognizes revenue on a straight-line basis over the initial term of the Customer Agreements (typically 20 years) that have minimum lease payments, or as earned when the customers are billed based on the actual electricity generated at a specific rate under the terms of the Customer Agreements.

The Company considers upfront rebate incentives received from states and utilities for solar energy systems subject to Customer Agreements to be minimum lease payments. Rebate revenue is recognized on a straight-line basis over the life of the initial contract term of the Customer Agreement beginning when a PTO letter is issued by the local utility company or on the date daily operation commences if utility approval is not required.

The Company monetizes the ITCs associated with the leased systems on its lease pass-through financing obligations by assigning them to the investor together with the future customer lease payments. A portion of the cash consideration received from the investors is allocated to the estimated fair value of the assigned ITCs. The estimated fair value of the ITCs is determined by applying the expected internal rate of return to the investor on this structure to the gross amount of the ITCs that may be claimed by the investor.

The ITCs are subject to recapture under the Internal Revenue Code ("Code") if the underlying solar energy system either ceases to be a qualifying property or undergoes a change in ownership within five years of its placed in service date. The recapture amount decreases by 20% on each anniversary of the PTO date. As the Company has an obligation to ensure the solar energy systems is in service and operational for a term of five years to avoid any recapture of the ITCs, the Company recognizes revenue as the recapture provisions lapse assuming the other aforementioned revenue recognition criteria have been met. The monetized ITCs are initially recorded within deferred revenue on the consolidated balance sheets, and subsequently, one-fifth of the monetized ITCs are recognized as revenue in the consolidated statements of operations on each anniversary of the solar energy systems' PTO date over the following five years.

SREC revenue arises from the sale of environmental credits generated by solar energy systems. SREC revenue is recorded in operating leases and incentives revenue. We recognize revenue related to the sale of SRECs to the extent the cumulative value of delivered SRECs per contract exceeds any possible liquidated damages for non-delivery, if any.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

The Company has determined that Customer Agreements are operating leases as opposed to capital leases pursuant to ASC 840, *Leases*. Management estimates the estimated useful life of solar energy systems to be 20 years, which coincides with the expected holding period and initial lease term of 20 years, as discussed in Note 2, *Summary of Significant Accounting Policies*, above. However, since the estimated economic life of solar energy systems is estimated to be at least 30 years, the lease term is less than 75% of its estimated economic life. Additionally, the Company evaluated the following lease classification criteria: (i) whether there is a transfer of ownership or bargain purchase option at the end of the lease and (ii) whether the present value of minimum lease payments exceeds 90% of the fair value at lease inception and determined that these criteria were not met.

Solar energy systems and product sales

For solar energy systems sold to customers, the Company recognizes revenue when the solar energy system passes inspection by the authority having jurisdiction, provided all other revenue recognition criteria have been met. The Company's installation projects are typically completed in a short period of time.

Product sales consist of solar panels, racking systems, inverters, other solar energy products sold to resellers and customer leads. Product sales revenue is recognized at the time when title is transferred, generally upon shipment. Shipping and handling fees charged to customers are included in net sales. Total shipping and handling fees charged to customers were $2.6 million and $2.4 million for the year ended December 31, 2015 and 2014, respectively. Volume discounts given to customers are recorded as a reduction of revenue, since the Company does not receive goods or services in exchange for the discounts offered. Customer lead revenue, included in product sales, is recognized at the time the lead is delivered.

Taxes assessed by government authorities that are directly imposed on revenue producing transactions are excluded from product revenue.

Cost of Revenue

Operating leases and incentives

Cost of revenue for operating leases and incentives is primarily comprised of the (1) depreciation of the cost of the solar energy systems, as reduced by amortization of U.S. Treasury grants, (2) amortization of initial direct costs, (3) lease operations, monitoring and maintenance costs including associated personnel costs, and (4) allocated corporate overhead costs.

Solar energy systems and product sales

Cost of revenue for solar energy systems and non-lead generation product sales consist of direct and indirect material and labor costs for solar energy systems installations and product sales. Also included are engineering and design costs, estimated warranty costs, freight costs, allocated corporate overhead costs, vehicle depreciation costs and personnel costs associated with supply chain, logistics, operations management, safety and quality control. Cost of revenue for lead generations consists of costs related to direct-response advertising activities associated with generating customer leads.

Research and Development Expense

Research and development expenses include personnel costs, allocated overhead costs, and other costs related to the development of the Company's BrightPath software suite as well as its racking equipment.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Advertising Costs

Advertising costs are expensed as incurred in the consolidated statements of operations. The Company incurred advertising costs of $34.8 million, $16.9 million and $7.7 million for the years ended December 31, 2015, 2014 and 2013, respectively.

Stock-Based Compensation

The Company grants stock-based compensation for its equity incentive plan and employee stock purchase plan. Stock-based compensation to employees is measured based on the grant date fair value of the awards and recognized over the period during which the employee is required to perform services in exchange for the award (generally the vesting period of the award). The Company estimates the fair value of stock based awards granted using the Black-Scholes option-valuation model. Compensation cost is recognized over the vesting period of the applicable award using the straight-line method for those options expected to vest.

The Company also grants restricted stock units ("RSUs") to non-employees that vest upon the satisfaction of both performance and service conditions. The Company starts recognizing expense on the RSUs when the performance condition is met.

Noncontrolling Interests and Redeemable Noncontrolling Interests

Noncontrolling interests represent investors' interests in the net assets of the Funds that the Company has created to finance the cost of its solar energy systems subject to the Company's Customer Agreements. The Company has determined that the contractual provisions in the funding arrangements represent substantive profit sharing arrangements. The Company has further determined that the appropriate methodology for attributing income and loss to the noncontrolling interests and redeemable noncontrolling interests each period is a balance sheet approach referred to as the hypothetical liquidation at book value ("HLBV") method.

Under the HLBV method, the amounts of income and loss attributed to the noncontrolling interests and redeemable noncontrolling interests in the consolidated statements of operations reflect changes in the amounts the investors would hypothetically receive at each balance sheet date under the liquidation provisions of the contractual agreements of these arrangements, assuming the net assets of these Funding structures were liquidated at recorded amounts. The Company's initial calculation of the investor's noncontrolling interest in the results of operations of these Funding arrangements is determined as the difference in the noncontrolling interests' claim under the HLBV method at the start and end of each reporting period, after taking into account any capital transactions, such as contributions or distributions, between the Fund and the investors.

The Company classifies certain noncontrolling interests with redemption features that are not solely within the control of the Company outside of permanent equity on its consolidated balance sheets. Redeemable noncontrolling interests are reported using the greater of their carrying value as determined by the HLBV method or their estimated redemption value at each reporting date.

Income Taxes

During November 2015, the FASB issued ASU 2015-17, *Balance Sheet Classification of Deferred Taxes*, which simplifies the presentation of deferred income taxes. ASU 2015-17 provides presentation requirements to classify deferred tax assets and liabilities as noncurrent in a classified statement of financial position. The standard is effective for fiscal years beginning after December 15, 2016, including interim periods within that reporting period. Early adoption is permitted for any interim and annual financial statements that have not yet been issued. We early adopted ASU 2015-17 effective December 31, 2015, retrospectively. Adoption resulted $3.0 million decrease in deferred tax assets, current and a $3.0 million decrease in deferred tax liabilities in our Consolidated Balance Sheets at December 31, 2014. Adoption had no impact on our results of operations.

The Company recognizes deferred tax assets and liabilities for the expected future tax consequences of events that have been included in the consolidated financial statements and tax returns. Under this method, deferred tax assets and liabilities are determined based on the difference between the financial statement and tax basis of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse. Valuation allowances are provided against deferred tax assets to the extent that it is more likely than not that the deferred tax asset will not be realized. The Company is subject to the provisions of ASC 740, *Income Taxes*, which establishes consistent thresholds as it relates to accounting for income taxes. It defines the threshold for recognizing the benefits of tax return positions in the financial statements as "more likely than not" to be sustained by the taxing authority and requires measurement of a tax position meeting the more-likely-than-not criterion, based on the largest benefit that is more than 50% likely to be realized. Management has analyzed the Company's inventory of tax positions with respect to all applicable income tax issues for all open tax years (in each respective jurisdiction).

The Company sells solar energy systems to the Funds. As the Funds are consolidated by the Company, the gain on the sale of the solar energy systems is not recognized in the consolidated financial statements. However, this gain is recognized for tax reporting purposes. Since these transactions are intercompany sales, any tax expense incurred related to these intercompany sales is deferred and recorded as a prepaid tax asset and amortized over the depreciable life of the underlying solar energy systems which has been estimated to be 20 years in accordance with ASC Topic 810.

The Company files tax returns as prescribed by the tax laws of the jurisdictions in which it operates. In the normal course of business, the Company is subject to examination by federal, state and local jurisdictions, where applicable. The statute of limitations for the tax returns varies by jurisdiction.

Concentrations of Credit and Supplier Risk

Financial instruments which potentially subject the Company to concentrations of credit risk consist primarily of cash and accounts receivable, which includes rebates receivable. The associated risk of concentration for cash is mitigated by banking with institutions with high credit ratings. At certain times, amounts on deposit exceed Federal Deposit Insurance Corporation insurance limits. The Company does not require collateral or other security to support accounts receivable. To reduce credit risk, management performs periodic credit evaluations and ongoing evaluations of its customers' financial condition. Rebates receivable are due from various states and local governments as well as various utility companies. The Company considers the collectability risk of such amounts to be low. The Company is not dependent on any single customer or installer. The loss of a customer or an installer would not adversely impact the Company's operating results or financial position. The Company's customers under Customer Agreements are primarily located in California, Hawaii, Maryland, Massachusetts, New Jersey and New York. During the year ended December 31, 2015 and 2014, the solar materials purchases from the top five suppliers were approximately $160.5 million and $69.1 million, respectively.

Recently Issued Accounting Standards

In May 2014, the FASB issued Accounting Standards Update ("ASU") No. 2014-09 *Revenue from Contracts with Customers* (Topic 606), to replace the existing revenue recognition criteria for contracts with customers and to establish the disclosure requirements for revenue from contracts with customers. The core principle of this standard is to recognize revenue when promised goods or services are transferred to customers in an amount that reflects the consideration that is expected to be received for those goods or services. This ASU is effective for the Company for Annual Reporting periods beginning after December 15, 2017 including the interim reporting periods within that fiscal year, and early adoption is permitted. Adoption of the ASU is either retrospective to each prior period presented or retrospective with a cumulative adjustment to retained earnings or accumulated deficit as of the adoption date. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

In November 2014, the FASB issued ASU 2014-16 *Determining Whether the Host Contract in a Hybrid Financial Instrument Issued in the Form of a Share is More Akin to Debt or to Equity.* This guidance requires issuers and investors to consider all of a hybrid instrument's stated and implied substantive terms and features, including any embedded derivative features being evaluated for bifurcation. The guidance eliminates the "chameleon approach", under which all embedded features except the feature being analyzed are considered. The guidance is effective for the year beginning after December 15, 2015 and for interim periods within fiscal years beginning after December 15, 2016. Early adoption is permitted. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In November 2014, the FASB issued ASU 2014-15, *Disclosure of Uncertainties About an Entity's Ability to Continue as a Going Concern*, which provides guidance on determining when and how to disclose going-concern uncertainties in the financial statements. The new standard requires management to perform interim and annual assessments of an entity's ability to continue as a going concern within one year of the date of issuance of the entity's financial statements and provide certain disclosures when there is substantial doubt about the entity's ability to continue as a going concern. This guidance applies to all entities and is effective for annual periods beginning after December 15, 2016, and interim periods thereafter, with early adoption permitted. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In February 2015, the FASB issued ASU 2015-02 *Amendments to the Consolidation Analysis*, which provides consolidation guidance and changes the way reporting enterprises evaluate consolidation for limited partnerships, investment companies and similar entities, as well as variable interest entities. The ASU is effective for annual and interim periods in fiscal years beginning after December 15, 2015. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In April 2015, the FASB issued ASU 2015-03, *Interest—Imputation of Interest (Subtopic 835-30) Simplifying the Presentation of Debt Issuance Costs*, to simplify the presentation of debt issuance costs. In August 2015, the FASB issued ASU 2015-15, *Interest—Imputation of Interest (Subtopic 835-30) Presentation and Subsequent Measurement of Debt Issuance Costs Associated with Line-of-Credit Arrangement.* Prior to ASU 2015-03 and ASU 2015-15, issuance costs were presented as an asset on the balance sheet. Under ASU 2015-03 and ASU 2015-15, debt issuance costs related to a recognized debt liability are required to be presented in the balance sheet as a direct deduction from the carrying amount of that debt liability, consistent with debt discounts. ASU 2015-15 clarified that the SEC will not object to an entity presenting the cost of securing a revolving line of credit as an asset regardless of whether a balance is outstanding. The recognition and measurement guidance for debt issuance costs are not affected by the amendments in these updates. The ASUs are effective for annual and interim periods in fiscal years beginning after December 15, 2015 and interim periods within those fiscal years. The effect on the Company's consolidated balance sheet for the year ended December 31, 2015 will be to reclassify $3.6 million in debt issuance costs from assets to a reduction in liabilities.

In July 2015, the FASB issued ASU No. 2015-11, *Simplifying the Measurement of Inventory*, to specify that inventory should be subsequently measured at the lower of cost or net realizable value, which is the ordinary selling price less any completion, transportation and disposal costs. However, the ASU does not apply to inventory measured using the last-in-first-out or retail methods. The ASU is effective for interim and annual periods beginning after December 15, 2016. Adoption of the ASU is prospective. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

In February 2016, the FASB issued ASU No. 2016-02, *Leases*. Under the new guidance, lessees will be required to recognize for all leases (with the exception of short-term leases) a lease liability, which is a lessee's obligation to make lease payments arising from a lease, measured on a discounted basis and a right-of-use asset, which is an asset that represents the lessee's right to use, or control the use of, a specified asset for the lease term. The ASU is effective for fiscal years beginning after December 15, 2018 and interim periods within those fiscal years. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

Note 3. Acquisitions

Acquisition of Residential Business

In February 2014, the Company acquired the residential business of MEC pursuant to an Agreement and Plan of Merger dated January 19, 2014. The residential business acquired engages in designing, installing and selling solar energy systems to residential customers, wholesale distributions as well as assembling of mounting systems and hardware for solar energy systems.

The purchase consideration for the assets acquired and liabilities assumed was approximately $78.8 million consisting of $75.0 million in the issuance of 12,762,894 shares of common stock, $1.8 million in cash, $1.8 million in settlement of balances under a pre-existing relationship and $0.2 million in the form of 576,878 stock options. The settlement of the pre-existing relationship was related to the partner installation agreement between the Company and MEC, which existed prior to the acquisition date.

The Company has included the results of operations of the acquired business in the consolidated statements of operations from the acquisition date. The assets acquired and liabilities assumed in the MEC acquisition have been recorded based on their fair value at the acquisition date. Goodwill represents the excess of the purchase price over the net tangible and intangible assets acquired and is not deductible for tax purposes. Goodwill recorded is primarily attributable to the acquired assembled workforce and the synergies expected to arise after the acquisition of the residential business, such as lowering the Company's overall cost of the Company's solar energy systems by enabling it to procure and build some of the solar energy systems themselves, ensuring access to MEC installation capacity, and scaling the Company's growth by adding direct-to-consumer sales and installation activities. In addition, the Company is able to provide customers the option to purchase solar energy systems outright, as compared to offering leasing and PPA options. Transaction costs related to the acquisition were expensed as incurred.

The following table summarizes the fair value of assets acquired and liabilities assumed (in thousands):

Cash	$	5,440
Accounts receivable		8,881
Inventory		23,886
Prepaid expenses		2,028
Property and equipment		6,113
Intangible assets		15,380
Other long-term assets		200
Accounts payable and accrued liabilities		(24,975)
Deferred revenue		(768)
Capital lease obligation		(2,869)
Other liabilities		(1,509)
Deferred tax liabilities		(4,843)
Indentifiable assets and liabilities assumed		26,964
Goodwill		51,786
Total	$	78,750

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

In 2014, the contribution of the acquired business to the Company's total revenues was $114.2 million as measured from the date of the acquisition. The portion of total expenses and net income associated with the acquired business was not separately identifiable due to the integration with the Company's operations.

Unaudited Pro Forma Information

The following table summarizes the unaudited pro forma total revenue and net loss of the combined company for the years ended December 31, 2014 and 2013 assuming that the acquisition occurred as of January 1, 2013 (in thousands, except per share):

	For the year ended December 31,	
	2014	2013
Revenue	$ 205,355	$ 143,614
Net loss	(164,974)	(88,326)
Net loss attributable to common stockholders	(78,336)	(24,032)
Net loss per share attributable to common stockholders, basic and diluted	(3.44)	(1.07)

The pro forma financial information is based on the combined results of operations of MEC and the Company with adjustments for MEC's sales to the Company, the amortization of the acquired intangibles assets and the timing of acquisition expenses. The pro forma financial information is not necessarily indicative of the actual consolidated results of operations in prior or future periods had the acquisition actually been consummated on January 1, 2013.

Clean Energy Experts, LLC

In April 2015, the Company acquired Clean Energy Experts, LLC, a consumer demand and solar lead generation company, for $25.0 million in cash and 1.9 million shares of common stock valued at $19.1 million, net of settlement of a preexisting payable to CEE. Of this amount, $15.0 million in cash was paid and 1.4 million shares were issued in April 2015. The remaining $10.0 million in cash and 500,000 shares are due in two equal installments: $5.0 million which was paid and 250,000 shares were issued in October 2015 and the second installment of $5.0 million and 250,000 shares is due in April 2016.

An additional $9.1 million in cash and 600,000 shares of common stock may be issued on April 1, 2017, subject to the achievement of certain sales targets as well as continued employment of certain key employees acquired in the transaction, which will be recorded as compensation expense over a two-year period unless and until the Company assesses that the achievement of sales targets is not probable. The acquisition is expected to enhance the Company's efficient and consistent access to high-quality leads in existing and new markets.

The Company has included the results of operations of the acquired business in the consolidated statements of operations from the acquisition date. The assets acquired and liabilities assumed in the CEE acquisition have been recorded based on their fair value at the acquisition date. Goodwill represents the excess of the purchase price over the net tangible and intangible assets acquired and is not deductible for tax purposes. Goodwill recorded is primarily attributable to the acquired assembled workforce and the synergies expected to arise after the CEE acquisition. Transaction costs related to the acquisition were expensed as incurred.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

The following table summarizes the fair value of assets acquired and liabilities assumed (in thousands):

Cash	$	424
Accounts receivable		639
Intangible assets		13,290
Accounts payable and accrued liabilities		(1,247)
Deferred tax liability		(5,146)
Identifiable assets and liabilities assumed		7,960
Goodwill		35,757
Total	$	43,717

The fair value of acquired intangible assets and their estimated useful life are as follows (in thousands, except estimated useful life):

	Fair Value		Estimated Useful Life
Developed technology	$	5,910	5
Customer relationships		4,390	8
Trade names		2,990	8
Total	$	13,290	

For the year ending December 31, 2015, the contribution of the acquired business to the Company's total revenues was $16.9 million, as measured from the date of the acquisition. The portion of total expenses and net income associated with the acquired business was not separately identifiable due to the integration with the Company's operations.

Acquisition of Solar Projects with the Associated Leases

In March 2014, the Company entered into a Backlog Lease Assignment and Assumption Agreement and Channel Agreement with an installation partner and purchased certain solar projects with the associated leases already originated by the installation partner. The Company paid $39.4 million to acquire 2,924 solar projects and the associated leases with an average remaining lease term of 20 years. The Company has accounted for the acquisition under ASC 805 and recorded the assets acquired at fair value at the acquisition date. As the terms of the acquired leases associated with these projects were at market terms at the acquisition date, no lease premiums or discounts were recorded. No goodwill was recognized from this acquisition as the Company paid fair value for the assets acquired.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Note 4. Fair Value Measurement

At December 31, 2015 and 2014, the carrying value of receivables, accounts payable, accrued expenses, and distributions payable to noncontrolling interests approximates fair value due to their short-term nature. The carrying values and fair values of debt instruments are as follows (in thousands):

	December 31, 2015		December 31, 2014	
	Carrying Value	Fair Value	Carrying Value	Fair Value
Line of credit	194,975	194,975	$ 48,597	$ 48,597
Non-bank term loans	—	—	3,138	3,853
Syndicated term loans	170,664	170,664	124,571	124,571
Bank term loan	30,740	32,692	33,382	35,653
Note payable	33,059	32,568	29,563	28,900
Solar asset-backed notes	108,880	110,103	—	—
Total	$ 538,318	$ 541,002	$ 239,251	$ 241,574

At December 31, 2015 and 2014, the fair value of the Company's lines of credit and the syndicated term loans approximates their carrying values because their interest rates are variable rates that approximate rates currently available to the Company. At December 31, 2015, the fair value of the Company's bank term loan, note payable and asset-backed notes are based on rates currently offered for debt with similar maturities and terms. At December 31, 2014, the fair value of the Company's non-bank term loan, bank term loan, and note payable are based on rates currently offered for debt with similar maturities and terms. The Company's fair value of the debt instruments fell under the Level 3 hierarchy. These valuation techniques involve some level of management estimation and judgment, the degree of which is dependent on the price transparency for the instruments or market.

The Company determines the fair value of its interest rate swaps using a discounted cash flow model which incorporates an assessment of the risk of non-performance by the interest rate swap counterparty and an evaluation of the Company's credit risk in valuing derivative instruments. The valuation model uses various inputs including contractual terms, interest rate curves, credit spreads and measures of volatility.

The Company determines the fair value of its warrants issued using the Black-Scholes option-pricing model. The key inputs used to determine value of the warrants was an estimated fair value of the Company's common stock of $11.77 per share, risk-free interest rate of 1.21%, expected volatility of 32.03%, the remaining contact life of 2.56 years and expected dividend yield rate of 0.00%. The significant unobservable input used in the fair value measurement of the warrant liability was the expected volatility of the Company. Generally, increases (decreases) in the expected volatility of the Company would result in a directionally similar impact to the measurement of the Company's stock options.

At December 31, 2015, financial instruments measured at fair value on a recurring basis, based upon the fair value hierarchy are as follows (in thousands):

	December 31, 2015			
	Level 1	Level 2	Level 3	Total
Derivative liabilities:				
Interest rate swaps	$ —	$ 921	$ —	$ 921
Warrants	—	—	557	557
Total	$ —	$ 921	$ 557	$ 1,478

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Note 5. Inventories

Inventories consist of the following (in thousands):

	December 31,	
	2015	2014
Raw materials	62,967	$ 21,531
Work-in-process	8,291	2,383
Total	$ 71,258	$ 23,914

Note 6. Solar Energy Systems, net

Solar energy systems, net consists of the following (in thousands):

	December 31,	
	2015	2014
Solar energy system equipment costs	$ 1,846,103	$ 1,406,478
Inverters	177,202	123,910
Initial direct costs	68,280	40,307
Total solar energy systems	2,091,585	1,570,695
Less: accumulated depreciation and amortization	(212,671)	(143,028)
Add: construction-in-progress	113,107	56,584
Total solar energy systems, net	$ 1,992,021	$ 1,484,251

All solar energy systems, construction-in-progress, and inverters have been leased to or are subject to a signed Customer Agreement with customers. The Company recorded depreciation expense related to solar energy systems of $70.7 million, $54.7 million and $40.0 million for the years ended December 31, 2015, 2014 and 2013, respectively. The depreciation expense was reduced by the amortization of deferred grants of $14.2 million, $13.9 million and $13.4 million for the years ended December 31, 2015, 2014 and 2013, respectively.

Note 7. Property and Equipment, net

Property and equipment, net consists of the following (in thousands):

	December 31,	
	2015	2014
Machinery and equipment	$ 2,808	$ 1,031
Leasehold improvements, furniture, and computer hardware	10,669	6,386
Vehicles	33,048	8,942
Computer software	19,883	16,431
Total property and equipment	66,408	32,790
Less: accumulated depreciation and amortization	(21,542)	(10,595)
Total solar energy systems, net	$ 44,866	$ 22,195

Depreciation and amortization expense was $11.2 million, $6.4 million and $3.0 million for the years ended December 31, 2015, 2014 and 2013, respectively.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

The Company vehicles are assets under capital leases with a corresponding accumulated amortization of $5.8 million and $1.2 million at December 31, 2015 and 2014, respectively. Amortization expense related to these assets was $5.3 million and $1.2 for the years ended December 31, 2015 and 2014. Prior to December 31, 2013, the Company did not have any assets under capital leases and therefore, did not record amortization expense related to these assets in the year ended December 31, 2013.

Note 8. Goodwill and Intangible Assets, net

The change in the carrying value of goodwill is as follows (in thousands):

Balance—January 1, 2014	$	—
Acquisition of MEC (Note 3)		51,786
Balance—December 31, 2014	$	51,786
Acquisition of CEE (Note 3)		35,757
Balance—December 31, 2015	$	87,543

The intangible assets were acquired as part of the acquisition of MEC and CEE referred to in Note 3, *Acquisitions*.

Intangible assets, net as of December 31, 2015 consist of the following (in thousands):

	Cost	Accumulated amortization	Carrying value	Weighted average remaining life (in years)
Backlog	$ 200	$ (200)	$ —	—
Customer relationships	14,660	(2,618)	12,042	7.4
Developed technology	6,820	(1,235)	5,585	4.1
Trade names	6,990	(1,912)	5,078	5.3
Total	$ 28,670	$ (5,965)	$ 22,705	

Intangible assets, net as of December 31, 2014 consist of the following (in thousands):

	Cost	Accumulated amortization	Carrying value	Weighted average remaining life (in years)
Backlog	$ 200	$ (183)	$ 17	0.1
Customer relationships	10,270	(1,055)	9,215	8.4
Developed technology	910	(167)	743	4.1
Trade names	4,000	(864)	3,136	4.1
Total	$ 15,380	$ (2,269)	$ 13,111	

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

The Company recorded amortization of intangible assets expense of $3.7 million and $2.3 for the years ended December 31, 2015 and 2014. As of December 31, 2015, expected amortization of intangible assets for each of the five succeeding fiscal years and thereafter is as follows (in thousands):

2016	$	4,205
2017		4,205
2018		4,205
2019		3,335
2020		2,143
Thereafter		4,612
Total	$	22,705

Note 9. Prepaid Expense and Other Current Assets

Prepaid expenses and other current assets consist of the following (in thousands):

	December 31,			
	2015		2014	
Prepaid expenses	$	5,134	$	4,564
Reimbursement receivable		337		2,808
State tax receivable		427		1,117
Other current assets		798		1,071
Total	$	6,696	$	9,560

Note 10. Accrued Expenses and Other Liabilities

Accrued expenses and other liabilities consist of the following (in thousands):

	December 31,			
	2015		2014	
Accrued employee compensation	$	21,353	$	12,588
Other accrued expenses		19,313		9,526
CEE acquisition consideration		5,000		—
Accrued professional fees		3,480		3,331
Total	$	49,146	$	25,445

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

Note 11. Indebtedness

As of December 31, 2015, debt consisted of the following (in thousands):

	Carrying Values, net of debt discount			Unused Borrowing Capacity	Annual Contractual Interest Rate	Interest Rate	Maturity Date
	Current	Long Term	Total				
Recourse debt:							
Bank line of credit	$ —	$ 194,975	$ 194,975	$ 6,571	Varies1	3.67%	April 2018
Total recourse debt	$ —	$ 194,975	$ 194,975	$ 6,571			
Non-recourse debt:							
Syndicated term loans	926	169,739	170,665	5,600	LIBOR + 2.75% - Term A	3.07%	December 2021
					LIBOR + 5.00% - Term B	6.00%	December 2021
Bank term loans	1,159	29,580	30,739	—	6.25%	6.25%	April 2022
Note payable	—	33,059	33,059	—	12.00%	12.00%	December 2018
Solar asset-backed notes	3,323	105,557	108,880	—	4.40% - Class A	4.40%	July 2024
					5.38% - Class B	5.38%	July 2024
Total non-recourse debt	5,408	337,935	343,343	5,600			
Total debt	$ 5,408	$ 532,910	$ 538,318	$ 12,171			

1 Loans under the facility bear interest at LIBOR + 3.25% or the Base Rate + 2.25%. The Base Rate is the highest of the Federal Funds Rate + 0.50%, the Prime Rate, or LIBOR + 1.00%.

As of December 31, 2014, debt consisted of the following (in thousands):

	Carrying Values, net of debt discount			Unused Borrowing Capacity	Annual Contractual Interest Rate	Interest Rate	Maturity Date
	Current	Long Term	Total				
Recourse debt:							
Bank line of credit	$ —	$ 48,597	$ 48,597	$ —	Prime Rate + 1.00%	4.25%	December 2016
Total recourse debt	$ —	$ 48,597	$ 48,597	$ —			
Non-recourse debt:							
Non-bank term loans	207	2,931	3,138	—	9.08%	9.08%	December 2024
Syndicated term loans	958	123,613	124,571	5,000	LIBOR + 2.75% - Term A	3.01%	December 2021
					LIBOR + 5.00% - Term B	6.00%	December 2021
Bank term loans	1,437	31,945	33,382	—	6.25%	6.25%	April 2022
Note payable	—	29,563	29,563	—	12.00%	12.00%	December 2018
Total non-recourse debt	2,602	188,052	190,654	5,000			
Total debt	$ 2,602	$ 236,649	$ 239,251	$ 5,000			

Bank Line of Credit

In December 2014, the Company entered into credit facility agreements with a syndicate of banks to borrow amounts that were used to pay off an existing line of credit, and obtain funding for working capital and general corporate purposes. The credit facility agreements had a $50.0 million committed facility which included a $1.0 million letter of credit sub-facility. On April 1, 2015, the Company paid off the unpaid balance of $49.7 million under the credit facility agreements, which included accrued interest and other fees, and terminated the facility.

In April 2015, the Company entered into a new syndicated working capital facility with banks for a total commitment of up to $205.0 million. The working capital facility is secured by substantially all of the unencumbered assets of the Company as well as ownership interests in certain subsidiaries of the Company.

Under the terms of the new working capital facility, the Company is required to meet various restrictive covenants, including meeting certain reporting requirements, such as the completion and presentation of audited consolidated financial statements. The Company is also required to maintain minimum unencumbered liquidity of at least $25.0 million in the aggregate as of the last day of each calendar month. The Company is further required to maintain a modified interest coverage ratio of 2.00:1.00 or greater, measured quarterly as of the last day of each quarter. The Company was in compliance with all debt covenants as of December 31, 2015.

Non-Bank Term Loans

In 2013, a subsidiary of the Company entered into an agreement with a non-bank lender for a term loan with an aggregate amount of up to $119.5 million. The proceeds of this term loan were principally used to finance the design, procurement, and installation of solar systems. The loan was collateralized by the assets and related cash flows of the borrower subsidiary and is non-recourse to our other assets.

In April 2015, the Company paid $3.5 million to repay the remaining outstanding balance of the non-bank term loan and incurred a loss on extinguishment charge of $0.4 million, which is recorded in non-operating loss from ordinary operations on our statement of operations.

Syndicated Credit Facilities

In December 2014, subsidiaries of the Company entered into secured credit facilities agreements with a syndicate of banks for up to $195.4 million in committed facilities. These facilities include a $158.5 million senior term loan ("Term Loan A") and a $24.0 million subordinated term loan ("Term Loan B"). In addition, the credit facilities also include a $5.0 million working capital revolver commitment and a $7.9 million senior secured revolving letter of credit facility which draws are solely for the purpose of satisfying the required debt service reserve amount if necessary. Term Loan A, the working capital revolver and the letter of credit bear interest at a rate of LIBOR + 2.75% with a 25 basis point step up triggered on the fourth anniversary. Term Loan B bears interest at a rate of LIBOR + 5.00% with a LIBOR floor of not less than 1.00%. Prepayments are permitted under Term Loan A at par without premium or penalty, and under Term Loan B prepayment penalties range from 0%-2%, depending on the timing of the prepayment. The proceeds of these facilities were used to repay certain non-bank term loans of $94.4 million and to fund general corporate needs.

One of the Company's subsidiaries is the borrower under the Term Loan A agreement and another of the Company's subsidiaries is the borrower under the Term Loan B agreement. All obligations under the Term Loan A, working capital revolver and letter of credit are collateralized by the subsidiary borrower's membership interests and assets in the Company's investment Funds. All obligations under the Term Loan B are collateralized by the membership interest in the subsidiary borrower. The credit facilities also contain certain provisions in the event of default, which entitle lenders to take actions, including acceleration of amounts due under the credit facilities and acquisition of membership interests and assets that are pledged to the lenders under the terms of the credit facilities.

The Company is required to maintain certain financial measurements and reporting covenants under the terms of the credit facilities. At December 31, 2015, the Company was in compliance with the credit facility covenants.

Bank Term Loan

In December 2013, a subsidiary of the Company entered into an agreement with a bank for a term loan of $38.0 million. The proceeds of this term loan were distributed to the members of this subsidiary, including the Company. The loan is secured by the assets and related cash flow of this subsidiary and is nonrecourse to the Company's other assets. The Company was in compliance with all debt covenants as of December 31, 2015.

Notes Payable

In December 2013, a subsidiary of the Company entered into a Note Purchase Agreement with an investor for the issuance of senior notes in exchange for proceeds of $27.2 million. The loan proceeds were distributed to the Company for general corporate purposes. On the last business day of each quarter, commencing with March 31, 2014, to the extent the Company's subsidiary has insufficient funds to pay the full amount of the stated interest of the outstanding loan balance, a PIK interest rate of 12% is accrued and added to the outstanding balance. As of December 31, 2015 and 2014, the portion of the outstanding loan balance that related to PIK interest was $6.3 million and $2.9 million, respectively. The senior notes are secured by the assets and related cash flows of certain of the Company's subsidiaries and are nonrecourse to the Company's other assets. The entire outstanding principal balance is payable in full on the maturity date. The Company was in compliance with all debt covenants as of December 31, 2015.

Solar Asset-Backed Notes

In July 2015, the Company entered into a securitization transaction pursuant to which the Company pooled and transferred qualifying solar energy systems and related lease agreements secured by associated customer contracts ("Solar Assets") into a special purpose entity ("Issuer"), and issued $100.0 million in aggregate principal of Solar Asset-Backed Notes, Series 2015-1, Class A, and $11.0 million in aggregate principal of Solar Asset-Backed Notes, Class B, backed by these Solar Assets to certain investors ("Notes"). The Issuer is wholly owned by the Company and is consolidated in the Company's financial statements. Accordingly, the Company did not recognize a gain or loss on the transfer of these assets. As of December 31, 2015, these Solar Assets had a carrying value of $190.2 million and are included under Solar energy systems, net, in the consolidated balance sheets. The Notes were issued at a discount of 0.08%.

The Company retained $7.3 million net of fees from proceeds from the Notes. In connection with the transaction, the Company modified two lease pass-through arrangements with an investor. The lease pass-through arrangements had been accounted for as a borrowing and any amounts outstanding from the arrangements were reported as lease pass-through financing obligation as further explained in Note 13, *Lease Pass-Through Financing Obligations*. The balance that was then outstanding under these arrangements was $119.7 million. The Company partially repaid this obligation by paying the investor an aggregate amount of $88.9 million. The Company accounted for the modification of the lease pass-through obligation as a modification of debt and did not record any gain or loss on the transaction.

The modified lease-pass through arrangements require the majority of the cash flows generated by the Solar Assets to be passed on to the Issuer through monthly lease payments from the investor. Those cash flows are used to service the monthly Note principal and interest payments and satisfy the Issuer's expenses, and any residual cash flows are retained by the fund investor and recorded as a reduction in the remaining financing obligation. The Company recognizes revenue earned from the associated Customer Agreements in accordance with the Company's revenue recognition policy. The assets and cash flows generated by the Solar Assets are not available to the other creditors of the Company, and the creditors of the Issuer, including the Note holders, have no recourse to the Company's other assets. The Company was in compliance with all debt covenants as of December 31, 2015.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

The schedules maturities of debt, excluding debt discount, as of December 31, 2015 are as follows (in thousands:

2016	$ 6,330
2017	7,392
2018	238,250
2019	9,253
2020	11,414
Thereafter	273,693
Subtotal	$ 546,332
Less: Debt Discount	(8,014)
Total	$ 538,318

Note 12. Derivatives

Interest Rate Swaps

Starting in 2015, the Company uses interest rate swaps to hedge variable interest payments due on its syndicated term loans. These swaps allow the Company to pay at fixed interest rates and receive payments based on variable interest rates with the swap counterparty based on the three month LIBOR on the notional amounts over the life of the swaps. The Company did not use interest rate swaps prior to 2015.

In January 2015, the Company purchased interest rate swaps with a notional amount aggregating $109.1 million. The interest rate swap contracts were executed with four counterparties who were part of the lender group on the Company's syndicated term loans. As of December 31, 2015 the unrealized fair market value loss on the interest rate swaps was $0.9 million as included in other liabilities in the consolidated balance sheet.

The interest rate swaps have been designated as cash flow hedges. In the year ended December 31, 2015, the hedge relationships on the Company's interest rate swaps have been assessed as highly effective as the critical terms of the interest rate swaps match the critical terms of the underlying forecasted hedged transactions. Accordingly, changes in the fair value of these derivatives are recorded as a component of accumulated other comprehensive loss, net of a provision for income taxes. Changes in the fair value of these derivatives are subsequently reclassified into earnings, and are included in interest expense, net in the Company's statement of operations, in the period that the hedged forecasted transactions affects earnings. During the next twelve months, the Company estimates that an additional $1.7 million will be reclassified as an increase to interest expense. There were no undesignated derivative instruments recorded by the Company as of December 31, 2015.

At December 31, 2015, the Company had the following designated derivative instruments classified as derivative liabilities as reported in other liabilities in the Company's balance sheet (in thousands, other than quantity and interest rates):

Type	Quantity	Maturity Dates	Hedge Interest Rates	Notional Amount	Fair Market Value	Credit Risk Adjustment	Adjusted Fair Market Value	Deferred Tax Benefit	Loss Recognized in Accumulated Comprehensive Loss	Interest Expense Recognized into Earnings
Interest rate swaps	4	10/31/2028	2.17%-2.18%	$ 109,143	$ 384	$ 537	$ 921	$ —	$ 921	$ 1,521

Warrants

In July 2015, the Company entered into a letter of intent to issue 1,250,764 warrants to purchase the Company's common stock to the former Series D and E preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the closing of the Company's initial public offering and waive any potential anti-dilution adjustments resulting from the issuance of shares in the Company's common stock in the Company's initial public offering. The warrants were issued on September 30, 2015. The warrants are exercisable for three years from the date of grant and have an exercise price of $22.50 per share. The warrant derivatives are recorded at fair value as derivative liabilities as reported in other liabilities in the Company's consolidated balance sheet. The fair market value of the warrants on the commitment date was $1.5 million. The warrants are remeasured at each reporting period with the changes in the fair value presented in other expenses in the Company's statement of operations.

At December 31, 2015, the fair market value of the warrant was $0.6 million, resulting in a gain of $0.9 million for the year ended December 31, 2015.

Note 13. Lease Passthrough Financing Obligations

The Company has five ongoing transactions referred to as "lease pass-through arrangements." Under lease pass-through arrangements, the Company leases solar energy systems to Fund investors under a master lease agreement, and these investors in turn are assigned the leases with customers. The Company receives all of the value attributable to the accelerated tax depreciation and some or all of the value attributable to the other incentives. The Company assigns to the Fund investors the value attributable to the ITC, and, for the duration of the master lease term, the long-term recurring customer payments. Given the assignment of the operating cash flows, these arrangements are accounted for as financing obligations. In addition, in one of the lease pass-through structures, the Company sold, as well as leased, solar energy systems to a Fund investor under a master purchase agreement. As the substantial risks and rewards in the underlying solar energy systems were retained by the Company, this arrangement was also accounted for as a financing obligation.

Under these lease pass-through arrangements, wholly owned subsidiaries of the Company finance the cost of solar energy systems with investors for an initial term of 20 – 25 years. The solar energy systems are subject to Customer Agreements with an initial term not exceeding 20 years. These solar energy systems are reported under the line item solar energy systems, net in the consolidated balance sheets. As of December 31, 2015 and 2014, the cost of the solar energy systems placed in service under the lease pass-through arrangements was $447.4 million and $322.2 million, respectively. The accumulated depreciation related to these assets as of December 31, 2015 and 2014 was $33.5 million and $19.3 million, respectively.

The investors make a series of large up-front payments and in certain cases subsequent smaller quarterly payments (lease payments) to the subsidiaries of the Company. The Company accounts for the payments received from the investors under the arrangements as borrowings by recording the proceeds received as lease pass-through financing obligations. These financing obligations are reduced over a period of approximately 20 years by customer payments under the Customer Agreements, U.S. Treasury grants (where applicable), incentive rebates (where applicable), the fair value of the ITCs monetized (where applicable) and proceeds from the contracted resale of SRECs as they are received by the investor. Under this approach, the Company continues to account for the arrangement with the customers in its consolidated financial statements as if it is the lessor in the arrangement with the customer and accounts for the customer lease and any related U.S. Treasury grants or incentive rebates as well the resale of SRECs consistent with the Company's revenue recognition accounting policies and the monetization of investment tax credits as described in Note 2, *Summary of Significant Accounting Policies*.

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Interest is calculated on the lease pass-through financing obligations using the effective interest rate method. The effective interest rate, which is adjusted on a prospective basis, is the interest rate that equates the present value of the estimated cash amounts, including ITCs, to be received by the investor over the lease term with the present value of the cash amounts paid by the investor to the Company, adjusted for amounts received by the investor. The lease pass-through financing obligations are nonrecourse once the associated assets have been placed in service and all the contractual arrangements have been assigned to the investor.

Under four of the lease pass-through arrangements, the investor has a right to extend its right to receive cash flows from the customers beyond the initial term in certain circumstances. The Company has the option to settle the outstanding financing obligation on the ninth anniversary for two of the lease pass-through obligations and on the eleventh anniversary for two of the lease pass-through financing obligations at a price equal to the higher of (a) the fair value of future remaining cash flows or (b) the amount that would result in the investor earning their targeted return. In three of these lease pass-through arrangements, the investor has an option to require repayment of the entire outstanding balance of the financing obligation on the tenth anniversary at a price equal to the fair value of the future remaining cash flows. In the fourth lease pass through arrangement, the investor has an option to require repayment of the entire outstanding balance of the financing obligation three business days prior to the 7th anniversary and on the 10th anniversary at a price equal to the fair value of the future remaining cash flows.

In the fifth lease pass-through arrangement, the investor has a right, on June 30, 2019, to purchase all of the systems leased at a price equal to the higher of (a) the sum of the present value of the expected remaining lease payments due by the investor, discounted at 5%, and the fair market value of the investor's residual interest in the systems as determined through independent valuation or (b) a set value per kilowatt applied to the aggregate size of all leased systems.

Under all lease pass-through arrangements, the Company is responsible for services such as warranty support, accounting, lease servicing and performance reporting to the host customers. As part of the warranty and performance guarantee with the host customers, the Company guarantees certain specified minimum annual solar energy production output for the solar energy systems leased to the customers, which the Company accounts for as disclosed in Note 2, *Summary of Significant Accounting Policies.*

As discussed in Note 11, *Indebtedness*, in connection with the pooling of assets related to the securitization transaction entered into in July 2015, an aggregate amount of $88.9 million of the lease pass-through financing obligation was repaid.

In September 2015, the Company entered into a new lease pass-through arrangement and in connection with this arrangement, the Company agreed to defer a portion (up to 25%) of the amounts required to be paid upfront under the arrangement through a loan between an indirectly wholly owned subsidiary of the Company and a subsidiary of the fund investor. The term loan agreement is for an aggregate amount up to $30.0 million. The loan is collateralized by the related cash flows assigned to the fund investor. There is a legal right to offset the loan if an event of default has occurred. Therefore, the lease pass-through related to this arrangement is recorded net of the loan. As of December 31, 2015, the loan amount was $21.8 million.

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Notes to Consolidated Financial Statements — Continued

At December 31, 2015, future minimum lease payments expected to be made by the investor under the lease pass-through fund arrangement for each of the next five years and thereafter are as follows (in thousands):

2016	$	524
2017		524
2018		524
2019		524
2020		524
Thereafter		3,516
Total	$	6,136

Note 14. VIE Arrangements

The Company consolidated various VIEs at December 31, 2015 and 2014. The carrying amounts and classification of the VIEs' assets and liabilities included in the consolidated balance sheets are as follows (in thousands):

	December 31,			
	2015		2014	
Assets				
Current assets				
Cash	$	44,407	$	29,099
Restricted cash		757		228
Accounts receivable, net		12,965		14,351
Prepaid expenses and other current assets		66		180
Total current assets		58,195		43,858
Restricted cash	$	—	$	365
Solar energy systems, net		1,305,420		942,655
Total Assets	$	1,363,615	$	986,878
Liabilities				
Current liabilities				
Accounts payable	$	11,025	$	9,057
Distribution payable to noncontrolling interests and redeemable noncontrolling interests		8,063		6,426
Accrued expenses and other liabilities		175		340
Deferred revenue, current portion		21,344		16,991
Deferred grants, current portion		7,198		7,225
Long-term debt, current portion		1,159		1,437
Total current liabilities		48,964		41,476
Deferred revenue, net of current portion		353,392		284,801
Deferred grants, net of current portion		108,528		116,126
Long-term debt, net of current portion		29,580	$	31,945
Total liabilities	$	540,464	$	474,348

The Company holds a variable interest in an entity that provides the noncontrolling interest with a right to terminate the leasehold interests in all of the leased projects on the tenth anniversary of the effective date of the master lease. In this circumstance, the Company would be required to pay the noncontrolling interest an amount equal to the fair market value, as defined in the governing agreement of all leased projects as of that date.

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Notes to Consolidated Financial Statements — Continued

The Company holds certain variable interests in nonconsolidated VIEs established as a result of five lease pass-through Fund arrangements as further explained in Note 13, *Lease Pass-Through Financing Obligations.* The Company does not have material exposure to losses as a result of its involvement with the VIEs in excess of the amount of the financing liability recorded in the Company's consolidated financial statements. The Company is not considered the primary beneficiary of the VIEs.

In 2013, the Company acquired an investor's interest in three consolidated VIEs for a total cash consideration of $22.0 million. In these three entities, the Company was contractually required to make payments to the investor so that the investor achieved a specified minimum internal rate of return upon occurrence of certain events. Upon purchase of the investor's stake in these entities, this obligation was satisfied. This transaction decreased the Company's additional paid-in-capital, net of the related tax impact, by $2.8 million.

Note 15. Redeemable Noncontrolling Interests

During certain specified periods of time (the "Early Exit Periods"), noncontrolling interests in certain funding arrangements have the right to put all of their membership interests to the Company (the "Put Provisions"). During a specific period of time (the "Call Periods"), the Company has the right to call all membership units of the related redeemable noncontrolling interests.

The carrying value of redeemable noncontrolling interests at December 31, 2015 and 2014 was greater than the redemption value, except for two funds at December 31, 2015 and 2014, where the carrying value has been adjusted to the redemption value.

Note 16. Stockholders' Equity

On August 10, 2015, the Company closed its initial public offering in which 17,900,000 shares of common stock were sold at a public offering price of $14.00 per share, resulting in net proceeds of approximately $221.3 million, after deducting underwriting discounts and commissions and $7.5 million in offering expenses paid by the Company, and excluding the proceeds received by the selling stockholders who sold an aggregate of 417,732 shares of the total 17,900,000 shares sold in the initial public offering.

Convertible Preferred Stock

Immediately prior to closing of the Company's initial public offering, all 54,840,767 shares of the Company's outstanding preferred stock were automatically converted into shares of the Company's common stock. In addition, the Company issued 1,667,683 shares of common stock and executed a letter of intent to issue 1,250,764 warrants subject to contingencies being met to purchase the Company's common stock to the former Series D and E preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the closing of the Company's initial public offering and to waive any potential anti-dilution adjustments resulting from the issuance of shares in the Company's common stock in the Company's initial public offering. The additional shares and warrants resulted in a beneficial conversion feature as a result of the inducement for Series D and E preferred stock and the Company recognized a $24.9 million deemed dividend to Series D and E preferred stockholders at the conversion date. This non-cash charge impacts net loss attributable to our common stockholders and basic and diluted net loss per share applicable to common stockholders. The warrants were issued on September 30, 2015 and are considered freestanding derivatives as disclosed in Note 12, *Derivatives.*

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Notes to Consolidated Financial Statements — Continued

The Company did not have any convertible preferred stock issued and outstanding as of December 31, 2015. The Company had five series of convertible preferred stock as follows as of December 31, 2014 (in thousands, except per share amounts):

	Shares Authorized	Shares Issued and Outstanding	Aggregate Liquidation Preference	Noncumulative Dividend Per Share Per Annum
Series A	12,043	12,007	$ 12,007	$ 0.08
Series B	10,758	10,758	18,420	0.14
Series C	13,613	13,613	55,000	0.32
Series D	7,584	7,584	70,000	0.74
Series E	13,030	10,879	150,456	1.11
Total	57,028	54,841	$ 305,883	

From the inception of the Company through December 31, 2015, no dividends have been declared or paid other than the $24.9 million deemed dividend to Series D and E preferred stockholders in August 2015.

Common Stock

The Company has reserved sufficient shares of common stock for issuance upon the exercise of stock options and the exercise of warrants. Common stockholders are entitled to dividends if and when declared by the board of directors, subject to the prior rights of the preferred stockholders. As of December 31, 2015, no common stock dividends had been declared by the board of directors.

The Company has reserved shares of common stock for issuance as follows (in thousands):

	December 31,	
	2015	2014
Series A Convertible Preferred Stock	—	12,007
Series B Convertible Preferred Stock	—	10,758
Series C Convertible Preferred Stock	—	13,613
Series D Convertible Preferred Stock	—	7,584
Series E Convertible Preferred Stock	—	10,879
Stock option plans		
Shares available for grant		
2013 Equity Incentive Plan	—	694
2015 Equity Incentive Plan	12,006	—
2015 Employee Stock Purchase Plan	1,000	—
Options outstanding	12,795	11,408
Restricted stock units outstanding	1,506	947
Total	27,307	67,890

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Notes to Consolidated Financial Statements — Continued

Note 17. Stock-Based Compensation

MEC 2009 Stock Plan

In connection with the MEC acquisition in February 2014, the Company assumed nonstatutory stock options granted under the Mainstream Energy Corporation 2009 Stock Plan (the "MEC Plan") held by MEC employees who continued employment with the Company after the closing and converted them into options to purchase shares of the Company's common stock. The MEC Plan was terminated on the closing of the acquisition but the outstanding awards under the MEC Plan that the Company assumed in the acquisition will continue to be governed by their existing terms. As of December 31, 2015, options to purchase 527,770 shares of the Company's common stock remained outstanding under the MEC Plan.

2013 Equity Incentive Plan

In July 2013, the Board of Directors approved the 2013 Plan. In March 2015, the Board of Directors authorized an additional 3,000,000 shares reserved for issuance under the 2013 Plan. An aggregate of 4,500,000 shares of common stock are reserved for issuance under the 2013 Plan plus (i) any shares that were reserved but not issued under the plan that was previously in place, and (ii) any shares subject to stock options or similar awards granted under the plan that was previously in place that expire or otherwise terminate without having been exercised in full and shares issued that are forfeited to or repurchased by the Company, with the maximum number of shares to be added to the 2013 Plan pursuant to clauses (i) and (ii) equal to 8,044,829 shares. Stock options granted to employees generally have a maximum term of ten-years and vest over a four-year period from the date of grant; 25% vest at the end of one year, and 75% vest monthly over the remaining three years. The options may include provisions permitting exercise of the option prior to full vesting. Any unvested shares shall be subject to repurchase by the Company at the original exercise price of the option in the event of a termination of an optionee's employment prior to vesting. All the remaining shares that were available for future grants under the 2013 Plan were transferred to the 2015 Equity Incentive Plan ("2015 Plan") at the inception of the 2015 Plan. As of December 31, 2015, the Company had not granted restricted stock or other equity awards (other than options) under the 2013 Plan.

2014 Equity Incentive Plan

In August 2014, the Board approved the 2014 Equity Incentive Plan ("2014 Plan"). An aggregate of 947,342 shares of common stock are reserved for issuance under the 2014 Plan. The 2014 Plan was adopted to accommodate a broader transaction with a sales entity and to allow for similar transactions in the future. In July 2015, the Board approved an increase in the number of shares of common stock reserved to 1,197,342. As of July 2015, the Company granted all 1,197,342 restricted stock units ("RSUs") available under the 2014 Plan.

2015 Equity Incentive Plan

In July 2015, the Board approved the 2015 Plan. An aggregate of 11,400,000 shares of common stock are reserved for issuance under the 2015 Plan plus (i) any shares that were reserved but not issued under the 2013 Plan at the inception of the 2015 Plan, and (ii) any shares subject to stock options or similar awards granted under the 2008 Plan, 2013 Plan and 2014 Plan that expire or otherwise terminate without having been exercised in full and shares issued that are forfeited to or repurchased by the Company, with the maximum number of shares to be added to the 2015 Plan pursuant to clauses (i) and (ii) equal to 15,439,334 shares. Stock options granted to employees generally have a maximum term of ten-years and vest over a four-year period from the date of grant; 25% vest at the end of one year, and 75% vest monthly over the remaining three years. The options may include provisions permitting exercise of the option prior to full vesting. Any unvested shares shall be subject to repurchase by the Company at the original exercise price of the option in the event of a termination of an optionee's employment prior to vesting. RSUs granted to employees generally vest over a four-year period from the date of grant; 25% vest at the end of one year, and 75% vest quarterly over the remaining three years.

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Stock Options

The following table summarizes the activity for all stock options under the Company's equity incentive plans for the year ended December 31, 2015 (shares in thousands):

	Options Outstanding	Weighted Average Exercise Price Outstanding	Weighted Average Remaining Contractual Life
Outstanding at December 31, 2014	11,408	$ 4.42	8.20
Granted	3,806	9.50	
Exercised	(1,210)	2.96	
Cancelled / forfeited	(1,209)	6.27	
Outstanding at December 31, 2015	12,795	$ 5.89	7.82
Options vested and exercisable at December 31, 2015	6,409	$ 3.88	6.80
Options vested and expected to vest at December 31, 2015	10,460	$ 5.69	7.65

As of December 31, 2015, 180,000 outstanding stock options had a performance feature that is required to be satisfied before the option is vested and exercisable. There were 517,285 and 469,000 unvested exercisable shares as of December 31, 2015 and December 31, 2014, respectively, which are subject to a repurchase option held by the Company at the original exercise price. These exercisable but unvested shares have a weighted average remaining vesting period of 3.2 years. There was no exercise of unvested options in the year ended December 31, 2015 and 2014. There were no unvested options subject to repurchase as of December 31, 2015 and 2014.

The weighted-average grant-date fair value of stock options granted during the year ended December 31, 2015, 2014 and 2013 were $4.56, $3.72 and $1.77 per share, respectively. The total intrinsic value of the options exercised during the year ended December 31, 2015, 2014 and 2013 was $8.1 million, $4.8 million and $1.4 million, respectively. The intrinsic value is the difference of the current fair value of the stock and the exercise price of the stock option. The total fair value of options vested during the year ended December 31, 2015, 2014 and 2013 was $9.1 million, $3.9 million and $2.3 million, respectively.

The Company estimates the fair value of stock-based awards on their grant date using the Black-Scholes option-pricing model. The Company estimates the fair value using a single-option approach and amortizes the fair value on a straight-line basis for options expected to vest. All options are amortized over the requisite service periods of the awards, which are generally the vesting periods.

The Company estimated the fair value of stock options with the following assumptions:

	Year Ended December 31,		
	2015	2014	2013
Risk-free interest rate	1.55%-1.95%	1.68%-2.01%	0.82%-2.06%
Volatility	36.30%-39.63%	37.41%-46.68%	54.36%-55.80%
Expected term (in years)	5.50-6.23	5.34-6.08	5.54-6.08
Expected dividend yield	0.00%	0.00%	0.00%

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Notes to Consolidated Financial Statements — Continued

The expected term assumptions were determined based on the average vesting terms and contractual lives of the options. The risk-free interest rate is based on the rate for a U.S. Treasury zero-coupon issue with a term that approximates the expected life of the option grant. For stock options granted in the year ended December 31, 2015, 2014 and 2013, the Company considered the volatility data of a group of publicly traded peer companies in its industry. Forfeiture rates are estimated using the Company's expectations of forfeiture rates for the Company's employees and are adjusted when estimates change. The estimation of stock awards that will ultimately vest requires judgment, and to the extent actual results or updated estimates differ from the Company's current estimates, such amounts will be recorded as a cumulative adjustment in the period the estimates are revised. The Company considers many factors when estimating expected forfeitures, including historical forfeiture pattern, the types of awards and employee class. Actual results, and future changes in estimates, may differ substantially from management's current estimates.

Restricted Stock Units

In 2014, the Company granted a total of 947,342 RSUs that are subject to certain performance targets to a third party partner. The RSUs will vest upon the third party originating certain thresholds of expected megawatts in new systems for the period starting August 2014 and ending August 2017. In addition, these RSUs are subject to a clawback provision that requires the holder of the RSUs to either forfeit all the RSUs or pay the Company the grant date fair value for all RSUs that are not forfeited if the third party breaches the exclusivity provision of the parties' commercial agreement. Additionally, 372,342 of these RSUs are also subject to an additional performance-based clawback provision that is based on the third party originating certain additional thresholds of expected megawatts in new systems from April 2016 through September 2017. Both the exclusivity and performance-based clawback provisions expire in 2017.

The performance-based provision is considered substantive. As a result, the Company will start recognizing expense when the performance targets are met. The Company recognized $0.8 million compensation expense in the year ended December 31, 2015 as certain performance targets were met.

In 2015, the Company granted 250,000 RSUs to a third party partner, in addition to RSUs granted to employees as part of the 2015 Equity Incentive Plan. As of December 31, 2015, 783,228 outstanding RSUs had a performance feature that is required to be satisfied before the option is vested and exercisable. The following table summarizes the activity for all RSUs under all the Company's equity incentive plans for the year ended December 31, 2015 (shares in thousands):

	Shares	Weighted Average Grant Date Fair Value
Unvested balance at December 31, 2014	947	$ 9.40
Granted	808	11.13
Issued	(182)	9.58
Cancelled / forfeited	(67)	11.37
Unvested balance at December 31, 2015	1,506	$ 10.44

Employee Stock Purchase Plan

In July 31, 2015, the board of directors approved the 2015 Employee Stock Purchase Plan ("ESPP") and adopted the ESPP in August 2015, under which 1,000,000 shares of the Company's common stock have been reserved for issuance to eligible employees. The number of shares of common stock available for sale under the Company's ESPP will also include an annual increase on the first day of each fiscal year beginning on January 1, 2016, equal to the least of (i) 5,000,000 shares (ii) 2% of the common stock as of the last day of the immediately preceding fiscal year or (iii) such other amount as the Company's board of directors may determine. Employees are offered shares bi-annually through two six month

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Notes to Consolidated Financial Statements — Continued

offering periods, which begin on the first trading day on or after May 15 and November 15 of each year. The first offering period began on November 16, 2015. Employees may purchase a limited number of shares of the Company's common stock via regular payroll deductions at a discount of 15% of the lower of the fair market value of the Company's common stock on the first trading date of each offering period or on the exercise date. Employees may deduct up to 15% of payroll up to $25,000 per calendar year, with a cap of 2,000 shares per employee per offering period. As of December 31, 2015 the Company has 1,000,000 total shares of common stock reserved for issuance under the 2015 ESPP.

Inputs used to calculate our stock based compensation for each stock purchase right granted under the 2015 ESPP included risk-free interest rate of 0.33%, expected volatility of 33.84%, expected term of 0.5 years and expected dividend yield rate of 0.00%.

Stock-Based Compensation Expense

The Company recognized stock-based compensation expense, including the compensation expense resulting from the sales of common stock by employees and former employees to existing investors and ESPP expenses, in the consolidated statements of operations as follows (in thousands):

	Year Ended December 31,		
	2015	2014	2013
Cost of operating leases and incentives	$ 1,649	$ 155	$ 116
Cost of solar energy systems and product sales	236	682	—
Sales and marketing	5,242	897	474
Research and development	205	270	379
General and administration	8,491	7,214	1,686
Total	$ 15,823	$ 9,218	$ 2,655

In the year ended December 31, 2015 and 2014, the Company recognized $1.6 million and $3.4 million, respectively, in compensation expense resulting from sales of 1,131,028 shares and 1,092,421 shares, respectively, by employees and former employees to existing investors for amounts in excess of the deemed fair value.

The Company capitalized $0.2 million, $0.1 million and $0.0 million of stock based compensation for internal use software development projects during the years ended December 31, 2015, 2014 and 2013, respectively.

As of December 31, 2015 and 2014, total unrecognized compensation cost related to outstanding stock options was $20.9 million and $12.1 million, respectively, which is expected to be recognized over a weighted-average period of 2.8 years and 2.8 years, respectively.

Note 18. Retirement Plan

The Company offers a retirement plan qualified under Section 401(k) of the Code to its employees (the "401(k) plan"). The available investments are selected by the Company and allow participants to defer pre-tax amounts to the plan as allowed by the Code.

Upon acquisition of MEC, the Company incurred post-acquisition contributions of $0.5 million to the MEC 401(k) plan for the year ended December 31, 2014. The MEC 401(k) plan was terminated effective December 31, 2014.

Note 19. Operating Revenues under Customer Agreements

Customer Agreements representing PPAs require customers to make payments to Sunrun based on the electricity production of the related Project, whereas Customer Agreements representing leases require fixed monthly payments from customers.

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Notes to Consolidated Financial Statements — Continued

Total revenue from customers' contingent payments under PPAs recognized in the years ended December 31, 2015, 2014 and 2013 was $59.8 million, $42.8 million and $31.5 million, respectively.

Future minimum lease payments to be received from customers whose Customer Agreements represent non-cancelable leases are as follows (in thousands):

2016	$	13,557
2017		13,697
2018		13,817
2019		13,939
2020		14,065
Thereafter		199,278
Total	$	268,353

Note 20. Income Taxes

The following table presents the loss before income taxes for the periods presented (in thousands):

	For the year ended December 31,		
	2015	2014	2013
Loss attributable to common stockholders	$ 33,545	$ 80,895	$ 1,792
Loss attributable to noncontrolling interest and redeemable noncontrolling interests	220,660	86,638	64,294
Total	$ 254,205	$ 167,533	$ 66,086

The income tax provision (benefit) consists of the following (in thousands):

	For the year ended December 31,		
	2015	2014	2013
Current:			
Federal	$ —	$ —	$ —
State	—	—	169
Total current expense	—	—	169
Deferred:			
Federal	(7,516)	(8,196)	(1,114)
State	2,217	(1,847)	354
Total deferred provision	(5,299)	(10,043)	(760)
Total	$ (5,299)	$ (10,043)	$ (591)

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Notes to Consolidated Financial Statements — Continued

The following table represents a reconciliation of the statutory federal rate and the Company's effective tax rate for the periods presented:

	For the year ended December 31,		
	2015	2014	2013
Tax provision (benefit) at federal statutory rate	(34.00)%	(34.00)%	(34.00)%
State income taxes, net of federal benefit	0.87	(1.10)	0.79
Effect of noncontrolling and redeemable noncontrolling interests	29.53	17.59	34.10
Stock-based compensation	1.06	1.37	0.94
Effect of prepaid tax asset	0.04	9.39	—
Tax credits	(0.43)	(0.22)	(2.16)
Other	0.85	0.98	(0.56)
Total	(2.08)%	(5.99)%	(0.89)%

Deferred income taxes reflect the net tax effects of temporary differences between the carrying amounts of assets and liabilities for financial reporting purposes and the amounts used for income tax purposes. The following table represents significant components of the Company's deferred tax assets and liabilities for the periods presented (in thousands):

	December 31,	
	2015	2014
Deferred tax assets:		
Accruals and prepaids	$ 12,904	$ 4,302
Deferred revenue	34,710	44,359
Net operating loss carryforwards	229,464	176,555
Stock-based Compensation	3,748	1,612
Investment tax and other credits	11,261	7,369
Gross deferred tax assets	292,087	234,197
Deferred tax liabilities:		
Capitalized initial direct costs	27,539	16,640
Fixed asset depreciation	178,511	142,866
Deferred tax on investment in partnerships	276,183	184,240
Gross deferred tax liabilities	482,233	343,746
Net deferred tax liabilities	$ (190,146)	$ (109,549)

An analysis of deferred tax liabilities is as follows (in thousands):

	December 31,	
	2015	2014
Deferred tax assets	$ 292,087	$ 234,197
Deferred tax liabilities	(482,233)	(343,746)
Net deferred tax liabilities	$ (190,146)	$ (109,549)

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

As of December 31, 2015, the Company had net operating loss carryforwards for federal, California and other state income tax purposes of approximately $595.0 million, $368.0 million and $178.6 million, respectively, which will begin to expire in the year 2028, 2020 and 2020, respectively, if not utilized. Of the federal, California, and other state NOL carryover, $5.3 million, $1.3 million and $2.5 million relates to windfall stock option deductions which, when realized, will be an increase to additional paid in capital. As of December 31, 2014, the Company had net operating loss carryforwards for federal, California and other state income tax purposes of approximately $454.5 million, $283.1 million and $126.5 million, respectively. Of the federal, California, and other state NOL carryover, $1.8 million, $1.1 million and $0.5 million relates to windfall stock option deductions which, when realized, will be an increase to additional paid in capital.

As of December 31, 2015, the Company has an investment tax credit carryforward of approximately $4.2 million and California enterprise zone credits of approximately $1.0 million, which begins to expire in the year 2028 and 2023, respectively, if not utilized. As of December 31, 2014, the Company has an investment tax credit carryforward of approximately $2.4 million and California enterprise zone credits of approximately $0.9 million.

Generally, utilization of the net operating loss carryforwards and credits may be subject to a substantial annual limitation due to the ownership change limitations provided by the Internal revenue Code (IRC) of 1986, as amended and similar state provisions. The Company performed an analysis to determine whether an ownership change under Section 382 of the Code had occurred and determined that no ownership changes were identified as of December 31, 2015.

Valuation allowances are provided against deferred tax assets to the extent that it is more likely than not that the deferred tax asset will not be realized. The Company's management considers all available positive and negative evidence including its history of operating income or losses, future reversals of existing taxable temporary difference, taxable income in carryback years and tax-planning strategies. The Company has concluded there was sufficient positive evidence based on the reversal pattern of the deferred tax liability and available tax planning strategies being relied upon at the end of December 31, 2015 and December 31, 2014 to support the position that the Company does not need to maintain a valuation allowance on deferred tax assets.

Uncertain Tax Positions

The Company files tax returns as prescribed by the tax laws of the jurisdictions in which it operates. In the normal course of business, the Company is subject to examination by federal, state and local jurisdictions, where applicable. The statute of limitations for the tax returns varies by jurisdictions.

We determine whether a tax position is more likely than not to be sustained upon examination, including resolution of any related appeals or litigation processes, based on the technical merits of the position. We use a two-step approach to recognize and measure uncertain tax positions. The first step is to evaluate the tax position for recognition by determining if the weight of available evidence indicates that it is more likely than not that the position will be sustained upon tax authority examination, including resolution of related appeals or litigation processes, if any. The second step is to measure the tax benefit as the largest amount that is more than 50% likely of being realized upon ultimate settlement. We have analyzed the Company's inventory of tax positions with respect to all applicable income tax issues for all open tax years (in each respective jurisdiction).

Our policy is to include interest and penalties related to unrecognized tax benefits, if any, within the provision for taxes in the consolidated statements of operations. The Company does not have any tax positions for which it is reasonably possible that the total amount of gross unrecognized tax benefits will significantly change within 12 months of December 31, 2015.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

A reconciliation of the beginning and ending amounts of unrecognized tax benefits is as follows (in thousands):

Balance at January 1, 2014 and December 31, 2014	$	—
Acquired from CEE		1,525
Balance at December 31, 2015	$	1,525

There was 0.3 million of interest and penalties for uncertain tax positions as of December 31, 2015. As of December 31, 2014, there was no unrecognized tax benefits and there were no interest and penalties accrued for any uncertain tax position.

Three of our investment funds are currently being audited by the IRS. The Company is subject to taxation in the U.S., and various state and local jurisdictions. The following table summarizes the tax years that remain open and subject to examination by the tax authorities in the most significant jurisdictions in which the Company operates:

	Tax Years
U.S. Federal	2011 - 2015
State	2010 - 2015

Note 21. Commitments and Contingencies

Letters of Credit

As of December 31, 2015 and 2014, the Company had $3.5 million and $5.8 million, respectively, of unused letters of credit outstanding, with carry fees ranging from 2.00% - 3.25% per annum.

Non-cancellable Operating Leases

The Company leases facilities and equipment under non-cancellable operating leases. Total operating lease expenses were $19.7 million, $13.8 million and $2.0 million for the years ended December 31, 2015, 2014 and 2013, respectively. Certain operating leases contain rent escalation clauses, which are recorded on a straight-line basis over the initial term of the lease with the difference between the rent paid and the straight-line rent recorded as a deferred rent liability. Lease incentives received from landlords are recorded as deferred rent liabilities and are amortized on a straight-line basis over the lease term as a reduction to rent expense. Deferred rent liabilities were $1.9 million and $2.0 million as of December 31, 2015 and 2014, respectively.

Future minimum lease payments expected to be made under non-cancelable operating lease agreements as of December 31, 2015 for each of the years ending December 31, are as follows (in thousands):

2016	$	7,019
2017		6,669
2018		5,906
2019		2,521
2020		879
Thereafter		53
Total	$	23,047

Capital Lease Obligations

As of December 31, 2015 and 2014, capital lease obligations were $24.0 million and $7.4, respectively. The capital lease obligations bear interest at rates up to 10% per annum.

The following is a schedule of future lease payments as of December 31, 2015 (in thousands):

2016	$ 9,727
2017	7,444
2018	5,321
2019	2,799
2020	219
Thereafter	200
Total future lease payments	25,710
Less: amount representing estimated executory costs included in future lease payments	537
Net minimum future lease payments	25,173
Amount representing interest	1,180
Present value of future payments	23,993
Less: current portion	8,951
Long term portion	$ 15,042

Purchase Commitments

In January 2015, the Company entered into a purchase commitment with one of its suppliers to purchase $70.0 million of photovoltaic modules over the next 12 months with the first modules delivered in January 2015. In October 2015, the Company amended its commitment to purchase additional photovoltaic modules to be delivered until December 2016, for a total commitment of $146.0 million. As of December 31, 2015, the Company had $78.0 million of purchase commitments remaining.

In June 2015, the Company entered into a purchase commitment with one of its suppliers to purchase $32.0 million of photovoltaic modules through December 2016. As of December 31, 2015, the Company had $8.0 million of purchase commitments remaining.

Guarantees

The Company guarantees one of its investors in one of its Funds an internal rate of return, calculated on an after-tax basis, in the event that it purchases the investor's interest or the investor sells its interest to the Company. The Company does not expect the internal rate of return to fall below the guaranteed amount; however, due to uncertainties associated with estimating the timing and amount of distributions to the investor and the possibility for and timing of the liquidation of the Fund, the Company is unable to determine the potential maximum future payments that it would have to make under this guarantee.

ITC Indemnification

The Company is contractually committed to compensate certain investors for any losses that they may suffer in certain limited circumstances resulting from reductions in ITCs. Generally, such obligations would arise as a result of reductions to the value of the underlying solar energy systems as assessed by the IRS. At each balance sheet date, the Company assesses and recognizes, when applicable, the potential exposure from this obligation based on all the information available at that time, including any audits undertaken by the IRS. The Company believes that any payments to the investors in excess of the amount already recognized by the Company for this obligation are not probable based on the facts known at the reporting date. The maximum potential future payments that the Company could have to make under this obligation would depend on the difference between the fair values of the solar energy systems sold or transferred to the Funds as determined by the Company and the values the IRS would determine as the fair value for the systems for purposes of claiming ITCs. ITCs are claimed based on the statutory regulations from the IRS. The Company uses fair values determined with the assistance of an independent third-party appraisal as the basis for determining the ITCs that are passed-through to and claimed by the Fund investors. Since the Company cannot determine how the IRS will evaluate system values used in claiming ITCs, the Company is unable to reliably estimate the maximum potential future payments that it could have to make under this obligation as of each balance sheet date.

Litigation

The Company is subject to certain legal proceedings, claims, investigations and administrative proceedings in the ordinary course of its business. The Company records a provision for a liability when it is both probable that the liability has been incurred and the amount of the liability can be reasonably estimated. These provisions, if any, are reviewed at least quarterly and adjusted to reflect the impacts of negotiations, settlements, rulings, advice of legal counsel and other information and events pertaining to a particular case. Depending on the nature and timing of any such proceedings that may arise, an unfavorable resolution of a matter could materially affect the Company's future consolidated results of operations, cash flows, or financial position in a particular period.

In July 2012, the Department of Treasury and the Department of Justice (together, the "Government") opened a civil investigation into the participation by residential solar developers in the Section 1603 grant program. The Government served subpoenas on several developers, including Sunrun, along with their investors and valuation firms. The focus of the investigation is the claimed fair market value of the solar systems the developers submitted to the Government in their grant applications. We have cooperated fully with the Government and plan to continue to do so. No claims have been brought against us. The Company is not able to estimate the ultimate outcome or a range of possible loss at this point.

Note 22. Net Loss Per Share

Prior to the Company's initial public offering and conversion of all preferred stock, the Company calculated net income (loss) per share (EPS) available to common stockholders using the two-class method. The two-class method allocates net income that otherwise would have been available to common shareholders to holders of participating securities. In connection with the Company's initial public offering, the Company recognized a deemed dividend of $24.9 million to Series D and E convertible preferred shareholders, as further discussed in Note 16, Shareholders' *Equity.*

Basic net income (loss) per share is computed by dividing net income (loss) available to common stockholders by the weighted-average number of common shares outstanding during the period. Diluted net income (loss) per share is computed by dividing net income (loss) available to common stockholders by the weighted-average number of common shares outstanding during the period adjusted to include the effect of potentially dilutive securities. Potentially dilutive securities are excluded from the computation of dilutive EPS in periods in which the effect would be antidilutive.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

The computation of the Company's basic and diluted net loss per share are as follows (in thousands, except share and per share amounts):

	Years Ended December 31,		
	2015	2014	2013
Numerator:			
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Deemed dividend to convertible preferred stockholders	(24,890)	—	—
Net loss available to common stockholders	(53,136)	(70,852)	(1,201)
Denominator:			
Weighted average shares used to compute net loss per share available to common stockholders, basic and diluted	55,091	22,795	9,780
Basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)

The following shares were excluded from the computation of diluted net loss per share as the impact of including those shares would be anti-dilutive:

	Year Ended December 31,		
	2015	2014	2013
Preferred stock	—	54,841	43,998
Warrants	1,251	—	—
Outstanding stock options	12,615	11,408	8,127
Unvested restricted stock units	723	—	—
ESPP	79	—	—
Total	14,668	66,249	52,125

Note 23. Related Party Transactions

An individual who serves as one of the Company's directors has direct and indirect ownership interests in Enphase Energy, Inc. For the years ended December 31, 2015 and 2014, the Company recorded $11.9 million and $8.9 million, respectively, in purchases from Enphase Energy, Inc. and had outstanding payables of $0.7 million and $1.1 million as of December 31, 2015 and 2014.

An individual who served as one of the Company's directors until March 2015 and his spouse have a direct material ownership interest in REC Solar Commercial Corporation (RECC). For the years ended December 31, 2015 and 2014, the Company recorded $0.3 million and $7.6 million, respectively, in solar energy systems and products sales revenue from sales to RECC and had outstanding receivables of $0.0 million and $0.1 million as of December 31, 2015 and 2014, respectively.

Note 24. Subsequent Events

In January 2016, certain subsidiaries of the Company entered into secured credit facilities agreements with a syndicate of banks for up to $250.0 million in committed facilities. The facilities include a $220.0 million aggregate facility ("Aggregate Facility"), $23.0 million term loan ("Term Loan") and a $7.0 million letter of credit facility. The Aggregate Facility and letter of credit bear an interest rate of LIBOR + 250 basis points for the initial three-year revolving availability period, stepping up to LIBOR + 275 basis points in the following two-year period. The Term Loan bears an interest rate of LIBOR + 500 basis points (with a LIBOR floor of 100 basis points) in the first three years, stepping up to LIBOR plus 650 basis points in the following two-year period. The principal and accrued interest on any outstanding loans mature on December 31, 2020.

Sunrun Inc.
Notes to Consolidated Financial Statements — Continued

The facilities are non-recourse to Sunrun and are secured by net cash flows of certain subsidiaries from power purchase agreements and leases, less certain operating, maintenance and other expenses which are available to the borrowers after distributions to tax equity investors. The facilities contain customary covenants including the requirement to maintain certain financial measurements and provide lender reporting. The credit facilities also contain certain provisions in the event of default which entitle lenders to take certain actions including acceleration of amounts due under the facilities.

In March 2016, a subsidiary of the Company entered into a $24.5 million secured, non-recourse loan agreement. The loan will be repaid through cashflows from a lease pass-through arrangement previously entered into by the Company. The loan matures in September 2022 and has an interest rate of LIBOR + 2.25%. The loan agreement contains customary covenants including the requirement to maintain certain financial measurements and provide lender reporting. The loan also contains certain provisions in the event of default which entitles the lender to take certain actions including acceleration of amounts due under the loan.

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure.

Not applicable

Item 9A. Controls and Procedures.

Evaluation of Disclosure Controls and Procedures

We carried out an evaluation, under the supervision and with the participation of our management, including our Chief Executive Officer and our Chief Financial Officer, of the effectiveness of our "disclosure controls and procedures" as of the end of the period covered by this Annual Report on Form 10-K, pursuant to Rules 13a-15(e) and 15d-15(e) under the Exchange Act.

In connection with that evaluation, our Chief Executive Officer and our Chief Financial Officer concluded that our disclosure controls and procedures were effective and designed to provide reasonable assurance that the information required to be disclosed is recorded, processed, summarized and reported within the time periods specified in the Securities and Exchange Commission rules and forms as of December 31, 2015. The term "disclosure controls and procedures," as defined in Rules 13a-15l and 15d-15l under the Securities Exchange Act of 1934, as amended (the "Exchange Act"), means controls and other procedures of a company that are designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the SEC's rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is accumulated and communicated to the company's management, including its principal executive and principal financial officers, or persons performing similar functions, as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures.

Changes in Internal Control over Financial Reporting

There was no change in our internal control over financial reporting identified in connection with the evaluation required by Rule 13a-15(d) and 15d-15(d) of the Exchange Act that occurred during the period covered by this Annual Report on Form 10-K that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Management's Report on Internal Control over Financial Reporting

This Annual Report on Form 10-K does not include a report of management's assessment regarding internal control over financial reporting or an attestation report of our independent registered public accounting firm due to a transition period established by the rules of the SEC for newly public companies.

Item 9B. Other Information.

None.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

The information required by this Item 10 of Form 10-K that is found in our proxy statement to be filed with the SEC in connection with the solicitation of proxies for our 2016 Annual Meeting of Stockholders (Proxy Statement) is incorporated by reference to our 2015 Proxy Statement. The 2015 Proxy Statement will be filed with the SEC within 120 days after the year-end of the fiscal year which this report relates.

Item 11. Executive Compensation.

The information required by this Item 11 will be set forth in the Proxy Statement and is incorporated herein by reference.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.

The information required by this Item 12 will be set forth in the Proxy Statement and is incorporated herein by reference.

Item 13. Certain Relationships and Related Transactions, and Director Independence.

The information required by this Item 13 will be set forth in the Proxy Statement and is incorporated herein by reference.

Item 14. Principal Accounting Fees and Services.

The information required by this Item 14 will be set forth in the Proxy Statement and is incorporated herein by reference.

PART IV

Item 15. Exhibits, Financial Statement Schedules.

Documents filed as part of this report are as follows:

(1) Consolidated Financial Statements

Our Consolidated Financial Statements are listed in the "Index to Consolidated Financial Statements" under Item 8 of Part II of this Annual Report.

(2) Financial Statement Schedules

The required information is included elsewhere in this Annual Report, not applicable, or not material.

(3) Exhibits

The exhibits listed in the accompanying "Exhibit Index" are filed or incorporated by reference as part of this Annual Report.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, as amended, the Registrant has duly caused this Report to be signed on its behalf by the undersigned, thereunto duly authorized.

Company Name

Date: March 10, 2016

By: /s/ Lynn Jurich
Lynn Jurich
Chief Executive Officer and Director

Pursuant to the requirements of the Securities Exchange Act of 1934, as amended, this Report has been signed below by the following persons on behalf of the Registrant in the capacities and on the dates indicated.

Name	Title	Date
/s/ Lynn Jurich **Lynn Jurich**	Chief Executive Officer and Director (Principal Executive Officer)	March 10, 2016
/s/ Robert Komin **Robert Komin**	Chief Financial Officer (Principal Accounting and Financial Officer)	March 10, 2016
/s/ Edward Fenster **Edward Fenster**	Chairman and Director	March 10, 2016
/s/ Steve Vassallo **Steve Vassallo**	Director	March 10, 2016
/s/ Richard Wong **Richard Wong**	Director	March 10, 2016
/s/ Gerald Risk **Gerald Risk**	Director	March 10, 2016
/s/ Jameson McJunkin **Jameson McJunkin**	Director	March 10, 2016
/s/ Katherine August-deWilde **Katherine August-deWilde**	Director	March 10, 2016

EXHIBIT INDEX

Exhibit Number	Exhibit Description	Incorporated by Reference Form	File No.	Exhibit	Filing Date
3.1	Amended and Restated Certificate of Incorporation of the Registrant	10-Q	001-37511	3.1	9/15/15
3.2	Amended and Restated Bylaws of the Registrant	10-Q	001-37511	3.2	9/15/15
4.1	Form of common stock certificate of the Registrant.	S-1	333-205217	4.1	6/25/15
4.2	Form of Warrant	8-K	001-37511	4.1	10/2/15
4.3	Tenth Amended and Restated Investors' Rights Agreement among the Registrant and certain holders of its capital stock, dated as of March 31, 2015.	S-1	333-205217	4.2	6/25/15
4.4	Shareholders Agreement among the Registrant and certain holders of its capital stock, dated as of April 1, 2015.	S-1	333-205217	4.4	6/25/15
4.5	Form of Stock Issuance Agreement.	S-1/A	333-205217	4.4	7/22/15
10.1+	Form of Indemnification Agreement between the Registrant and each of its directors and executive officers.	S-1	333-205217	10.1	6/25/15
10.2+	Sunrun Inc. 2015 Equity Incentive Plan and related form agreements.	S-1/A	333-205217	10.2	7/22/15
10.3+	Sunrun Inc. 2015 Employee Stock Purchase Plan and related form agreements.	S-1/A	333-205217	10.3	7/22/15
10.4+	Sunrun Inc. 2014 Equity Incentive Plan.	S-1	333-205217	10.4	6/25/15
10.5+	Sunrun Inc. 2013 Equity Incentive Plan and related form agreements.	S-1	333-205217	10.5	6/25/15
10.6+	Sunrun Inc. 2008 Equity Incentive Plan and related form agreements.	S-1	333-205217	10.6	6/25/15
10.7+	Mainstream Energy Corporation 2009 Stock Plan.	S-1	333-205217	10.7	6/25/15
10.8+	Sunrun Inc. Executive Incentive Compensation Plan.	S-1	333-205217	10.8	6/25/15
10.9+	Key Employee Change in Control and Severance Plan and Summary Plan Description.	S-1	333-205217	10.9	6/25/15
10.10+	Employment Letter between the Registrant and Lynn Jurich, dated as of May 8, 2015.	S-1	333-205217	10.10	6/25/15
10.11+	Employment Letter between the Registrant and Edward Fenster, dated as of May 8, 2015.	S-1	333-205217	10.11	6/25/15
10.12+	Employment Letter between the Registrant and Bob Komin, dated as of May 8, 2015.	S-1	333-205217	10.12	6/25/15
10.13+	Employment Letter between the Registrant and Thomas Holland, dated as of May 8, 2015.	S-1	333-205217	10.13	6/25/15
10.14+	Employment Letter between the Registrant and Paul Winnowski, dated as of May 8, 2015.	S-1	333-205217	10.14	6/25/15

Exhibit Number	Exhibit Description	Incorporated by Reference Form	File No.	Exhibit	Filing Date
10.15+	Board Services Agreement between the Registrant and Gerald Risk, dated as of February 1, 2014.	S-1	333-205217	10.15	6/25/15
10.16	Agreement of Sublease between the Registrant and Visa U.S.A. Inc., dated as of April 1, 2013, as amended on April 29, 2013.	S-1	333-205217	10.16	6/25/15
10.17¥	Credit Agreement among the Registrant, Credit Suisse Securities (USA) LLC and the other parties thereto, dated as of April 1, 2015.	S-1	333-205217	10.17	6/25/15
10.18¥	Credit Agreement among Sunrun Aurora Portfolio 2014-A, LLC, Investec Bank PLC, Keybank National Association and the Lenders from time to time as party thereto, dated December 31, 2014.	S-1	333-205217	10.18	6/25/15
10.19	Transition, Separation and General Release Agreement, dated December 7, 2015 between Tom Holland and Sunrun Inc.	8-K	001-37511	10.1	12/8/15
21.1	List of subsidiaries of the Registrant.	S-1	333-205217	21.1	6/25/15
23.1	Consent of Independent Registered Public Accounting Firm.				
31.1	Certification of Chief Executive Officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.				
31.2	Certification of Chief Financial Officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.				
32.1	Certifications of Chief Executive Officer and Chief Financial Officer pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.				
101.INS	XBRL Instance Document.				
101.SCH	XBRL Taxonomy Schema Linkbase Document.				
101.CAL	XBRL Taxonomy Definition Linkbase Document.				
101.DEF	XBRL Taxonomy Calculation Linkbase Document.				
101.LAB	XBRL Taxonomy Labels Linkbase Document.				
101.PRE	XBRL Taxonomy Presentation Linkbase Document.				

† The certifications attached as Exhibit 32.1 that accompany this Annual Report on Form 10-K, are deemed furnished and not filed with the Securities and Exchange Commission and are not to be incorporated by reference into any filing of Sunrun Inc. under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended, whether made before or after the date of this Annual Report on Form 10-K, irrespective of any general incorporation language contained in such filing.
\+ Indicates management contract or compensatory plan.
¥ Confidential treatment has been requested as to certain portions of this exhibit, which portions have been omitted and submitted separately to the Securities and Exchange Commission.

Exhibit 23.1

Consent of Independent Registered Public Accounting Firm

We consent to the incorporation by reference in the Registration Statement (Form S-8 No. 333-206120) pertaining to the Sunrun Inc. 2015 Equity Incentive Plan, Sunrun Inc. 2015 Employee Stock Purchase Plan, Sunrun Inc. 2014 Equity Incentive Plan, Sunrun Inc. 2013 Equity Incentive Plan, Sunrun Inc. 2008 Equity Incentive Plan, and Mainstream Energy Corporation 2009 Stock Plan of Sunrun, Inc. of our report dated March 10, 2016, with respect to the consolidated financial statements of Sunrun, Inc. included in this Annual Report (Form 10-K) for the year ended December 31, 2015.

/s/ Ernst & Young LLP
San Francisco, California
March 10, 2016

Exhibit 31.1

**CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) UNDER THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Lynn Jurich, certify that:

1. I have reviewed this Annual Report on Form 10-K of Sunrun Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) for the registrant and have:
   (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
   (b) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
   (c) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an Annual Report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
   (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
   (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 10, 2016 By: /s/ Lynn Jurich

Lynn Jurich
Chief Executive Officer and Director
(Principal Executive Officer)

Exhibit 31.2

**CERTIFICATION PURSUANT TO
RULES 13a-14(a) AND 15d-14(a) UNDER THE SECURITIES EXCHANGE ACT OF 1934,
AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Bob Komin, certify that:

1. I have reviewed this Annual Report on Form 10-K of Sunrun Inc.;
2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;
3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;
4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) for the registrant and have:
   (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;
   (b) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and
   (c) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an Annual Report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and
5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):
   (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and
   (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 10, 2016

By: /s/ Bob Komin
Bob Komin
Chief Financial Officer
(Principal Accounting and Financial Officer)

Exhibit 32.1

**Certifications Pursuant to
Section 906 of the Sarbanes-Oxley Act of 2002
(18 U.S.C. Section 1350)**

Pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, each of the undersigned officers of Sunrun Inc. (the "Company") hereby certifies that the Company's Annual Report on Form 10-K for the year ended December 31, 2015 (the "Report") fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934 and that the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: March 10, 2016

By: /s/ Lynn Jurich
Lynn Jurich
Chief Executive Officer and Director
(Principal Executive Officer)

By: /s/ Bob Komin
Bob Komin
Chief Financial Officer
(Principle Accounting and Financial Officer)

Attachment: XBRL INSTANCE DOCUMENT

Attachment: XBRL TAXONOMY EXTENSION SCHEMA

Attachment: XBRL TAXONOMY EXTENSION CALCULATION LINKBASE

Attachment: XBRL TAXONOMY EXTENSION DEFINITION LINKBASE

Attachment: XBRL TAXONOMY EXTENSION LABEL LINKBASE

Attachment: XBRL TAXONOMY EXTENSION PRESENTATION LINKBASE

Document and Entity Information - USD ($) $ in Millions	12 Months Ended Dec. 31, 2015	Mar. 08, 2016	Aug. 05, 2015
Document And Entity Information [Abstract]			
Document Type	10-K		
Amendment Flag	false		
Document Period End Date	Dec. 31, 2015		
Document Fiscal Year Focus	2015		
Document Fiscal Period Focus	FY		
Trading Symbol	RUN		
Entity Registrant Name	Sunrun Inc.		
Entity Central Index Key	0001469367		
Current Fiscal Year End Date	--12-31		
Entity Well-known Seasoned Issuer	No		
Entity Current Reporting Status	Yes		
Entity Voluntary Filers	No		
Entity Filer Category	Non-accelerated Filer		
Entity Public Float			$ 371.9
Entity Common Stock, Shares Outstanding		101,495,385	

Consolidated Balance Sheets - USD ($) $ in Thousands		Dec. 31, 2015	Dec. 31, 2014
Current assets:			
Cash		$ 203,864	$ 152,154
Restricted cash		9,203	2,534
Accounts receivable (net of allowances for doubtful accounts of $1,641 and $703 as of December 31, 2015 and December 31, 2014, respectively)		60,275	43,189
State tax credits receivable		9,198	5,183
Inventories		71,258	23,914
Prepaid expenses and other current assets		6,696	9,560
Total current assets		360,494	236,534
Restricted cash		8,094	6,012
Solar energy systems, net		1,992,021	1,484,251
Property and equipment, net		44,866	22,195
Intangible assets, net		22,705	13,111
Goodwill		87,543	51,786
Prepaid tax asset		190,146	109,381
Other assets		32,277	9,314
Total assets	[1]	2,738,146	1,932,584
Current liabilities:			
Accounts payable		104,133	51,166
Distributions payable to noncontrolling interests and redeemable noncontrolling interests		8,144	6,764
Accrued expenses and other liabilities		49,146	25,445
Deferred revenue, current portion		59,726	44,398
Deferred grants, current portion		13,949	13,754
Capital lease obligation, current portion		8,951	1,593
Long-term debt, current portion		2,085	2,602
Solar asset-backed notes, current portion		3,323	
Lease pass-through financing obligation, current portion		3,710	5,161
Total current liabilities		253,167	150,883
Deferred revenue, net of current portion		559,066	467,726
Deferred grants, net of current portion		220,784	226,801
Capital lease obligation, net of current portion		15,042	5,761
Line of credit		194,975	48,597
Long-term debt, net of current portion		232,378	188,052
Solar asset-backed notes, net of current portion		105,557	

Lease pass-through financing obligation, net of current portion		153,188	180,224
Other liabilities		7,144	2,424
Deferred tax liabilities		190,146	109,549
Total liabilities	[1]	$ 1,931,447	$ 1,380,017
Commitments and contingencies (Note 21)			
Redeemable noncontrolling interests		$ 147,139	$ 135,948
Stockholders' equity:			
Preferred stock			
Common stock, $0.0001 par value—authorized, 2,000,000 and 119,547 shares as of December 31, 2015 and 2014, respectively; issued and outstanding, 101,282 and 24,249 shares as of December 31, 2015 and 2014, respectively		$ 10	$ 2
Additional paid-in capital		642,229	383,860
Accumulated other comprehensive loss		(921)	
Accumulated deficit		(87,249)	(59,003)
Total stockholders' equity		554,069	324,864
Noncontrolling interests		105,491	91,755
Total equity		659,560	416,619
Total liabilities, redeemable noncontrolling interests and total equity		$ 2,738,146	1,932,584
Convertible Preferred Stock			
Stockholders' equity:			
Preferred stock			$ 5

[1] The Company's consolidated assets as of December 31, 2015 and 2014 include $1,363,615 and $986,878, respectively, in assets of variable interest entities, or VIEs, that can only be used to settle obligations of the VIEs. Solar energy systems, net, as of December 31, 2015 and 2014 were $1,305,420 and $942,655, respectively; cash as of December 31, 2015 and 2014 were $44,407 and $29,099, respectively; restricted cash as of December 31, 2015 and 2014 were $757 and $593, respectively; accounts receivable, net as of December 31, 2015 and 2014 were $12,965 and $14,351; respectively; prepaid expenses and other current assets as of December 31, 2015 and 2014 were $66 and $180, respectively. The Company's consolidated liabilities as of December 31, 2015 and 2014 include $540,464 and $474,348, respectively, in liabilities of VIEs whose creditors have no recourse to the Company. These liabilities include accounts payable as of December 31, 2015 and 2014 of $11,025 and $9,057, respectively; distributions payable to noncontrolling interests and redeemable noncontrolling interests as of December 31, 2015 and 2014 of $8,063 and $6,426, respectively; accrued expenses and other liabilities as of December 31, 2015 and 2014 of $175 and $340, respectively; deferred revenue as of December 31, 2015 and 2014 of $374,736 and $301,792, respectively; deferred grants as of December 31, 2015 and 2014 of $115,726 and $123,351, respectively; and long-term debt as of December 31, 2015 and 2014 of $30,739 and $33,382, respectively.

Consolidated Balance Sheets (Parenthetical) - USD ($) $ in Thousands		**Dec. 31, 2015**	**Dec. 31, 2014**
Allowance for doubtful accounts		$ 1,641	$ 703
Preferred stock, par value		$ 0.0001	$ 0.0001
Preferred stock, shares authorized		200,000,000	0
Preferred stock, shares issued		0	0
Preferred stock, shares outstanding		0	0
Common stock, par value		$ 0.0001	$ 0.0001
Common stock, shares authorized		2,000,000,000	119,547,000
Common stock, shares issued		101,282,000	24,249,000
Common stock, shares outstanding		101,282,000	24,249,000
Total assets	[1]	$ 2,738,146	$ 1,932,584
Solar energy systems, net		1,992,021	1,484,251
Cash		203,864	152,154
Accounts receivable, net		60,275	43,189
Prepaid expenses and other current assets		6,696	9,560
Total liabilities	[1]	1,931,447	1,380,017
Accounts payable		104,133	51,166
Distributions payable to noncontrolling interests and redeemable noncontrolling interests		8,144	6,764
Accrued expenses and other liabilities		49,146	25,445
Deferred revenue		618,792	512,124
Long-term debt		538,318	239,251
Variable Interest Entities			
Total assets		1,363,615	986,878
Solar energy systems, net		1,305,420	942,655
Cash		44,407	29,099
Restricted cash		757	593
Accounts receivable, net		12,965	14,351
Prepaid expenses and other current assets		66	180
Total liabilities		540,464	474,348
Accounts payable		11,025	9,057
Distributions payable to noncontrolling interests and redeemable noncontrolling interests		8,063	6,426
Accrued expenses and other liabilities		175	340
Deferred revenue		374,736	301,792
Deferred grants		115,726	123,351
Long-term debt		$ 30,739	$ 33,382
Convertible Preferred Stock			

Preferred stock, par value	$ 0.0001	$ 0.0001
Preferred stock, shares authorized	0	57,028,000
Preferred stock, shares issued	0	54,841,000
Preferred stock, shares outstanding	0	54,841,000
Aggregate liquidation preference	$ 0	$ 305,883

[1] The Company's consolidated assets as of December 31, 2015 and 2014 include $1,363,615 and $986,878, respectively, in assets of variable interest entities, or VIEs, that can only be used to settle obligations of the VIEs. Solar energy systems, net, as of December 31, 2015 and 2014 were $1,305,420 and $942,655, respectively; cash as of December 31, 2015 and 2014 were $44,407 and $29,099, respectively; restricted cash as of December 31, 2015 and 2014 were $757 and $593, respectively; accounts receivable, net as of December 31, 2015 and 2014 were $12,965 and $14,351; respectively; prepaid expenses and other current assets as of December 31, 2015 and 2014 were $66 and $180, respectively. The Company's consolidated liabilities as of December 31, 2015 and 2014 include $540,464 and $474,348, respectively, in liabilities of VIEs whose creditors have no recourse to the Company. These liabilities include accounts payable as of December 31, 2015 and 2014 of $11,025 and $9,057, respectively; distributions payable to noncontrolling interests and redeemable noncontrolling interests as of December 31, 2015 and 2014 of $8,063 and $6,426, respectively; accrued expenses and other liabilities as of December 31, 2015 and 2014 of $175 and $340, respectively; deferred revenue as of December 31, 2015 and 2014 of $374,736 and $301,792, respectively; deferred grants as of December 31, 2015 and 2014 of $115,726 and $123,351, respectively; and long-term debt as of December 31, 2015 and 2014 of $30,739 and $33,382, respectively.

Consolidated Statements of Operations - USD ($) shares in Thousands, $ in Thousands	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Revenue:			
Operating leases and incentives	$ 118,004	$ 84,006	$ 54,740
Solar energy systems and product sales	186,602	114,551	
Total revenue	304,606	198,557	54,740
Operating expenses:			
Cost of operating leases and incentives	111,784	72,898	43,088
Cost of solar energy systems and product sales	168,751	100,802	
Sales and marketing	145,477	78,723	22,395
Research and development	9,657	8,386	9,984
General and administrative	84,442	68,098	33,242
Amortization of intangible assets	3,695	2,269	
Total operating expenses	523,806	331,176	108,709
Loss from operations	(219,200)	(132,619)	(53,969)
Interest expense, net	33,236	27,521	11,752
Loss on early extinguishment of debt	431	4,350	
Other expenses	1,338	3,043	365
Loss before income taxes	(254,205)	(167,533)	(66,086)
Income tax benefit	(5,299)	(10,043)	(591)
Net loss	(248,906)	(157,490)	(65,495)
Net loss attributable to noncontrolling interests and redeemable noncontrolling interests	(220,660)	(86,638)	(64,294)
Net loss attributable to common stockholders	(28,246)	(70,852)	(1,201)
Deemed dividend to convertible preferred stockholders	(24,890)		
Net loss available to common stockholders	$ (53,136)	$ (70,852)	$ (1,201)
Net loss per share available to common shareholders— basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)
Weighted average shares used to compute net loss per share available to common stockholders— basic and diluted	55,091	22,795	9,780

Consolidated Statements of Comprehensive Loss - USD ($) $ in Thousands	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Statement Of Income And Comprehensive Income [Abstract]			
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Other comprehensive income:			
Unrealized loss on derivatives, net of tax benefit for the year ended December 31, 2015	(2,442)		
Less interest expense on derivatives recognized into earnings	(1,521)		
Comprehensive loss	$ (29,167)	$ (70,852)	$ (1,201)

Consolidated Statements of Redeemable Noncontrolling Interests and Stockholders' Equity - USD ($) shares in Thousands, $ in Thousands	Total	Series E Convertible Preferred Stock	Series D And E Preferred Stock	Redeemable Noncontrolling Interests	Preferred Stock	Preferred Stock Series E Convertible Preferred Stock	Common Stock	Common Stock Series D And E Preferred Stock	Additional Paid-In Capital	Additional Paid-In Capital Series E Convertible Preferred Stock	Additional Paid-In Capital Series D And E Preferred Stock	Accu O Compi I
Beginning Balance at Dec. 31, 2012				$ 95,941								
Beginning Balance at Dec. 31, 2012	$ 222,661				$ 4		$ 1		$ 152,134			
Beginning Balance, (in shares) at Dec. 31, 2012					43,998		9,450					

Exercise of stock options	1,119						1,119	
Exercise of stock options, (in shares)						962		
Stock-based compensation	2,655						2,655	
Acquisition of noncontrolling interests			(16,906)					
Acquisition of noncontrolling interests	(5,118)						(5,118)	
Income tax effect of acquisition of noncontrolling interests	2,339						2,339	
Contributions from noncontrolling interests and redeemable noncontrolling interests	92,142		73,189					
Distributions to noncontrolling interests and redeemable noncontrolling interests	(61,178)		(8,973)					
Net loss	(31,909)		(33,586)					
Net loss, Noncontrolling Interest	(30,708)							
Ending Balance at Dec. 31, 2013			109,665					
Ending Balance at Dec. 31, 2013	222,711			$ 4		$ 1	153,129	
Ending Balance, (in shares) at Dec. 31, 2013				43,998		10,412		
Conversion of Preferred Stock		$ 143,393			$ 1			$ 143,392
Conversion of Preferred Stock, (in shares)				(36)		36		
Issuance of Series E convertible preferred stock, (in shares)					10,879			
Issuance of shares for an acquisition	75,281					$ 1	75,280	
Issuance of shares for an acquisition, (in shares)						12,763		
Exercise of stock options	2,707						2,707	
Exercise of stock options, (in shares)						1,038		
Stock-based compensation	9,352						9,352	
Contributions from noncontrolling interests and redeemable noncontrolling interests	80,653		88,837					
Distributions to noncontrolling interests and redeemable noncontrolling interests	(10,923)		(11,619)					
Net loss	(106,555)		(50,935)					
Net loss, Noncontrolling Interest	(35,703)							
Ending Balance at Dec. 31, 2014			135,948					
Ending Balance at Dec. 31, 2014	416,619			$ 5		$ 2	383,860	
Ending Balance, (in shares) at Dec. 31, 2014				54,841		24,249		
Issuance of Series E convertible preferred stock, (in shares)				(54,841)		54,841		
Issuance of shares for an acquisition	19,148						19,148	
Issuance of shares for an acquisition, (in shares)						1,650		
Exercise of stock options	$ 3,548						3,548	
Exercise of stock options, (in shares)	1,210					1,210		
Issuance of restricted stock units, net of tax withholdings	$ (103)						(103)	
Issuance of restricted stock units, net of tax withholdings, (in shares)						182		
Stock-based compensation	16,002						16,002	
	147,238		128,466					

Contributions from noncontrolling interests and redeemable noncontrolling interests									
Distributions to noncontrolling interests and redeemable noncontrolling interests	(17,193)		(12,924)						
Inducement shares issued		$ 23,349				$ 1		$ 23,348	
Inducement shares issued, (in shares)						1,668			
Deemed dividend		$ (24,890)						$ (24,890)	
Conversion of convertible preferred stock to common stock				$ (5)	$ 5				
Issuance of common stock in connection with underwritten public offering, net of issuance costs	221,318				$ 2		221,316		
Issuance of common stock in connection with underwritten public offering, net of issuance costs, (in shares)					17,482				
Net loss	(144,555)		(104,351)						
Net loss, Noncontrolling Interest	(116,309)								
Unrealized Gain Loss On Derivatives	(921)								$ (921
Ending Balance at Dec. 31, 2015			$ 147,139						
Ending Balance at Dec. 31, 2015	$ 659,560				$ 10		$ 642,229		$ (921
Ending Balance, (in shares) at Dec. 31, 2015					101,282				

Consolidated Statements of Redeemable Noncontrolling Interests and Stockholders' Equity (Parenthetical) $ in Thousands	12 Months Ended Dec. 31, 2014 USD ($)
Series E Convertible Preferred Stock	
Issuance costs of preferred stock	$ 7,108

Consolidated Statements of Cash Flows - USD ($) $ in Thousands	12 Months Ended Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Operating activities:			
Net loss	$ (248,906)	$ (157,490)	$ (65,495)
Adjustments to reconcile net loss to net cash provided by (used in) operating activities:			
Noncash losses	3,516	4,350	
Depreciation and amortization, net of amortization of deferred grants	71,373	49,541	30,192
Bad debt expense	1,998	546	172
Interest on lease pass-through financing	11,959	10,204	6,437
Noncash tax benefit	(5,299)	(10,043)	(591)
Noncash interest expense	6,997	2,384	1,551
Stock-based compensation expense	15,823	9,218	2,655
Reduction in lease pass—through financing obligations	(16,780)	(12,323)	(9,573)
Changes in operating assets and liabilities:			
Accounts receivable	(15,517)	(14,075)	(954)
Inventories	(47,344)	(3,788)	
Prepaid and other assets	(884)	(1,920)	(2,176)
Accounts payable	50,946	11,063	1,351
Accrued expenses and other liabilities	19,168	7,010	2,734
Deferred revenue	47,684	97,395	57,071
Net cash provided by (used in) operating activities	(105,266)	(7,928)	23,374
Investing activities:			
Payments for the costs of solar energy systems, leased and to be leased	(594,887)	(412,267)	(322,034)
Purchases of property and equipment	(13,027)	(15,317)	(3,720)
Acquisitions of businesses, net of cash acquired	(19,575)	(36,384)	
Net cash used in investing activities	(627,489)	(463,968)	(325,754)
Financing activities:			
Proceeds from grants and state tax credits, net of recapture	4,685	1,579	29,321

Proceeds from issuance of debt	544,385	192,750	148,282
Repayment of debt	(357,878)	(120,054)	(612)
Payment of debt fees	(14,798)	(7,939)	(5,493)
Proceeds from solar asset-backed notes	111,000		
Repayment of solar asset-backed notes	(2,120)		
Proceeds from issuance of convertible preferred stock, net of issuance costs		143,393	
Proceeds from lease pass-through financing obligations	129,121	174,159	64,888
Repayment of lease pass-through financing obligations	(88,918)		
Contributions received from noncontrolling interests and redeemable noncontrolling interests	275,704	169,490	165,331
Distributions paid to noncontrolling interests and redeemable noncontrolling interests	(28,737)	(31,967)	(63,907)
Acquisition of noncontrolling interests		(21)	(22,024)
Proceeds from exercises of stock options	3,548	2,707	1,119
Proceeds from initial public offering, net of offering costs	222,078		
Payment of capital lease obligation	(4,854)	(1,181)	
Change in restricted cash	(8,751)	1,435	(4,611)
Net cash provided by financing activities	784,465	524,351	312,294
Net increase in cash	51,710	52,455	9,914
Cash, beginning of period	152,154	99,699	89,785
Cash, end of period	203,864	152,154	99,699
Supplemental disclosures of cash flow information			
Cash paid for interest	11,954	11,101	3,657
Supplemental disclosures of noncash investing and financing activities			
Costs of solar energy systems and property and equipment included in accounts payable and accrued expenses	15,850	14,074	14,469
Distributions payable to noncontrolling interests and redeemable noncontrolling interests	8,144	6,764	$ 16,189
Vehicles acquired under capital leases	21,556	5,666	
Noncash purchase consideration on acquisition of business	18,718	$ 76,964	
Offering costs prepaid in prior year	760		
Series D and E Preferred Shares			
Supplemental disclosures of noncash investing and financing activities			
Deemed dividend on Series D and E preferred shares	$ 24,890		

Organization	12 Months Ended Dec. 31, 2015
Organization Consolidation And Presentation Of Financial Statements [Abstract]	
Organization	See Note 1 below

Note 1. Organization

Sunrun Inc. ("Sunrun" or the "Company") was originally formed in 2007 as a California limited liability company, and was converted into a Delaware corporation in 2008. The Company is engaged in the design, development, installation sale, ownership, and maintenance of residential solar energy systems ("Projects") in the United States.

Sunrun acquires customers directly and through relationships with various solar and strategic partners ("Partners"). The Projects are constructed either by Sunrun or by Sunrun's Partners and are owned by the Company. Sunrun's customers enter into a power purchase agreement ("PPA") or a lease (each, a "Customer Agreement") which typically has a term of 20 years. Sunrun monitors, maintains and insures the Projects. As a result of the acquisition of Mainstream Energy Corporation, its fulfillment business AEE Solar and its racking business SnapNrack (collectively, "MEC") completed in February 2014, the Company also sells solar energy systems and products to customers.

The Company has formed various subsidiaries ("Funds") to finance the development of Projects. These Funds, structured as limited liability companies, obtain financing from outside investors and purchase or lease Projects from Sunrun under master purchase or master lease agreements. The Company currently utilizes three legal structures in its investment Funds, which are referred to as: (i) lease pass-throughs, (ii) partnership-flips and (iii) joint venture ("JV") inverted leases.

Sunrun acquired Clean Energy Experts, LLC ("CEE"), a consumer demand and solar lead generation company, in April 2015, to support the growth of the business, including reducing costs of obtaining customer leads externally. As a result of acquisition, the Company also sells a portion of solar leads generated to customers.

The Company completed its initial public offering in August 2015 and its common stock is listed on the NASDAQ Global Select Market under the symbol "RUN".

Summary of Significant Accounting Policies	12 Months Ended Dec. 31, 2015
Accounting Policies [Abstract]	
Summary of Significant Accounting Policies	See Note 2 below

Note 2. Summary of Significant Accounting Policies

Basis of Presentation and Principles of Consolidation

The consolidated financial statements have been prepared in conformity with U.S. generally accepted accounting principles ("GAAP") and reflect the accounts and operations of the Company and those of its subsidiaries, including Funds, in which the Company has a controlling financial interest. The typical condition for a controlling financial interest ownership is holding a majority of the voting interests of an entity. However, a controlling financial interest may also exist in entities, such as variable interest entities ("VIEs"), through arrangements that do not involve controlling financial interests. In accordance with the provisions of Financial Accounting Standards Board ("FASB") Accounting Standards Codification Topic 810 ("ASC 810") Consolidation, the Company consolidates any VIE of which it is the primary beneficiary. The primary beneficiary, as defined in ASC 810, is the party that has (1) the power to direct the activities of a VIE that most significantly impact the VIE's economic performance and (2) the obligation to absorb the losses of the VIE or the right to receive benefits from the VIE that could potentially be significant to the VIE. The Company evaluates its relationships with its VIEs on an ongoing basis to determine whether it continues to be the primary beneficiary. The consolidated financial statements reflect the assets and liabilities of VIEs that are consolidated. All intercompany transactions and balances have been eliminated in consolidation.

Reclassifications

Certain prior period amounts have been reclassified to conform to current period presentation.

Use of Estimates

The preparation of the consolidated financial statements requires management to make estimates and assumptions that affect the amounts reported in the consolidated financial statements and accompanying notes. The Company regularly makes significant estimates and assumptions, including, but not limited to, the estimates that affect the collectability of accounts receivable, the valuation of inventories, the useful lives and estimated residual values of solar energy systems, the useful lives of property and equipment, the valuation and useful lives of intangible assets, the fair value of assets acquired and liabilities assumed in business combinations, the effective interest rate used to amortize lease pass-through financing obligations, the valuation of stock-based compensation, the valuation of the Company's common stock, the determination of valuation allowances associated with deferred tax assets, fair value of debt instruments disclosed and the redemption value of redeemable noncontrolling interests. The Company bases its estimates on historical experience and on various other assumptions believed to be reasonable. Actual results may differ from such estimates.

Segment Information

The Company has one operating segment with one business activity, providing solar energy services and products to customers. The Company's chief operating decision maker ("CODM") is its Chief Executive Officer, who manages operations on a consolidated basis for purposes of allocating resources. When evaluating performance and allocating resources, the CODM reviews financial information presented on a consolidated basis.

Revenues from external customers for each group of similar products and services are as follows (in thousands):

	Year Ended December 31,		
	2015	2014	2013
Operating leases	$ 86,332	$ 63,962	$ 44,249
Incentives	31,672	20,044	10,491
Operating leases and incentives	118,004	84,006	54,740
Solar energy systems	50,191	23,687	—
Products	136,411	90,864	—
Solar energy systems and product sales	186,602	114,551	—
Total revenue	$ 304,606	$ 198,557	$ 54,740

Cash

Cash consists of bank deposits held in checking and savings accounts. The Company considers all highly liquid investments purchased with an original maturity of three months or less to be cash equivalents. The Company has exposure to credit risk to the extent cash balances exceed amounts covered by federal deposit insurance. The Company believes that its credit risk is not significant.

Restricted Cash

Restricted cash represents balances collateralizing standby letters of credit, amounts related to replacement of solar energy systems and obligations under certain financing transactions.

Accounts Receivable

Accounts receivable consist of amounts due from customers as well as state and utility rebates due from government agencies and utility companies. Under arrangements with customers, the customers typically assign incentive rebates to the Company.

Accounts receivable are recorded at net realizable value. The Company maintains allowances for the applicable portion of receivables when collection becomes doubtful. The Company estimates anticipated losses from doubtful accounts based upon the expected collectability of all accounts receivables, which takes into account the number of days past due, collection history, identification of specific customer exposure, and current economic trends. Once a receivable is deemed to be uncollectible, it is written off. In 2015, 2014 and 2013, the Company recorded provision for bad debt expense of $2.0 million, $0.5 million and $0.2 million, respectively, and wrote-off uncollectible receivables of $1.1 million, $0.1 million and $0.0 million, respectively.

Accounts receivable, net consists of the following (in thousands):

	December 31,	
	2015	2014
Customer receivables	$ 46,169	$ 24,477
Customer deposits	10,150	11,135
Other receivables	4,376	5,936
Rebates receivable	1,221	2,344
Allowance for doubtful accounts	(1,641)	(703)
Total	$ 60,275	$ 43,189

State Tax Credits Receivable

State tax credits receivable are recognized upon submission of the state income tax return.

Inventories

Inventories are stated at the lower of cost or market on a first-in, first-out basis. Inventories consist of raw materials such as photovoltaic panels, inverters and mounting hardware as well as miscellaneous electrical components that are sold as-is by the distribution operations and used in installations and work-in-process. Work-in-process primarily relates to solar energy systems that will be sold to customers, which are partially installed and have yet to pass inspection by the responsible city or utility department. For solar energy systems where the Company performs the installation, the Company commences transferring component parts from inventories to construction in progress, a component of solar energy systems, once a lease contract with a lease customer has been executed and the component parts have been assigned to a specific project. Additional costs incurred including labor and overhead are recorded within construction in progress.

The Company periodically reviews inventories for unusable and obsolete items based on assumptions about future demand and market conditions. Based on this evaluation, provisions are made to write inventories down to their market value.

Solar Energy Systems, net

The Company records solar energy systems leased to customers and solar energy systems that are under installation as solar energy systems, net on its consolidated balance sheet. Solar energy systems, net is comprised of system equipment costs and initial direct costs related to solar energy systems, less accumulated depreciation and amortization. Depreciation on solar energy systems is calculated on a straight-line basis to their estimated residual values over the estimated useful lives of the systems to the Company, which is the expected holding period of typically 20 years, coinciding with the initial lease term of the Company's Customer Agreements. The Company has determined that it is more likely that the customer will elect to purchase the solar energy system at the end of the initial lease period rather than renew their customer agreement, due to the cost of purchasing the solar energy system being significantly lower than it was at the initiation of the customer agreement, in order to reduce electricity costs, as well as increase the value and marketing attributes of their home. If a customer elects to renew their lease at the end of the initial lease term, the residual value will be depreciated over a revised estimated remaining useful life to the Company. The Company periodically reviews its estimates of residual value and its estimated useful life and recognizes changes in estimates by prospectively adjusting depreciation expense. Inverters are depreciated over their estimated useful life of 10 years.

Solar energy systems under installation will be depreciated as solar energy systems leased to customers when the respective systems are completed and interconnected.

Initial direct costs from the origination of Customer Agreements are capitalized and amortized over the initial term of the related Customer Agreement and are included within solar energy systems, net in the consolidated balance sheets. Amortization of these costs is recorded in cost of operating leases and incentives in the accompanying consolidated statements of operations.

Property and Equipment, net

Property and equipment, net consists of leasehold improvements, furniture, computer hardware and software, machinery and equipment, and automobiles. All property and equipment are stated at historical cost net of accumulated depreciation. Repairs and maintenance are expensed as incurred.

Property and equipment is depreciated on a straight-line basis over the following periods:

Leasehold improvements	Lesser of estimated useful life of the asset or lease term, which is typically 2 to 6 years
Furniture	5 years
Computer hardware and software	3 years
Machinery and equipment	5-7 years
Automobiles	4-5 years

Capitalization of Software Costs

For costs incurred in the development of internal use software, the Company capitalizes costs incurred during the application development stage. Costs related to preliminary project activities and post implementation activities are expensed as incurred. Internal use software is amortized on a straight-line basis over its estimated useful life.

Intangible Assets, net

Finite-lived intangible assets are initially recorded at fair value and presented net of accumulated amortization. Intangible assets are amortized on a straight-line basis over their estimated useful lives as follows:

Customer relationships	6-10 years
Backlog	1 year
Developed technology	5 years
Trade names	4 months to 5 years

Impairment of Long-Lived Assets

The carrying amounts of the Company's long-lived assets, including solar energy systems and intangible assets subject to depreciation and amortization, are periodically reviewed for impairment whenever events or changes in circumstances indicate that the carrying value of these assets may not be recoverable or that the useful life is shorter than originally estimated. Factors that are considered in deciding when to perform an impairment review would include significant negative industry or economic trends and significant changes or planned changes in the use of the assets. Recoverability of these assets is measured by comparison of the carrying amount of each asset to the future undiscounted cash flows the asset is expected to generate over its remaining life. If the asset is considered to be impaired, the amount of any impairment is measured as the difference between the carrying value and the fair value of the impaired asset. If the useful life is shorter than originally estimated, the Company amortizes the remaining carrying value over the new shorter useful life. No impairment of long-lived assets has been recorded for the years ended December 31, 2015, 2014 and 2013.

Business Combinations

Acquisitions of entities and certain solar projects with the associated leases that meet the definition of a business are accounted for as business combinations in accordance with ASC 805, *Business Combinations*. The Company records assets acquired and liabilities assumed based on their estimated fair values at the acquisition date. The excess of the purchase price over those fair values is recorded as goodwill. Acquisition-related expenses are expensed as incurred.

Goodwill

Goodwill represents the excess of the purchase price over the fair value of assets acquired and liabilities assumed of MEC in February 2014 and CEE in April 2015. Goodwill is reviewed for impairment at least annually or whenever events or changes in circumstances indicate that the carrying amount may be impaired. The Company has determined that it operates as one reporting unit and the Company's goodwill is recorded at the enterprise level. The Company performs its annual impairment test of goodwill on October 1 of each fiscal year or whenever events or circumstances change or occur that would indicate that goodwill might be impaired. When assessing goodwill for impairment, the Company uses qualitative and if necessary, quantitative methods in accordance with FASB ASC Topic 350 ("ASC 350"), *Goodwill*. The Company also considers its enterprise value and if necessary, discounted cash flow model, which involves assumptions and estimates, including the Company's future financial performance, weighted-average cost of capital and interpretation of currently enacted tax laws.

Circumstances that could indicate impairment and require the Company to perform a quantitative impairment test include a significant decline in the Company's financial results, a significant decline in the Company's enterprise value relative to its net book value, an unanticipated change in competition or the Company's market share and a significant change in the Company's strategic plans. The Company did not note any indicators of impairment in the qualitative assessment that would require a quantitative analysis in 2015. The Company did not have any goodwill prior to 2014, and no impairment charges have been recorded to date.

Deferred Revenue

Deferred revenue consists of amounts for which the criteria for revenue recognition have not yet been met and includes a) amounts that are collected from customers, including upfront deposits and lease prepayments; b) rebates and incentives received and receivables from utility companies and various local and state government agencies; c) amounts related to investment tax credits ("ITC") that the Company monetized in connection with its lease-pass through financing obligations; and d) amounts received related to the sales of solar renewable energy credits ("SRECs").

Deferred revenue consists of the following (in thousands):

	December 31, 2015	December 31, 2014
Customer payments	$ 370,754	$ 311,193
Rebates and incentives	102,827	101,318
ITCs	126,853	85,767
SRECs	18,358	13,846
Total	$ 618,792	$ 512,124

Deferred Grants

Deferred grants consist of U.S. Treasury grants and State Grants. The Company applied for a renewable energy technologies income tax credit offered by one of the states in the form of a cash payment and deferred the tax credit as a grant on the consolidated balance sheets. The Company initially recorded the grants as deferred grant income and recognizes the benefit on a straight-line basis over the estimated depreciable life of the associated assets as a reduction in cost of operating leases and incentives.

Warranty Accrual

The Company provides warranty service and replacement on the majority of all solar energy systems sold and installed. The major components are generally covered under a manufacturer's limited warranty.

In resolving claims under warranty services, the Company has the option of remedying the defect to the warranted level through repair, refurbishment, or replacement. The warranty accrual is estimated and is re-evaluated regularly by management based upon the Company's warranty policy, applicable contractual warranty obligations, an analysis of historical costs and age of installed systems and management's evaluation of current claims in process. The warranty accrual is recorded as a component of accrued expenses and other liabilities in the Company's consolidated balance sheets. Prior to the Company's acquisition of the residential business from MEC in February 2014, no warranty accrual was necessary. The Company recorded a warranty accrual of $1.1 million and $0.9 million as of December 31, 2015 and 2014, respectively.

Solar Energy Performance Guarantees

The Company guarantees to customers certain specified minimum solar energy production output for solar facilities over the initial term of the Customer Agreements. The Company monitors the solar energy systems to determine whether these specified minimum outputs are being achieved. If the Company determines that the guaranteed minimum energy output is not achieved, it records a liability for the estimated amounts payable. As of December 31, 2015 and 2014, the Company recorded liabilities of $0.3 million and $0.4 million, respectively, as accrued expenses and other liabilities in the consolidated balance sheets relating to these guarantees based on the Company's assessment of its exposure.

Derivative Financial Instruments

The Company recognizes all derivative instruments on the balance sheet at their fair value. Changes in the fair value of derivatives are recorded each period in current earnings or other comprehensive loss if a derivative is designated as part of a hedge transaction. The ineffective portion of the hedge, if any, is immediately recognized in earnings.

Beginning in 2015, the Company uses derivative financial instruments, primarily interest rate swaps, to manage its exposure to interest rate risks on its syndicated term loans, which are recognized on the balance sheet at their fair values. On the date that the Company enters into a derivative contract, the Company formally documents all relationships between the hedging instruments and the hedged items, as well as its risk management objective and strategy for undertaking each hedge transaction. Derivative instruments designated in a hedge relationship to mitigate exposure to variability in expected future cash flows, or other types of forecasted transactions, are considered cash flow hedges. Cash flow hedges are accounted for by recording the fair value of the derivative instrument on the balance sheet as either a freestanding asset or liability. Changes in the fair value of a derivative that is designated and qualifies as an effective cash flow hedge are recorded in accumulated other comprehensive loss, net of tax, until earnings are affected by the variability of cash flows of the hedged item. Any derivative gains and losses that are not effective in hedging the variability of expected cash flows of the hedged item or that do not qualify for hedge accounting treatment are recognized directly into income. At the hedge's inception and at least quarterly thereafter, a formal assessment is performed to determine whether changes in cash flows of the derivative instrument have been highly effective in offsetting changes in the cash flows of the hedged items and whether they are expected to be highly effective in the future. The Company discontinues hedge accounting prospectively when (i) it determines that the derivative is no longer effective in offsetting changes in the cash flows of a hedged item; (ii) the derivative expires or is sold, terminated, or exercised; or (iii) management determines that designating the derivative as a hedging instrument is no longer appropriate. In all situations in which hedge accounting is discontinued and the derivative remains outstanding, the derivative instrument is carried at its fair market value on the balance sheet with the changes in fair value recognized in current-period earnings. The remaining balance in accumulated other comprehensive loss associated with the derivative that has been discontinued is not recognized in the income statement unless it is probable that the forecasted transaction will not occur. Such amounts are recognized in earnings when earnings are affected by the hedged transaction.

The Company recognized warrants with former preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the Company's initial public offering as derivative liabilities. Such liabilities were valued when the financial instruments were initially issued, with the change in their respective fair values recorded as a gain or loss on revaluation within other expenses in the Company's statement of operations. The Company determines the fair value of its warrant derivative liabilities using the Black-Scholes option-pricing model.

Fair Value of Financial Instruments

The Company defines fair value as the exchange price that would be received for an asset or an exit price that would be paid to transfer a liability in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants on the measurement date. The Company uses valuation techniques to measure fair value that maximize the use of observable inputs and minimize the use of unobservable inputs. FASB establishes a three-tier fair value hierarchy for disclosure of fair value measurements as follows:

- Level 1—Inputs are unadjusted, quoted prices in active markets for identical assets or liabilities at the measurement date;
- Level 2—Inputs are observable, unadjusted quoted prices in active markets for similar assets or liabilities, unadjusted quoted prices for identical or similar assets or liabilities in markets that are not active, or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the related assets or liabilities; and
- Level 3—Inputs that are unobservable, significant to the measurement of the fair value of the assets or liabilities and are supported by little or no market data.

The Company's financial instruments include cash, receivables, accounts payable, accrued expenses, distributions payable to noncontrolling interests, derivatives, borrowings on the line of credit, long-term debt and solar asset-backed notes.

Revenue Recognition

The Company recognizes revenue when (i) persuasive evidence of an arrangement exists, (ii) delivery has occurred or services have been rendered, (iii) the sales price is fixed and determinable, and (iv) collection of the related receivable is reasonably assured.

Operating leases and incentives

Operating leases and incentives revenue is primarily comprised of revenue from customer agreements, revenue from solar energy system rebate incentives, revenue associated with ITCs assigned to investment funds that are classified as lease pass-through arrangements and revenue from the sales of SRECs generated by the Company's solar energy systems to third parties.

The Company begins to recognize revenue on Customer Agreements when permission to operate ("PTO") is given by the local utility company or on the date daily operation commences if utility approval is not required. The Company recognizes revenue on a straight-line basis over the initial term of the Customer Agreements (typically 20 years) that have minimum lease payments, or as earned when the customers are billed based on the actual electricity generated at a specific rate under the terms of the Customer Agreements.

The Company considers upfront rebate incentives received from states and utilities for solar energy systems subject to Customer Agreements to be minimum lease payments. Rebate revenue is recognized on a straight-line basis over the life of the initial contract term of the Customer Agreement beginning when a PTO letter is issued by the local utility company or on the date daily operation commences if utility approval is not required.

The Company monetizes the ITCs associated with the leased systems on its lease pass-through financing obligations by assigning them to the investor together with the future customer lease payments. A portion of the cash consideration received from the investors is allocated to the estimated fair value of the assigned ITCs. The estimated fair value of the ITCs is determined by applying the expected internal rate of return to the investor on this structure to the gross amount of the ITCs that may be claimed by the investor.

The ITCs are subject to recapture under the Internal Revenue Code ("Code") if the underlying solar energy system either ceases to be a qualifying property or undergoes a change in ownership within five years of its placed in service date. The recapture amount decreases by 20% on each anniversary of the PTO date. As the Company has an obligation to ensure the solar energy systems is in service and operational for a term of five years to avoid any recapture of the ITCs, the Company recognizes revenue as the recapture provisions lapse assuming the other aforementioned revenue recognition criteria have been met. The monetized ITCs are initially recorded within deferred revenue on the consolidated balance sheets, and subsequently, one-fifth of the monetized ITCs are recognized as revenue in the consolidated statements of operations on each anniversary of the solar energy systems' PTO date over the following five years.

SREC revenue arises from the sale of environmental credits generated by solar energy systems. SREC revenue is recorded in operating leases and incentives revenue. We recognize revenue related to the sale of SRECs to the extent the cumulative value of delivered SRECs per contract exceeds any possible liquidated damages for non-delivery, if any.

The Company has determined that Customer Agreements are operating leases as opposed to capital leases pursuant to ASC 840, *Leases*. Management estimates the estimated useful life of solar energy systems to be 20 years, which coincides with the expected holding period and initial lease term of 20 years, as discussed in Note 2, *Summary of Significant Accounting Policies*, above. However, since the estimated economic life of solar energy systems is estimated to be at least 30 years, the lease term is less than 75% of its estimated economic life. Additionally, the Company evaluated the following lease classification criteria: (i) whether there is a transfer of ownership or bargain purchase option at the end of the lease and (ii) whether the present value of minimum lease payments exceeds 90% of the fair value at lease inception and determined that these criteria were not met.

Solar energy systems and product sales

For solar energy systems sold to customers, the Company recognizes revenue when the solar energy system passes inspection by the authority having jurisdiction, provided all other revenue recognition criteria have been met. The Company's installation projects are typically completed in a short period of time.

Product sales consist of solar panels, racking systems, inverters, other solar energy products sold to resellers and customer leads. Product sales revenue is recognized at the time when title is transferred, generally upon shipment. Shipping and handling fees charged to customers are included in net sales. Total shipping and handling fees charged to customers were $2.6 million and $2.4 million for the year ended December 31, 2015 and 2014, respectively. Volume discounts given to customers are recorded as a reduction of revenue, since the Company does not receive goods or services in exchange for the discounts offered. Customer lead revenue, included in product sales, is recognized at the time the lead is delivered.

Taxes assessed by government authorities that are directly imposed on revenue producing transactions are excluded from product revenue.

Cost of Revenue

Operating leases and incentives

Cost of revenue for operating leases and incentives is primarily comprised of the (1) depreciation of the cost of the solar energy systems, as reduced by amortization of U.S. Treasury grants, (2) amortization of initial direct costs, (3) lease operations, monitoring and maintenance costs including associated personnel costs, and (4) allocated corporate overhead costs.

Solar energy systems and product sales

Cost of revenue for solar energy systems and non-lead generation product sales consist of direct and indirect material and labor costs for solar energy systems installations and product sales. Also included are engineering and design costs, estimated warranty costs, freight costs, allocated corporate overhead costs, vehicle depreciation costs and personnel costs associated with supply chain, logistics, operations management, safety and quality control. Cost of revenue for lead generations consists of costs related to direct-response advertising activities associated with generating customer leads.

Research and Development Expense

Research and development expenses include personnel costs, allocated overhead costs, and other costs related to the development of the Company's BrightPath software suite as well as its racking equipment.

Advertising Costs

Advertising costs are expensed as incurred in the consolidated statements of operations. The Company incurred advertising costs of $34.8 million, $16.9 million and $7.7 million for the years ended December 31, 2015, 2014 and 2013, respectively.

Stock-Based Compensation

The Company grants stock-based compensation for its equity incentive plan and employee stock purchase plan. Stock-based compensation to employees is measured based on the grant date fair value of the awards and recognized over the period during which the employee is required to perform services in exchange for the award (generally the vesting period of the award). The Company estimates the fair value of stock based awards granted using the Black-Scholes option-valuation model. Compensation cost is recognized over the vesting period of the applicable award using the straight-line method for those options expected to vest.

The Company also grants restricted stock units ("RSUs") to non-employees that vest upon the satisfaction of both performance and service conditions. The Company starts recognizing expense on the RSUs when the performance condition is met.

Noncontrolling Interests and Redeemable Noncontrolling Interests

Noncontrolling interests represent investors' interests in the net assets of the Funds that the Company has created to finance the cost of its solar energy systems subject to the Company's Customer Agreements. The Company has determined that the contractual provisions in the funding arrangements represent substantive profit sharing arrangements. The Company has further determined that the appropriate methodology for attributing income and loss to the noncontrolling interests and redeemable noncontrolling interests each period is a balance sheet approach referred to as the hypothetical liquidation at book value ("HLBV") method.

Under the HLBV method, the amounts of income and loss attributed to the noncontrolling interests and redeemable noncontrolling interests in the consolidated statements of operations reflect changes in the amounts the investors would hypothetically receive at each balance sheet date under the liquidation provisions of the contractual agreements of these arrangements, assuming the net assets of these Funding structures were liquidated at recorded amounts. The Company's initial calculation of the investor's noncontrolling interest in the results of operations of these Funding arrangements is determined as the difference in the noncontrolling interests' claim under the HLBV method at the start and end of each reporting period, after taking into account any capital transactions, such as contributions or distributions, between the Fund and the investors.

The Company classifies certain noncontrolling interests with redemption features that are not solely within the control of the Company outside of permanent equity on its consolidated balance sheets. Redeemable noncontrolling interests are reported using the greater of their carrying value as determined by the HLBV method or their estimated redemption value at each reporting date.

Income Taxes

During November 2015, the FASB issued ASU 2015-17, *Balance Sheet Classification of Deferred Taxes*, which simplifies the presentation of deferred income taxes. ASU 2015-17 provides presentation requirements to classify deferred tax assets and liabilities as noncurrent in a classified statement of financial position. The standard is effective for fiscal years beginning after December 15, 2016, including interim periods within that reporting period. Early adoption is permitted for any interim and annual financial statements that have not yet been issued. We early adopted ASU 2015-17 effective December 31, 2015, retrospectively. Adoption resulted $3.0 million decrease in deferred tax assets, current and a $3.0 million decrease in deferred tax liabilities in our Consolidated Balance Sheets at December 31, 2014. Adoption had no impact on our results of operations.

The Company recognizes deferred tax assets and liabilities for the expected future tax consequences of events that have been included in the consolidated financial statements and tax returns. Under this method, deferred tax assets and liabilities are determined based on the difference between the financial statement and tax basis of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse. Valuation allowances are provided against deferred tax assets to the extent that it is more likely than not that the deferred tax asset will not be realized. The Company is subject to the provisions of ASC 740, *Income Taxes,* which establishes consistent thresholds as it relates to accounting for income taxes. It defines the threshold for recognizing the benefits of tax return positions in the financial statements as "more likely than not" to be sustained by the taxing authority and requires measurement of a tax position meeting the more-likely-than-not criterion, based on the largest benefit that is more than 50% likely to be realized. Management has analyzed the Company's inventory of tax positions with respect to all applicable income tax issues for all open tax years (in each respective jurisdiction).

The Company sells solar energy systems to the Funds. As the Funds are consolidated by the Company, the gain on the sale of the solar energy systems is not recognized in the consolidated financial statements. However, this gain is recognized for tax reporting purposes. Since these transactions are intercompany sales, any tax expense incurred related to these intercompany sales is deferred and recorded as a prepaid tax asset and amortized over the depreciable life of the underlying solar energy systems which has been estimated to be 20 years in accordance with ASC Topic 810.

The Company files tax returns as prescribed by the tax laws of the jurisdictions in which it operates. In the normal course of business, the Company is subject to examination by federal, state and local jurisdictions, where applicable. The statute of limitations for the tax returns varies by jurisdiction.

Concentrations of Credit and Supplier Risk

Financial instruments which potentially subject the Company to concentrations of credit risk consist primarily of cash and accounts receivable, which includes rebates receivable. The associated risk of concentration for cash is mitigated by banking with institutions with high credit ratings. At certain times, amounts on deposit exceed Federal Deposit Insurance Corporation insurance limits. The Company does not require collateral or other security to support accounts receivable. To reduce credit risk, management performs periodic credit evaluations and ongoing evaluations of its customers' financial condition. Rebates receivable are due from various states and local governments as well as various utility companies. The Company considers the collectability risk of such amounts to be low. The Company is not dependent on any single customer or installer. The loss of a customer or an installer would not adversely impact the Company's operating results or financial position. The Company's customers under Customer Agreements are primarily located in California, Hawaii, Maryland, Massachusetts, New Jersey and New York. During the year ended December 31, 2015 and 2014, the solar materials purchases from the top five suppliers were approximately $160.5 million and $69.1 million, respectively.

Recently Issued Accounting Standards

In May 2014, the FASB issued Accounting Standards Update ("ASU") No. 2014-09 *Revenue from Contracts with Customers* (Topic 606), to replace the existing revenue recognition criteria for contracts with customers and to establish the disclosure requirements for revenue from contracts with customers. The core principle of this standard is to recognize revenue when promised goods or services are transferred to customers in an amount that reflects the consideration that is expected to be received for those goods or services. This ASU is effective for the Company for Annual Reporting periods beginning after December 15, 2017 including the interim reporting periods within that fiscal year, and early adoption is permitted. Adoption of the ASU is either retrospective to each prior period presented or retrospective with a cumulative adjustment to retained earnings or accumulated deficit as of the adoption date. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

In November 2014, the FASB issued ASU 2014-16 *Determining Whether the Host Contract in a Hybrid Financial Instrument Issued in the Form of a Share is More Akin to Debt or to Equity.* This guidance requires issuers and investors to consider all of a hybrid instrument's stated and implied substantive terms and features, including any embedded derivative features being evaluated for bifurcation. The guidance eliminates the "chameleon approach", under which all embedded features except the feature being analyzed are considered. The guidance is effective for the year beginning after December 15, 2015 and for interim periods within fiscal years beginning after December 15, 2016. Early adoption is permitted. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In November 2014, the FASB issued ASU 2014-15, *Disclosure of Uncertainties About an Entity's Ability to Continue as a Going Concern,* which provides guidance on determining when and how to disclose going-concern uncertainties in the financial statements. The new standard requires management to perform interim and annual assessments of an entity's ability to continue as a going concern within one year of the date of issuance of the entity's financial statements and provide certain disclosures when there is substantial doubt about the entity's ability to continue as a going concern. This guidance applies to all entities and is effective for annual periods beginning after December 15, 2016, and interim periods thereafter, with early adoption permitted. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In February 2015, the FASB issued ASU 2015-02 *Amendments to the Consolidation Analysis,* which provides consolidation guidance and changes the way reporting enterprises evaluate consolidation for limited partnerships, investment companies and similar entities, as well as variable interest entities. The ASU is effective for annual and interim periods in fiscal years beginning after December 15, 2015. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In April 2015, the FASB issued ASU 2015-03, *Interest—Imputation of Interest (Subtopic 835-30) Simplifying the Presentation of Debt Issuance Costs,* to simplify the presentation of debt issuance costs. In August 2015, the FASB issued ASU 2015-15, *Interest—Imputation of Interest (Subtopic 835-30) Presentation and Subsequent Measurement of Debt Issuance Costs Associated with Line-of-Credit Arrangement.* Prior to ASU 2015-03 and ASU 2015-15, issuance costs were presented as an asset on the balance sheet. Under ASU 2015-03 and ASU 2015-15, debt issuance costs related to a recognized debt liability are required to be presented in the balance sheet as a direct deduction from the carrying amount of that debt liability, consistent with debt discounts. ASU 2015-15 clarified that the SEC will not object to an entity presenting the cost of securing a revolving line of credit as an asset regardless of whether a balance is outstanding. The recognition and measurement guidance for debt issuance costs are not affected by the amendments in these updates. The ASUs are effective for annual and interim periods in fiscal years beginning after December 15, 2015 and interim periods within those fiscal years. The effect on the Company's consolidated balance sheet for the year ended December 31, 2015 will be to reclassify $3.6 million in debt issuance costs from assets to a reduction in liabilities.

In July 2015, the FASB issued ASU No. 2015-11, *Simplifying the Measurement of Inventory,* to specify that inventory should be subsequently measured at the lower of cost or net realizable value, which is the ordinary selling price less any completion, transportation and disposal costs. However, the ASU does not apply to inventory measured using the last-in-first-out or retail methods. The ASU is effective for interim and annual periods beginning after December 15, 2016. Adoption of the ASU is prospective. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

In February 2016, the FASB issued ASU No. 2016-02, *Leases.* Under the new guidance, lessees will be required to recognize for all leases (with the exception of short-term leases) a lease liability, which is a lessee's obligation to make lease payments arising from a lease, measured on a discounted basis and a right-of-use asset, which is an asset that represents the lessee's right to use, or control the use of, a specified asset for the lease term. The ASU is effective for fiscal years beginning after December 15, 2018 and interim periods within those fiscal years. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

Acquisitions	12 Months Ended Dec. 31, 2015
Business Combinations [Abstract]	
Acquisitions	**Note 3. Acquisitions** **Acquisition of Residential Business**

In February 2014, the Company acquired the residential business of MEC pursuant to an Agreement and Plan of Merger dated January 19, 2014. The residential business acquired engages in designing, installing and selling solar energy systems to residential customers, wholesale distributions as well as assembling of mounting systems and hardware for solar energy systems.

The purchase consideration for the assets acquired and liabilities assumed was approximately $78.8 million consisting of $75.0 million in the issuance of 12,762,894 shares of common stock, $1.8 million in cash, $1.8 million in settlement of balances under a pre-existing relationship and $0.2 million in the form of 576,878 stock options. The settlement of the pre-existing relationship was related to the partner installation agreement between the Company and MEC, which existed prior to the acquisition date.

The Company has included the results of operations of the acquired business in the consolidated statements of operations from the acquisition date. The assets acquired and liabilities assumed in the MEC acquisition have been recorded based on their fair value at the acquisition date. Goodwill represents the excess of the purchase price over the net tangible and intangible assets acquired and is not deductible for tax purposes. Goodwill recorded is primarily attributable to the acquired assembled workforce and the synergies expected to arise after the acquisition of the residential business, such as lowering the Company's overall cost of the Company's solar energy systems by enabling it to procure and build some of the solar energy systems themselves, ensuring access to MEC installation capacity, and scaling the Company's growth by adding direct-to-consumer sales and installation activities. In addition, the Company is able to provide customers the option to purchase solar energy systems outright, as compared to offering leasing and PPA options. Transaction costs related to the acquisition were expensed as incurred.

The following table summarizes the fair value of assets acquired and liabilities assumed (in thousands):

Cash	$	5,440
Accounts receivable		8,881
Inventory		23,886
Prepaid expenses		2,028
Property and equipment		6,113
Intangible assets		15,380
Other long-term assets		200
Accounts payable and accrued liabilities		(24,975)
Deferred revenue		(768)
Capital lease obligation		(2,869)
Other liabilities		(1,509)
Deferred tax liabilities		(4,843)
Indentifiable assets and liabilities assumed		26,964
Goodwill		51,786
Total	$	78,750

In 2014, the contribution of the acquired business to the Company's total revenues was $114.2 million as measured from the date of the acquisition. The portion of total expenses and net income associated with the acquired business was not separately identifiable due to the integration with the Company's operations.

Unaudited Pro Forma Information

The following table summarizes the unaudited pro forma total revenue and net loss of the combined company for the years ended December 31, 2014 and 2013 assuming that the acquisition occurred as of January 1, 2013 (in thousands, except per share):

	For the year ended December 31,			
	2014		2013	
Revenue	$	205,355	$	143,614
Net loss		(164,974)		(88,326)
Net loss attributable to common stockholders		(78,336)		(24,032)
Net loss per share attributable to common stockholders, basic and diluted		(3.44)		(1.07)

The pro forma financial information is based on the combined results of operations of MEC and the Company with adjustments for MEC's sales to the Company, the amortization of the acquired intangibles assets and the timing of acquisition expenses. The pro forma financial information is not necessarily indicative of the actual consolidated results of operations in prior or future periods had the acquisition actually been consummated on January 1, 2013.

Clean Energy Experts, LLC

In April 2015, the Company acquired Clean Energy Experts, LLC, a consumer demand and solar lead generation company, for $25.0 million in cash and 1.9 million shares of common stock valued at $19.1 million, net of settlement of a preexisting payable to CEE. Of this amount, $15.0 million in cash was paid and 1.4 million shares were issued in April 2015. The remaining $10.0 million in cash and 500,000 shares are due in two equal installments: $5.0 million which was paid and 250,000 shares were issued in October 2015 and the second installment of $5.0 million and 250,000 shares is due in April 2016.

An additional $9.1 million in cash and 600,000 shares of common stock may be issued on April 1, 2017, subject to the achievement of certain sales targets as well as continued employment of certain key employees acquired in the transaction, which will be recorded as compensation expense over a two-year period unless and until the Company assesses that the achievement of sales targets is not probable. The acquisition is expected to enhance the Company's efficient and consistent access to high-quality leads in existing and new markets.

The Company has included the results of operations of the acquired business in the consolidated statements of operations from the acquisition date. The assets acquired and liabilities assumed in the CEE acquisition have been recorded based on their fair value at the acquisition date. Goodwill represents the excess of the purchase price over the net tangible and intangible assets acquired and is not deductible for tax purposes. Goodwill recorded is primarily attributable to the acquired assembled workforce and the synergies expected to arise after the CEE acquisition. Transaction costs related to the acquisition were expensed as incurred.

The following table summarizes the fair value of assets acquired and liabilities assumed (in thousands):

Cash	$	424
Accounts receivable		639
Intangible assets		13,290
Accounts payable and accrued liabilities		(1,247)
Deferred tax liability		(5,146)
Identifiable assets and liabilities assumed		7,960
Goodwill		35,757
Total	$	43,717

The fair value of acquired intangible assets and their estimated useful life are as follows (in thousands, except estimated useful life):

	Fair Value	Estimated Useful Life

Developed technology	$	5,910	5
Customer relationships		4,390	8
Trade names		2,990	8
Total	$	13,290	

For the year ending December 31, 2015, the contribution of the acquired business to the Company's total revenues was $16.9 million, as measured from the date of the acquisition. The portion of total expenses and net income associated with the acquired business was not separately identifiable due to the integration with the Company's operations.

Acquisition of Solar Projects with the Associated Leases

In March 2014, the Company entered into a Backlog Lease Assignment and Assumption Agreement and Channel Agreement with an installation partner and purchased certain solar projects with the associated leases already originated by the installation partner. The Company paid $39.4 million to acquire 2,924 solar projects and the associated leases with an average remaining lease term of 20 years. The Company has accounted for the acquisition under ASC 805 and recorded the assets acquired at fair value at the acquisition date. As the terms of the acquired leases associated with these projects were at market terms at the acquisition date, no lease premiums or discounts were recorded. No goodwill was recognized from this acquisition as the Company paid fair value for the assets acquired.

Fair Value Measurement	12 Months Ended Dec. 31, 2015
Fair Value Disclosures [Abstract]	
Fair Value Measurement	

Note 4. Fair Value Measurement

At December 31, 2015 and 2014, the carrying value of receivables, accounts payable, accrued expenses, and distributions payable to noncontrolling interests approximates fair value due to their short-term nature. The carrying values and fair values of debt instruments are as follows (in thousands):

	December 31, 2015		December 31, 2014	
	Carrying Value	Fair Value	Carrying Value	Fair Value
Line of credit	194,975	194,975	$ 48,597	$ 48,597
Non-bank term loans	—	—	3,138	3,853
Syndicated term loans	170,664	170,664	124,571	124,571
Bank term loan	30,740	32,692	33,382	35,653
Note payable	33,059	32,568	29,563	28,900
Solar asset-backed notes	108,880	110,103	—	—
Total	$ 538,318	$ 541,002	$ 239,251	$ 241,574

At December 31, 2015 and 2014, the fair value of the Company's lines of credit and the syndicated term loans approximates their carrying values because their interest rates are variable rates that approximate rates currently available to the Company. At December 31, 2015, the fair value of the Company's bank term loan, note payable and asset-backed notes are based on rates currently offered for debt with similar maturities and terms. At December 31, 2014, the fair value of the Company's non-bank term loan, bank term loan, and note payable are based on rates currently offered for debt with similar maturities and terms. The Company's fair value of the debt instruments fell under the Level 3 hierarchy. These valuation techniques involve some level of management estimation and judgment, the degree of which is dependent on the price transparency for the instruments or market.

The Company determines the fair value of its interest rate swaps using a discounted cash flow model which incorporates an assessment of the risk of non-performance by the interest rate swap counterparty and an evaluation of the Company's credit risk in valuing derivative instruments. The valuation model uses various inputs including contractual terms, interest rate curves, credit spreads and measures of volatility.

The Company determines the fair value of its warrants issued using the Black-Scholes option-pricing model. The key inputs used to determine value of the warrants was an estimated fair value of the Company's common stock of $11.77 per share, risk-free interest rate of 1.21%, expected volatility of 32.03%, the remaining contact life of 2.56 years and expected dividend yield rate of 0.00%. The significant unobservable input used in the fair value measurement of the warrant liability was the expected volatility of the Company. Generally, increases (decreases) in the expected volatility of the Company would result in a directionally similar impact to the measurement of the Company's stock options.

At December 31, 2015, financial instruments measured at fair value on a recurring basis, based upon the fair value hierarchy are as follows (in thousands):

	December 31, 2015			
	Level 1	Level 2	Level 3	Total
Derivative liabilities:				
Interest rate swaps	$ —	$ 921	$ —	$ 921
Warrants	—	—	557	557
Total	$ —	$ 921	$ 557	$ 1,478

Inventories	12 Months Ended Dec. 31, 2015
Inventory Disclosure [Abstract]	
Inventories	

Note 5. Inventories

Inventories consist of the following (in thousands):

	December 31,	
	2015	2014
Raw materials	62,967	$21,531
Work-in-process	8,291	2,383
Total	$71,258	$23,914

Solar Energy Systems, Net	12 Months Ended Dec. 31, 2015
Solar Energy Systems Disclosure [Abstract]	

Solar Energy Systems, Net

Note 6. Solar Energy Systems, net

Solar energy systems, net consists of the following (in thousands):

	December 31, 2015	December 31, 2014
Solar energy system equipment costs	$ 1,846,103	$ 1,406,478
Inverters	177,202	123,910
Initial direct costs	68,280	40,307
Total solar energy systems	2,091,585	1,570,695
Less: accumulated depreciation and amortization	(212,671)	(143,028)
Add: construction-in-progress	113,107	56,584
Total solar energy systems, net	$ 1,992,021	$ 1,484,251

All solar energy systems, construction-in-progress, and inverters have been leased to or are subject to a signed Customer Agreement with customers. The Company recorded depreciation expense related to solar energy systems of $70.7 million, $54.7 million and $40.0 million for the years ended December 31, 2015, 2014 and 2013, respectively. The depreciation expense was reduced by the amortization of deferred grants of $14.2 million, $13.9 million and $13.4 million for the years ended December 31, 2015, 2014 and 2013, respectively.

Property and Equipment, net	12 Months Ended Dec. 31, 2015
Property Plant And Equipment [Abstract]	
Property and Equipment, net	

Note 7. Property and Equipment, net

Property and equipment, net consists of the following (in thousands):

	December 31, 2015	December 31, 2014
Machinery and equipment	$ 2,808	$ 1,031
Leasehold improvements, furniture, and computer hardware	10,669	6,386
Vehicles	33,048	8,942
Computer software	19,883	16,431
Total property and equipment	66,408	32,790
Less: accumulated depreciation and amortization	(21,542)	(10,595)
Total solar energy systems, net	$ 44,866	$ 22,195

Depreciation and amortization expense was $11.2 million, $6.4 million and $3.0 million for the years ended December 31, 2015, 2014 and 2013, respectively.

The Company vehicles are assets under capital leases with a corresponding accumulated amortization of $5.8 million and $1.2 million at December 31, 2015 and 2014, respectively. Amortization expense related to these assets was $5.3 million and $1.2 for the years ended December 31, 2015 and 2014. Prior to December 31, 2013, the Company did not have any assets under capital leases and therefore, did not record amortization expense related to these assets in the year ended December 31, 2013.

Goodwill and Intangible Assets, Net	12 Months Ended Dec. 31, 2015
Goodwill And Intangible Assets Disclosure [Abstract]	
Goodwill and Intangible Assets, Net	

Note 8. Goodwill and Intangible Assets, net

The change in the carrying value of goodwill is as follows (in thousands):

Balance—January 1, 2014	$ —
Acquisition of MEC (Note 3)	51,786
Balance—December 31, 2014	$ 51,786
Acquisition of CEE (Note 3)	35,757
Balance—December 31, 2015	$ 87,543

The intangible assets were acquired as part of the acquisition of MEC and CEE referred to in Note 3, *Acquisitions*.

Intangible assets, net as of December 31, 2015 consist of the following (in thousands):

	Cost	Accumulated amortization	Carrying value	Weighted average remaining life (in years)
Backlog	$ 200	$ (200)	$ —	—
Customer relationships	14,660	(2,618)	12,042	7.4
Developed technology	6,820	(1,235)	5,585	4.1
Trade names	6,990	(1,912)	5,078	5.3
Total	$ 28,670	$ (5,965)	$ 22,705	

Intangible assets, net as of December 31, 2014 consist of the following (in thousands):

	Cost	Accumulated amortization	Carrying value	Weighted average remaining life (in years)
Backlog	$ 200	$ (183)	$ 17	0.1
Customer relationships	10,270	(1,055)	9,215	8.4
Developed technology	910	(167)	743	4.1
Trade names	4,000	(864)	3,136	4.1
Total	$ 15,380	$ (2,269)	$ 13,111	

The Company recorded amortization of intangible assets expense of $3.7 million and $2.3 for the years ended December 31, 2015 and 2014. As of December 31, 2015, expected amortization of intangible assets for each of the five succeeding fiscal years and thereafter is as follows (in thousands):

2016	$ 4,205
2017	4,205
2018	4,205
2019	3,335
2020	2,143
Thereafter	4,612
Total	$ 22,705

Prepaid Expense and Other Current Assets — **12 Months Ended Dec. 31, 2015**

Deferred Costs Capitalized Prepaid And Other Assets Disclosure [Abstract]

Prepaid Expense and Other Current Assets

Note 9. Prepaid Expense and Other Current Assets

Prepaid expenses and other current assets consist of the following (in thousands):

	December 31, 2015	December 31, 2014
Prepaid expenses	$5,134	$ 4,564
Reimbursement receivable	337	2,808
State tax receivable	427	1,117
Other current assets	798	1,071
Total	$6,696	$ 9,560

Accrued Expenses and Other Liabilities — **12 Months Ended Dec. 31, 2015**

Payables And Accruals [Abstract]

Accrued Expenses and Other Liabilities

Note 10. Accrued Expenses and Other Liabilities

Accrued expenses and other liabilities consist of the following (in thousands):

	December 31, 2015	December 31, 2014
Accrued employee compensation	$21,353	$12,588
Other accrued expenses	19,313	9,526
CEE acquisition consideration	5,000	—
Accrued professional fees	3,480	3,331
Total	$49,146	$25,445

Indebtedness — **12 Months Ended Dec. 31, 2015**

Debt Disclosure [Abstract]

Indebtedness

Note 11. Indebtedness

As of December 31, 2015, debt consisted of the following (in thousands):

	Carrying Values, net of debt discount			Unused Borrowing Capacity	Annual Contractual Interest Rate	Interest Rate	Maturity Date
	Current	Long Term	Total				
Recourse debt:							
Bank line of credit	$ —	$ 194,975	$ 194,975	$ 6,571	Varies1	3.67%	April 2018
Total recourse debt	$ —	$ 194,975	$ 194,975	$ 6,571			
Non-recourse debt:							
Syndicated term loans	926	169,739	170,665	5,600	LIBOR + 2.75% - Term A	3.07%	December 2021
					LIBOR + 5.00% - Term B	6.00%	December 2021
Bank term loans	1,159	29,580	30,739	—	6.25%	6.25%	April 2022
Note payable	—	33,059	33,059	—	12.00%	12.00%	December 2018
Solar asset-backed notes	3,323	105,557	108,880	—	4.40% - Class A	4.40%	July 2024
					5.38% - Class B	5.38%	July 2024
Total non-recourse debt	5,408	337,935	343,343	5,600			
Total debt	$ 5,408	$ 532,910	$ 538,318	$ 12,171			

1 Loans under the facility bear interest at LIBOR + 3.25% or the Base Rate + 2.25%. The Base Rate is the highest of the Federal Funds Rate + 0.50%, the Prime Rate, or LIBOR + 1.00%.

As of December 31, 2014, debt consisted of the following (in thousands):

	Carrying Values, net of debt discount			Unused Borrowing Capacity	Annual Contractual Interest Rate	Interest Rate	Maturity Date
	Current	Long Term	Total				
Recourse debt:							
Bank line of credit	$ —	$ 48,597	$ 48,597	$ —	Prime Rate + 1.00%	4.25%	December 2016
Total recourse debt	$ —	$ 48,597	$ 48,597	$ —			
Non-recourse debt:							
Non-bank term loans	207	2,931	3,138	—	9.08%	9.08%	December 2024
Syndicated term loans	958	123,613	124,571	5,000	LIBOR + 2.75% - Term A	3.01%	December 2021

					LIBOR + 5.00% - Term B	6.00%	December 2021
Bank term loans	1,437	31,945	33,382	—	6.25%	6.25%	April 2022
Note payable	—	29,563	29,563	—	12.00%	12.00%	December 2018
Total non-recourse debt	2,602	188,052	190,654	5,000			
Total debt	$ 2,602	$ 236,649	$239,251	$ 5,000			

Bank Line of Credit

In December 2014, the Company entered into credit facility agreements with a syndicate of banks to borrow amounts that were used to pay off an existing line of credit, and obtain funding for working capital and general corporate purposes. The credit facility agreements had a $50.0 million committed facility which included a $1.0 million letter of credit sub-facility. On April 1, 2015, the Company paid off the unpaid balance of $49.7 million under the credit facility agreements, which included accrued interest and other fees, and terminated the facility.

In April 2015, the Company entered into a new syndicated working capital facility with banks for a total commitment of up to $205.0 million. The working capital facility is secured by substantially all of the unencumbered assets of the Company as well as ownership interests in certain subsidiaries of the Company.

Under the terms of the new working capital facility, the Company is required to meet various restrictive covenants, including meeting certain reporting requirements, such as the completion and presentation of audited consolidated financial statements. The Company is also required to maintain minimum unencumbered liquidity of at least $25.0 million in the aggregate as of the last day of each calendar month. The Company is further required to maintain a modified interest coverage ratio of 2.00:1.00 or greater, measured quarterly as of the last day of each quarter. The Company was in compliance with all debt covenants as of December 31, 2015.

Non-Bank Term Loans

In 2013, a subsidiary of the Company entered into an agreement with a non-bank lender for a term loan with an aggregate amount of up to $119.5 million. The proceeds of this term loan were principally used to finance the design, procurement, and installation of solar systems. The loan was collateralized by the assets and related cash flows of the borrower subsidiary and is non-recourse to our other assets.

In April 2015, the Company paid $3.5 million to repay the remaining outstanding balance of the non-bank term loan and incurred a loss on extinguishment charge of $0.4 million, which is recorded in non-operating loss from ordinary operations on our statement of operations.

Syndicated Credit Facilities

In December 2014, subsidiaries of the Company entered into secured credit facilities agreements with a syndicate of banks for up to $195.4 million in committed facilities. These facilities include a $158.5 million senior term loan ("Term Loan A") and a $24.0 million subordinated term loan ("Term Loan B"). In addition, the credit facilities also include a $5.0 million working capital revolver commitment and a $7.9 million senior secured revolving letter of credit facility which draws are solely for the purpose of satisfying the required debt service reserve amount if necessary. Term Loan A, the working capital revolver and the letter of credit bear interest at a rate of LIBOR + 2.75% with a 25 basis point step up triggered on the fourth anniversary. Term Loan B bears interest at a rate of LIBOR + 5.00% with a LIBOR floor of not less than 1.00%. Prepayments are permitted under Term Loan A at par without premium or penalty, and under Term Loan B prepayment penalties range from 0%-2%, depending on the timing of the prepayment. The proceeds of these facilities were used to repay certain non-bank term loans of $94.4 million and to fund general corporate needs.

One of the Company's subsidiaries is the borrower under the Term Loan A agreement and another of the Company's subsidiaries is the borrower under the Term Loan B agreement. All obligations under the Term Loan A, working capital revolver and letter of credit are collateralized by the subsidiary borrower's membership interests and assets in the Company's investment Funds. All obligations under the Term Loan B are collateralized by the membership interest in the subsidiary borrower. The credit facilities also contain certain provisions in the event of default, which entitle lenders to take actions, including acceleration of amounts due under the credit facilities and acquisition of membership interests and assets that are pledged to the lenders under the terms of the credit facilities.

The Company is required to maintain certain financial measurements and reporting covenants under the terms of the credit facilities. At December 31, 2015, the Company was in compliance with the credit facility covenants.

Bank Term Loan

In December 2013, a subsidiary of the Company entered into an agreement with a bank for a term loan of $38.0 million. The proceeds of this term loan were distributed to the members of this subsidiary, including the Company. The loan is secured by the assets and related cash flow of this subsidiary and is nonrecourse to the Company's other assets. The Company was in compliance with all debt covenants as of December 31, 2015.

Notes Payable

In December 2013, a subsidiary of the Company entered into a Note Purchase Agreement with an investor for the issuance of senior notes in exchange for proceeds of $27.2 million. The loan proceeds were distributed to the Company for general corporate purposes. On the last business day of each quarter, commencing with March 31, 2014, to the extent the Company's subsidiary has insufficient funds to pay the full amount of the stated interest of the outstanding loan balance, a PIK interest rate of 12% is accrued and added to the outstanding balance. As of December 31, 2015 and 2014, the portion of the outstanding loan balance that related to PIK interest was $6.3 million and $2.9 million, respectively. The senior notes are secured by the assets and related cash flows of certain of the Company's subsidiaries and are nonrecourse to the Company's other assets. The entire outstanding principal balance is payable in full on the maturity date. The Company was in compliance with all debt covenants as of December 31, 2015.

Solar Asset-Backed Notes

In July 2015, the Company entered into a securitization transaction pursuant to which the Company pooled and transferred qualifying solar energy systems and related lease agreements secured by associated customer contracts ("Solar Assets") into a special purpose entity ("Issuer"), and issued $100.0 million in aggregate principal of Solar Asset-Backed Notes, Series 2015-1, Class A, and $11.0 million in aggregate principal of Solar Asset-Backed Notes, Class B, backed by these Solar Assets to certain investors ("Notes"). The Issuer is wholly owned by the Company and is consolidated in the Company's financial statements. Accordingly, the Company did not recognize a gain or loss on the transfer of these assets. As of December 31, 2015, these Solar Assets had a carrying value of $190.2 million and are included under Solar energy systems, net, in the consolidated balance sheets. The Notes were issued at a discount of 0.08%.

The Company retained $7.3 million net of fees from proceeds from the Notes. In connection with the transaction, the Company modified two lease pass-through arrangements with an investor. The lease pass-through arrangements had been accounted for as a borrowing and any amounts outstanding from the arrangements were reported as lease pass-through financing obligation as further explained in Note 13, *Lease Pass-Through Financing Obligations*. The balance that was then outstanding under these arrangements was $119.7 million. The Company partially repaid this obligation by paying the investor an aggregate amount of $88.9 million. The Company accounted for the modification of the lease pass-through obligation as a modification of debt and did not record any gain or loss on the transaction.

The modified lease-pass through arrangements require the majority of the cash flows generated by the Solar Assets to be passed on to the Issuer through monthly lease payments from the investor. Those cash flows are used to service the monthly Note principal and interest payments and satisfy the Issuer's expenses, and any residual cash flows are retained by the fund investor and recorded as a reduction in the remaining financing obligation. The Company recognizes revenue earned from the associated Customer Agreements in accordance with the Company's revenue recognition policy. The assets and cash flows generated by the Solar Assets are not available to the other creditors of the Company, and the creditors of the Issuer, including the Note holders, have no recourse to the Company's other assets. The Company was in compliance with all debt covenants as of December 31, 2015.

The schedules maturities of debt, excluding debt discount, as of December 31, 2015 are as follows (in thousands:

2016	$ 6,330
2017	7,392
2018	238,250
2019	9,253
2020	11,414
Thereafter	273,693
Subtotal	$ 546,332
Less: Debt Discount	(8,014)
Total	$ 538,318

Derivatives	12 Months Ended Dec. 31, 2015

Derivative Instruments And Hedging Activities Disclosure [Abstract]

Derivatives

Note 12. Derivatives

Interest Rate Swaps

Starting in 2015, the Company uses interest rate swaps to hedge variable interest payments due on its syndicated term loans. These swaps allow the Company to pay at fixed interest rates and receive payments based on variable interest rates with the swap counterparty based on the three month LIBOR on the notional amounts over the life of the swaps. The Company did not use interest rate swaps prior to 2015.

In January 2015, the Company purchased interest rate swaps with a notional amount aggregating $109.1 million. The interest rate swap contracts were executed with four counterparties who were part of the lender group on the Company's syndicated term loans. As of December 31, 2015 the unrealized fair market value loss on the interest rate swaps was $0.9 million as included in other liabilities in the consolidated balance sheet.

The interest rate swaps have been designated as cash flow hedges. In the year ended December 31, 2015, the hedge relationships on the Company's interest rate swaps have been assessed as highly effective as the critical terms of the interest rate swaps match the critical terms of the underlying forecasted hedged transactions. Accordingly, changes in the fair value of these derivatives are recorded as a component of accumulated other comprehensive loss, net of a provision for income taxes. Changes in the fair value of these derivatives are subsequently reclassified into earnings, and are included in interest expense, net in the Company's statement of operations, in the period that the hedged forecasted transactions affects earnings. During the next twelve months, the Company estimates that an additional $1.7 million will be reclassified as an increase to interest expense. There were no undesignated derivative instruments recorded by the Company as of December 31, 2015.

At December 31, 2015, the Company had the following designated derivative instruments classified as derivative liabilities as reported in other liabilities in the Company's balance sheet (in thousands, other than quantity and interest rates):

Type	Quantity	Maturity Dates	Hedge Interest Rates	Notional Amount	Fair Market Value	Credit Risk Adjustment	Adjusted Fair Market Value	Deferred Tax Benefit	Loss Recognized in Accumulated Comprehensive Loss	Interest Expense Recognized into Earnings
Interest rate swaps	4	10/31/2028	2.17% -2.18%	$ 109,143	$ 384	$ 537	$ 921	$ —	$ 921	$ 1,521

Warrants

In July 2015, the Company entered into a letter of intent to issue 1,250,764 warrants to purchase the Company's common stock to the former Series D and E preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the closing of the Company's initial public offering and waive any potential anti-dilution adjustments resulting from the issuance of shares in the Company's common stock in the Company's initial public offering. The warrants were issued on September 30, 2015. The warrants are exercisable for three years from the date of grant and have an exercise price of $22.50 per share. The warrant derivatives are recorded at fair value as derivative liabilities as reported in other liabilities in the Company's consolidated balance sheet. The fair market value of the warrants on the commitment date was $1.5 million. The warrants are remeasured at each reporting period with the changes in the fair value presented in other expenses in the Company's statement of operations.

At December 31, 2015, the fair market value of the warrant was $0.6 million, resulting in a gain of $0.9 million for the year ended December 31, 2015.

Lease Passthrough Financing Obligations	12 Months Ended Dec. 31, 2015

Property Subject To Or Available For Operating Lease Net [Abstract]

Lease Passthrough Financing Obligations

Note 13. Lease Passthrough Financing Obligations

The Company has five ongoing transactions referred to as "lease pass-through arrangements." Under lease pass-through arrangements, the Company leases solar energy systems to Fund investors under a master lease agreement, and these investors in turn are assigned the leases with customers. The Company receives all of the value attributable to the accelerated tax depreciation and some or all of the value attributable to the other incentives. The Company assigns to the Fund investors the value attributable to the ITC, and, for the duration of the master lease term, the long-term recurring customer payments. Given the assignment of the operating cash flows, these arrangements are accounted for as financing obligations. In addition, in one of the lease pass-through structures, the Company sold, as well as leased, solar energy systems to a Fund investor under a master purchase agreement. As the substantial risks and rewards in the underlying solar energy systems were retained by the Company, this arrangement was also accounted for as a financing obligation.

Under these lease pass-through arrangements, wholly owned subsidiaries of the Company finance the cost of solar energy systems with investors for an initial term of 20 – 25 years. The solar energy systems are subject to Customer Agreements with an initial term not exceeding 20 years. These solar energy systems are reported under the line item solar energy systems, net in the consolidated balance sheets. As of December 31, 2015 and 2014, the cost of the solar energy systems placed in service under the lease pass-through arrangements was $447.4 million and $322.2 million, respectively. The accumulated depreciation related to these assets as of December 31, 2015 and 2014 was $33.5 million and $19.3 million, respectively.

The investors make a series of large up-front payments and in certain cases subsequent smaller quarterly payments (lease payments) to the subsidiaries of the Company. The Company accounts for the payments received from the investors under the arrangements as borrowings by recording the proceeds received as lease pass-through financing obligations. These financing obligations are reduced over a period of approximately 20 years by customer payments under the Customer Agreements, U.S. Treasury grants (where applicable), incentive rebates (where applicable), the fair value of the ITCs monetized (where applicable) and proceeds from the contracted resale of SRECs as they are received by the investor. Under this approach, the Company continues to account for the arrangement with the customers in its consolidated financial statements as if it is the lessor in the arrangement with the customer and accounts for the customer lease and any related U.S. Treasury grants or incentive rebates as well the resale of SRECs consistent with the Company's revenue recognition accounting policies and the monetization of investment tax credits as described in Note 2, *Summary of Significant Accounting Policies.*

Interest is calculated on the lease pass-through financing obligations using the effective interest rate method. The effective interest rate, which is adjusted on a prospective basis, is the interest rate that equates the present value of the estimated cash amounts, including ITCs, to be received by the investor over the lease term with the present value of the cash amounts paid by the investor to the Company, adjusted for amounts received by the investor. The lease pass-through financing obligations are nonrecourse once the associated assets have been placed in service and all the contractual arrangements have been assigned to the investor.

Under four of the lease pass-through arrangements, the investor has a right to extend its right to receive cash flows from the customers beyond the initial term in certain circumstances. The Company has the option to settle the outstanding financing obligation on the ninth anniversary for two of the lease pass-through obligations and on the eleventh anniversary for two of the lease pass-through financing obligations at a price equal to the higher of (a) the fair value of future remaining cash flows or (b) the amount that would result in the investor earning their targeted return. In three of these lease pass-through arrangements, the investor has an option to require repayment of the entire outstanding balance of the financing obligation on the tenth anniversary at a price equal to the fair value of the future remaining cash flows. In the fourth lease pass through arrangement, the investor has an option to require repayment of the entire outstanding balance of the financing obligation three business days prior to the 7th anniversary and on the 10th anniversary at a price equal to the fair value of the future remaining cash flows.

In the fifth lease pass-through arrangement, the investor has a right, on June 30, 2019, to purchase all of the systems leased at a price equal to the higher of (a) the sum of the present value of the expected remaining lease payments due by the investor, discounted at 5%, and the fair market value of the investor's residual interest in the systems as determined through independent valuation or (b) a set value per kilowatt applied to the aggregate size of all leased systems.

Under all lease pass-through arrangements, the Company is responsible for services such as warranty support, accounting, lease servicing and performance reporting to the host customers. As part of the warranty and performance guarantee with the host customers, the Company guarantees certain specified minimum annual solar energy production output for the solar energy systems leased to the customers, which the Company accounts for as disclosed in Note 2, *Summary of Significant Accounting Policies.*

As discussed in Note 11, *Indebtedness*, in connection with the pooling of assets related to the securitization transaction entered into in July 2015, an aggregate amount of $88.9 million of the lease pass-through financing obligation was repaid.

In September 2015, the Company entered into a new lease pass-through arrangement and in connection with this arrangement, the Company agreed to defer a portion (up to 25%) of the amounts required to be paid upfront under the arrangement through a loan between an indirectly wholly owned subsidiary of the Company and a subsidiary of the fund investor. The term loan agreement is for an aggregate amount up to $30.0 million. The loan is collateralized by the related cash flows assigned to the fund investor. There is a legal right to offset the loan if an event of default has occurred. Therefore, the lease pass-through related to this arrangement is recorded net of the loan. As of December 31, 2015, the loan amount was $21.8 million.

At December 31, 2015, future minimum lease payments expected to be made by the investor under the lease pass-through fund arrangement for each of the next five years and thereafter are as follows (in thousands):

2016	$	524
2017		524
2018		524
2019		524
2020		524
Thereafter		3,516
Total	$	6,136

VIE Arrangements	12 Months Ended Dec. 31, 2015
Variable Interest Entity Disclosure [Abstract]	
VIE Arrangements	

Note 14. VIE Arrangements

The Company consolidated various VIEs at December 31, 2015 and 2014. The carrying amounts and classification of the VIEs' assets and liabilities included in the consolidated balance sheets are as follows (in thousands):

	December 31, 2015		December 31, 2014	
Assets				
Current assets				
Cash	$	44,407	$	29,099
Restricted cash		757		228
Accounts receivable, net		12,965		14,351
Prepaid expenses and other current assets		66		180
Total current assets		58,195		43,858
Restricted cash	$	—	$	365
Solar energy systems, net		1,305,420		942,655
Total Assets	$	1,363,615	$	986,878
Liabilities				
Current liabilities				
Accounts payable	$	11,025	$	9,057
Distribution payable to noncontrolling interests and redeemable noncontrolling interests		8,063		6,426
Accrued expenses and other liabilities		175		340
Deferred revenue, current portion		21,344		16,991
Deferred grants, current portion		7,198		7,225
Long-term debt, current portion		1,159		1,437
Total current liabilities		48,964		41,476
Deferred revenue, net of current portion		353,392		284,801
Deferred grants, net of current portion		108,528		116,126
Long-term debt, net of current portion		29,580	$	31,945
Total liabilities	$	540,464	$	474,348

The Company holds a variable interest in an entity that provides the noncontrolling interest with a right to terminate the leasehold interests in all of the leased projects on the tenth anniversary of the effective date of the master lease. In this circumstance, the Company would be required to pay the noncontrolling interest an amount equal to the fair market value, as defined in the governing agreement of all leased projects as of that date.

The Company holds certain variable interests in nonconsolidated VIEs established as a result of five lease pass-through Fund arrangements as further explained in Note 13, *Lease Pass-Through Financing Obligations*. The Company does not have material exposure to losses as a result of its involvement with the VIEs in excess of the amount of the financing liability recorded in the Company's consolidated financial statements. The Company is not considered the primary beneficiary of the VIEs.

In 2013, the Company acquired an investor's interest in three consolidated VIEs for a total cash consideration of $22.0 million. In these three entities, the Company was contractually required to make payments to the investor so that the investor achieved a specified minimum internal rate of return upon occurrence of certain events. Upon purchase of the investor's stake in these entities, this obligation was satisfied. This transaction decreased the Company's additional paid-in-capital, net of the related tax impact, by $2.8 million.

Redeemable Noncontrolling Interests — 12 Months Ended Dec. 31, 2015

Equity [Abstract]

Redeemable Noncontrolling Interests

Note 15. Redeemable Noncontrolling Interests

During certain specified periods of time (the "Early Exit Periods"), noncontrolling interests in certain funding arrangements have the right to put all of their membership interests to the Company (the "Put Provisions"). During a specific period of time (the "Call Periods"), the Company has the right to call all membership units of the related redeemable noncontrolling interests.

The carrying value of redeemable noncontrolling interests at December 31, 2015 and 2014 was greater than the redemption value, except for two funds at December 31, 2015 and 2014, where the carrying value has been adjusted to the redemption value.

Stockholders' Equity — 12 Months Ended Dec. 31, 2015

Equity [Abstract]

Stockholders' Equity

Note 16. Stockholders' Equity

On August 10, 2015, the Company closed its initial public offering in which 17,900,000 shares of common stock were sold at a public offering price of $14.00 per share, resulting in net proceeds of approximately $221.3 million, after deducting underwriting discounts and commissions and $7.5 million in offering expenses paid by the Company, and excluding the proceeds received by the selling stockholders who sold an aggregate of 417,732 shares of the total 17,900,000 shares sold in the initial public offering.

Convertible Preferred Stock

Immediately prior to closing of the Company's initial public offering, all 54,840,767 shares of the Company's outstanding preferred stock were automatically converted into shares of the Company's common stock. In addition, the Company issued 1,667,683 shares of common stock and executed a letter of intent to issue 1,250,764 warrants subject to contingencies being met to purchase the Company's common stock to the former Series D and E preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the closing of the Company's initial public offering and to waive any potential anti-dilution adjustments resulting from the issuance of shares in the Company's common stock in the Company's initial public offering. The additional shares and warrants resulted in a beneficial conversion feature as a result of the inducement for Series D and E preferred stock and the Company recognized a $24.9 million deemed dividend to Series D and E preferred stockholders at the conversion date. This non-cash charge impacts net loss attributable to our common stockholders and basic and diluted net loss per share applicable to common stockholders. The warrants were issued on September 30, 2015 and are considered freestanding derivatives as disclosed in Note 12, *Derivatives*.

The Company did not have any convertible preferred stock issued and outstanding as of December 31, 2015. The Company had five series of convertible preferred stock as follows as of December 31, 2014 (in thousands, except per share amounts):

	Shares Authorized	Shares Issued and Outstanding	Aggregate Liquidation Preference	Noncumulative Dividend Per Share Per Annum
Series A	12,043	12,007	$ 12,007	$ 0.08
Series B	10,758	10,758	18,420	0.14
Series C	13,613	13,613	55,000	0.32
Series D	7,584	7,584	70,000	0.74
Series E	13,030	10,879	150,456	1.11
Total	57,028	54,841	$ 305,883	

From the inception of the Company through December 31, 2015, no dividends have been declared or paid other than the $24.9 million deemed dividend to Series D and E preferred stockholders in August 2015.

Common Stock

The Company has reserved sufficient shares of common stock for issuance upon the exercise of stock options and the exercise of warrants. Common stockholders are entitled to dividends if and when declared by the board of directors, subject to the prior rights of the preferred stockholders. As of December 31, 2015, no common stock dividends had been declared by the board of directors.

The Company has reserved shares of common stock for issuance as follows (in thousands):

	December 31, 2015	December 31, 2014
Series A Convertible Preferred Stock	—	12,007
Series B Convertible Preferred Stock	—	10,758
Series C Convertible Preferred Stock	—	13,613
Series D Convertible Preferred Stock	—	7,584
Series E Convertible Preferred Stock	—	10,879
Stock option plans		
Shares available for grant		
2013 Equity Incentive Plan	—	694
2015 Equity Incentive Plan	12,006	—
2015 Employee Stock Purchase Plan	1,000	—
Options outstanding	12,795	11,408
Restricted stock units outstanding	1,506	947
Total	27,307	67,890

Stock-Based Compensation — 12 Months Ended Dec. 31, 2015

Disclosure Of Compensation Related Costs Sharebased Payments [Abstract]

Stock-Based Compensation

Note 17. Stock-Based Compensation

MEC 2009 Stock Plan

In connection with the MEC acquisition in February 2014, the Company assumed nonstatutory stock options granted under the Mainstream Energy Corporation 2009 Stock Plan (the "MEC Plan") held by MEC employees who continued employment with the Company after the closing and converted them into options to purchase shares of the Company's common stock. The MEC Plan was terminated on the closing of the acquisition but the outstanding awards under the MEC Plan that the Company assumed in the acquisition will continue to be governed by their existing terms. As of December 31, 2015, options to purchase 527,770 shares of the Company's common stock remained outstanding under the MEC Plan.

2013 Equity Incentive Plan

In July 2013, the Board of Directors approved the 2013 Plan. In March 2015, the Board of Directors authorized an additional 3,000,000 shares reserved for issuance under the 2013 Plan. An aggregate of 4,500,000 shares of common stock are reserved for issuance under the 2013 Plan plus (i) any shares that were reserved but not issued under the plan that was previously in place, and (ii) any shares subject to stock options or similar awards granted under the plan that was previously in place that expire or otherwise terminate without having been exercised in full and shares issued that are forfeited to or repurchased by the Company, with the maximum number of shares to be added to the 2013 Plan pursuant to clauses (i) and (ii) equal to 8,044,829 shares. Stock options granted to employees generally have a maximum term of ten-years and vest over a four-year period from the date of grant; 25% vest at the end of one year, and 75% vest monthly over the remaining three years. The options may include provisions permitting exercise of the option prior to full vesting. Any unvested shares shall be subject to repurchase by the Company at the original exercise price of the option in the event of a termination of an optionee's employment prior to vesting. All the remaining shares that were available for future grants under the 2013 Plan were transferred to the 2015 Equity Incentive Plan ("2015 Plan") at the inception of the 2015 Plan. As of December 31, 2015, the Company had not granted restricted stock or other equity awards (other than options) under the 2013 Plan.

2014 Equity Incentive Plan

In August 2014, the Board approved the 2014 Equity Incentive Plan ("2014 Plan"). An aggregate of 947,342 shares of common stock are reserved for issuance under the 2014 Plan. The 2014 Plan was adopted to accommodate a broader transaction with a sales entity and to allow for similar transactions in the future. In July 2015, the Board approved an increase in the number of shares of common stock reserved to 1,197,342. As of July 2015, the Company granted all 1,197,342 restricted stock units ("RSUs") available under the 2014 Plan.

2015 Equity Incentive Plan

In July 2015, the Board approved the 2015 Plan. An aggregate of 11,400,000 shares of common stock are reserved for issuance under the 2015 Plan plus (i) any shares that were reserved but not issued under the 2013 Plan at the inception of the 2015 Plan, and (ii) any shares subject to stock options or similar awards granted under the 2008 Plan, 2013 Plan and 2014 Plan that expire or otherwise terminate without having been exercised in full and shares issued that are forfeited to or repurchased by the Company, with the maximum number of shares to be added to the 2015 Plan pursuant to clauses (i) and (ii) equal to 15,439,334 shares. Stock options granted to employees generally have a maximum term of ten-years and vest over a four-year period from the date of grant; 25% vest at the end of one year, and 75% vest monthly over the remaining three years. The options may include provisions permitting exercise of the option prior to full vesting. Any unvested shares shall be subject to repurchase by the Company at the original exercise price of the option in the event of a termination of an optionee's employment prior to vesting. RSUs granted to employees generally vest over a four-year period from the date of grant; 25% vest at the end of one year, and 75% vest quarterly over the remaining three years.

Stock Options

The following table summarizes the activity for all stock options under the Company's equity incentive plans for the year ended December 31, 2015 (shares in thousands):

	Options Outstanding	Weighted Average Exercise Price Outstanding	Weighted Average Remaining Contractual Life
Outstanding at December 31, 2014	11,408	$ 4.42	8.20
Granted	3,806	9.50	
Exercised	(1,210)	2.96	
Cancelled / forfeited	(1,209)	6.27	
Outstanding at December 31, 2015	12,795	$ 5.89	7.82
Options vested and exercisable at December 31, 2015	6,409	$ 3.88	6.80
Options vested and expected to vest at December 31, 2015	10,460	$ 5.69	7.65

As of December 31, 2015, 180,000 outstanding stock options had a performance feature that is required to be satisfied before the option is vested and exercisable. There were 517,285 and 469,000 unvested exercisable shares as of December 31, 2015 and December 31, 2014, respectively, which are subject to a repurchase option held by the Company at the original exercise price. These exercisable but unvested shares have a weighted average remaining vesting period of 3.2 years. There was no exercise of unvested options in the year ended December 31, 2015 and 2014. There were no unvested options subject to repurchase as of December 31, 2015 and 2014.

The weighted-average grant-date fair value of stock options granted during the year ended December 31, 2015, 2014 and 2013 were $4.56, $3.72 and $1.77 per share, respectively. The total intrinsic value of the options exercised during the year ended December 31, 2015, 2014 and 2013 was $8.1 million, $4.8 million and $1.4 million, respectively. The intrinsic value is the difference of the current fair value of the stock and the exercise price of the stock option. The total fair value of options vested during the year ended December 31, 2015, 2014 and 2013 was $9.1 million, $3.9 million and $2.3 million, respectively.

The Company estimates the fair value of stock-based awards on their grant date using the Black-Scholes option-pricing model. The Company estimates the fair value using a single-option approach and amortizes the fair value on a straight-line basis for options expected to vest. All options are amortized over the requisite service periods of the awards, which are generally the vesting periods.

The Company estimated the fair value of stock options with the following assumptions:

	Year Ended December 31,		
	2015	2014	2013
Risk-free interest rate	1.55%-1.95%	1.68%-2.01%	0.82%-2.06%
Volatility	36.30%-39.63%	37.41%-46.68%	54.36%-55.80%
Expected term (in years)	5.50-6.23	5.34-6.08	5.54-6.08
Expected dividend yield	0.00%	0.00%	0.00%

The expected term assumptions were determined based on the average vesting terms and contractual lives of the options. The risk-free interest rate is based on the rate for a U.S. Treasury zero-coupon issue with a term that approximates the expected life of the option grant. For stock options granted in the year ended December 31, 2015, 2014 and 2013, the Company considered the volatility data of a group of publicly traded peer companies in its industry. Forfeiture rates are estimated using the Company's expectations of forfeiture rates for the Company's employees and are adjusted when estimates change. The estimation of stock awards that will ultimately vest requires judgment, and to the extent actual results or updated estimates differ from the Company's current estimates, such amounts will be recorded as a cumulative adjustment in the period the estimates are revised. The Company considers many factors when estimating expected forfeitures, including historical forfeiture pattern, the types of awards and employee class. Actual results, and future changes in estimates, may differ substantially from management's current estimates.

Restricted Stock Units

In 2014, the Company granted a total of 947,342 RSUs that are subject to certain performance targets to a third party partner. The RSUs will vest upon the third party originating certain thresholds of expected megawatts in new systems for the period starting August 2014 and ending August 2017. In addition, these RSUs are subject to a clawback provision that requires the holder of the RSUs to either forfeit all the RSUs or pay the Company the grant date fair value for all RSUs that are not forfeited if the third party breaches the exclusivity provision of the parties' commercial agreement. Additionally, 372,342 of these RSUs are also subject to an additional performance-based clawback provision that is based on the third party originating certain additional thresholds of expected megawatts in new systems from April 2016 through September 2017. Both the exclusivity and performance-based clawback provisions expire in 2017.

The performance-based provision is considered substantive. As a result, the Company will start recognizing expense when the performance targets are met. The Company recognized $0.8 million compensation expense in the year ended December 31, 2015 as certain performance targets were met.

In 2015, the Company granted 250,000 RSUs to a third party partner, in addition to RSUs granted to employees as part of the 2015 Equity Incentive Plan. As of December 31, 2015, 783,228 outstanding RSUs had a performance feature that is required to be satisfied before the option is vested and exercisable. The following table summarizes the activity for all RSUs under all the Company's equity incentive plans for the year ended December 31, 2015 (shares in thousands):

	Shares	Weighted Average Grant Date Fair Value
Unvested balance at December 31, 2014	947	$ 9.40
Granted	808	11.13
Issued	(182)	9.58
Cancelled / forfeited	(67)	11.37
Unvested balance at December 31, 2015	1,506	$ 10.44

Employee Stock Purchase Plan

In July 31, 2015, the board of directors approved the 2015 Employee Stock Purchase Plan ("ESPP") and adopted the ESPP in August 2015, under which 1,000,000 shares of the Company's common stock have been reserved for issuance to eligible employees. The number of shares of common stock available for sale under the Company's ESPP will also include an annual increase on the first day of each fiscal year beginning on January 1, 2016, equal to the least of (i) 5,000,000 shares (ii) 2% of the common stock as of the last day of the immediately preceding fiscal year or (iii) such other amount as the Company's board of directors may determine. Employees are offered shares bi-annually through two six month offering periods, which begin on the first trading day on or after May 15 and November 15 of each year. The first offering period began on November 16, 2015. Employees may purchase a limited number of shares of the Company's common stock via regular payroll deductions at a discount of 15% of the lower of the fair market value of the Company's common stock on the first trading date of each offering period or on the exercise date. Employees may deduct up to 15% of payroll up to $25,000 per calendar year, with a cap of 2,000 shares per employee per offering period. As of December 31, 2015 the Company has 1,000,000 total shares of common stock reserved for issuance under the 2015 ESPP.

Inputs used to calculate our stock based compensation for each stock purchase right granted under the 2015 ESPP included risk-free interest rate of 0.33%, expected volatility of 33.84%, expected term of 0.5 years and expected dividend yield rate of 0.00%.

Stock-Based Compensation Expense

The Company recognized stock-based compensation expense, including the compensation expense resulting from the sales of common stock by employees and former employees to existing investors and ESPP expenses, in the consolidated statements of operations as follows (in thousands):

	Year Ended December 31,		
	2015	2014	2013
Cost of operating leases and incentives	$ 1,649	$ 155	$ 116
Cost of solar energy systems and product sales	236	682	—
Sales and marketing	5,242	897	474
Research and development	205	270	379
General and administration	8,491	7,214	1,686
Total	$ 15,823	$ 9,218	$ 2,655

In the year ended December 31, 2015 and 2014, the Company recognized $1.6 million and $3.4 million, respectively, in compensation expense resulting from sales of 1,131,028 shares and 1,092,421 shares, respectively, by employees and former employees to existing investors for amounts in excess of the deemed fair value.

The Company capitalized $0.2 million, $0.1 million and $0.0 million of stock based compensation for internal use software development projects during the years ended December 31, 2015, 2014 and 2013, respectively.

As of December 31, 2015 and 2014, total unrecognized compensation cost related to outstanding stock options was $20.9 million and $12.1 million, respectively, which is expected to be recognized over a weighted-average period of 2.8 years and 2.8 years, respectively.

Retirement Plan	12 Months Ended Dec. 31, 2015
Compensation And Retirement Disclosure [Abstract]	
Retirement Plan	**Note 18. Retirement Plan** The Company offers a retirement plan qualified under Section 401(k) of the Code to its employees (the "401(k) plan"). The available investments are selected by the Company and allow participants to defer pre-tax amounts to the plan as allowed by the Code. Upon acquisition of MEC, the Company incurred post-acquisition contributions of $0.5 million to the MEC 401(k) plan for the year ended December 31, 2014. The MEC 401(k) plan was terminated effective December 31, 2014.

Operating Revenues under Customer Agreements	12 Months Ended Dec. 31, 2015
Leases Operating [Abstract]	
Operating Revenues under Customer Agreements	**Note 19. Operating Revenues under Customer Agreements** Customer Agreements representing PPAs require customers to make payments to Sunrun based on the electricity production of the related Project, whereas Customer Agreements representing leases require fixed monthly payments from customers.

Total revenue from customers' contingent payments under PPAs recognized in the years ended December 31, 2015, 2014 and 2013 was $59.8 million, $42.8 million and $31.5 million, respectively.

Future minimum lease payments to be received from customers whose Customer Agreements represent non-cancelable leases are as follows (in thousands):

2016	$ 13,557
2017	13,697
2018	13,817
2019	13,939
2020	14,065
Thereafter	199,278
Total	$ 268,353

Income Taxes	12 Months Ended Dec. 31, 2015

Income Tax Disclosure [Abstract]

Income Taxes

Note 20. Income Taxes

The following table presents the loss before income taxes for the periods presented (in thousands):

	For the year ended December 31,		
	2015	2014	2013
Loss attributable to common stockholders	$ 33,545	$ 80,895	$ 1,792
Loss attributable to noncontrolling interest and redeemable noncontrolling interests	220,660	86,638	64,294
Total	$ 254,205	$ 167,533	$ 66,086

The income tax provision (benefit) consists of the following (in thousands):

	For the year ended December 31,		
	2015	2014	2013
Current:			
Federal	$ —	$ —	$ —
State	—	—	169
Total current expense	—	—	169
Deferred:			
Federal	(7,516)	(8,196)	(1,114)
State	2,217	(1,847)	354
Total deferred provision	(5,299)	(10,043)	(760)
Total	$ (5,299)	$ (10,043)	$ (591)

The following table represents a reconciliation of the statutory federal rate and the Company's effective tax rate for the periods presented:

	For the year ended December 31,		
	2015	2014	2013
Tax provision (benefit) at federal statutory rate	(34.00)%	(34.00)%	(34.00)%
State income taxes, net of federal benefit	0.87	(1.10)	0.79
Effect of noncontrolling and redeemable noncontrolling interests	29.53	17.59	34.10
Stock-based compensation	1.06	1.37	0.94
Effect of prepaid tax asset	0.04	9.39	—
Tax credits	(0.43)	(0.22)	(2.16)
Other	0.85	0.98	(0.56)
Total	(2.08)%	(5.99)%	(0.89)%

Deferred income taxes reflect the net tax effects of temporary differences between the carrying amounts of assets and liabilities for financial reporting purposes and the amounts used for income tax purposes. The following table represents significant components of the Company's deferred tax assets and liabilities for the periods presented (in thousands):

	December 31,	
	2015	2014
Deferred tax assets:		
Accruals and prepaids	$ 12,904	$ 4,302
Deferred revenue	34,710	44,359
Net operating loss carryforwards	229,464	176,555
Stock-based Compensation	3,748	1,612
Investment tax and other credits	11,261	7,369
Gross deferred tax assets	292,087	234,197
Deferred tax liabilities:		
Capitalized initial direct costs	27,539	16,640
Fixed asset depreciation	178,511	142,866
Deferred tax on investment in partnerships	276,183	184,240
Gross deferred tax liabilities	482,233	343,746
Net deferred tax liabilities	$ (190,146)	$ (109,549)

An analysis of deferred tax liabilities is as follows (in thousands):

	December 31,	
	2015	2014
Deferred tax assets	$ 292,087	$ 234,197
Deferred tax liabilities	(482,233)	(343,746)
Net deferred tax liabilities	$ (190,146)	$ (109,549)

As of December 31, 2015, the Company had net operating loss carryforwards for federal, California and other state income tax purposes of approximately $595.0 million, $368.0 million and $178.6 million, respectively, which will begin to expire in the year 2028, 2020 and 2020, respectively, if not utilized. Of the federal, California, and other state NOL carryover, $5.3 million, $1.3 million and $2.5 million relates to windfall stock option deductions which, when realized, will be an increase to additional paid in capital. As of December 31, 2014, the Company had net operating loss carryforwards for federal, California and other state income tax purposes of approximately $454.5 million, $283.1 million and $126.5 million, respectively. Of the federal, California, and other state NOL carryover, $1.8 million, $1.1 million and $0.5 million relates to windfall stock option deductions which, when realized, will be an increase to additional paid in capital.

As of December 31, 2015, the Company has an investment tax credit carryforward of approximately $4.2 million and California enterprise zone credits of approximately $1.0 million, which begins to expire in the year 2028 and 2023, respectively, if not utilized. As of December 31, 2014, the Company has an investment tax credit carryforward of approximately $2.4 million and California enterprise zone credits of approximately $0.9 million.

Generally, utilization of the net operating loss carryforwards and credits may be subject to a substantial annual limitation due to the ownership change limitations provided by the Internal revenue Code (IRC) of 1986, as amended and similar state provisions. The Company performed an analysis to determine whether an ownership change under Section 382 of the Code had occurred and determined that no ownership changes were identified as of December 31, 2015.

Valuation allowances are provided against deferred tax assets to the extent that it is more likely than not that the deferred tax asset will not be realized. The Company's management considers all available positive and negative evidence including its history of operating income or losses, future reversals of existing taxable temporary difference, taxable income in carryback years and tax-planning strategies. The Company has concluded there was sufficient positive evidence based on the reversal pattern of the deferred tax liability and available tax planning strategies being relied upon at the end of December 31, 2015 and December 31, 2014 to support the position that the Company does not need to maintain a valuation allowance on deferred tax assets.

Uncertain Tax Positions

The Company files tax returns as prescribed by the tax laws of the jurisdictions in which it operates. In the normal course of business, the Company is subject to examination by federal, state and local jurisdictions, where applicable. The statute of limitations for the tax returns varies by jurisdictions.

We determine whether a tax position is more likely than not to be sustained upon examination, including resolution of any related appeals or litigation processes, based on the technical merits of the position. We use a two-step approach to recognize and measure uncertain tax positions. The first step is to evaluate the tax position for recognition by determining if the weight of available evidence indicates that it is more likely than not that the position will be sustained upon tax authority examination, including resolution of related appeals or litigation processes, if any. The second step is to measure the tax benefit as the largest amount that is more than 50% likely of being realized upon ultimate settlement. We have analyzed the Company's inventory of tax positions with respect to all applicable income tax issues for all open tax years (in each respective jurisdiction).

Our policy is to include interest and penalties related to unrecognized tax benefits, if any, within the provision for taxes in the consolidated statements of operations. The Company does not have any tax positions for which it is reasonably possible that the total amount of gross unrecognized tax benefits will significantly change within 12 months of December 31, 2015.

A reconciliation of the beginning and ending amounts of unrecognized tax benefits is as follows (in thousands):

Balance at January 1, 2014 and December 31, 2014	$	—
Acquired from CEE		1,525
Balance at December 31, 2015	$	1,525

There was 0.3 million of interest and penalties for uncertain tax positions as of December 31, 2015. As of December 31, 2014, there was no unrecognized tax benefits and there were no interest and penalties accrued for any uncertain tax position.

Three of our investment funds are currently being audited by the IRS. The Company is subject to taxation in the U.S., and various state and local jurisdictions. The following table summarizes the tax years that remain open and subject to examination by the tax authorities in the most significant jurisdictions in which the Company operates:

	Tax Years
U.S. Federal	2011 - 2015
State	2010 - 2015

Commitments and Contingencies	12 Months Ended Dec. 31, 2015
Commitments And Contingencies Disclosure [Abstract]	
Commitments and Contingencies	Note 21. Commitments and Contingencies

Note 21. Commitments and Contingencies

Letters of Credit

As of December 31, 2015 and 2014, the Company had $3.5 million and $5.8 million, respectively, of unused letters of credit outstanding, with carry fees ranging from 2.00% - 3.25% per annum.

Non-cancellable Operating Leases

The Company leases facilities and equipment under non-cancellable operating leases. Total operating lease expenses were $19.7 million, $13.8 million and $2.0 million for the years ended December 31, 2015, 2014 and 2013, respectively. Certain operating leases contain rent escalation clauses, which are recorded on a straight-line basis over the initial term of the lease with the difference between the rent paid and the straight-line rent recorded as a deferred rent liability. Lease incentives received from landlords are recorded as deferred rent liabilities and are amortized on a straight-line basis over the lease term as a reduction to rent expense. Deferred rent liabilities were $1.9 million and $2.0 million as of December 31, 2015 and 2014, respectively.

Future minimum lease payments expected to be made under non-cancelable operating lease agreements as of December 31, 2015 for each of the years ending December 31, are as follows (in thousands):

2016	$	7,019
2017		6,669
2018		5,906
2019		2,521
2020		879
Thereafter		53
Total	$	23,047

Capital Lease Obligations

As of December 31, 2015 and 2014, capital lease obligations were $24.0 million and $7.4, respectively. The capital lease obligations bear interest at rates up to 10% per annum.

The following is a schedule of future lease payments as of December 31, 2015 (in thousands):

2016	$	9,727
2017		7,444
2018		5,321
2019		2,799
2020		219
Thereafter		200
Total future lease payments		25,710
Less: amount representing estimated executory costs included in future lease payments		537
Net minimum future lease payments		25,173
Amount representing interest		1,180
Present value of future payments		23,993
Less: current portion		8,951
Long term portion	$	15,042

Purchase Commitments

In January 2015, the Company entered into a purchase commitment with one of its suppliers to purchase $70.0 million of photovoltaic modules over the next 12 months with the first modules delivered in January 2015. In October 2015, the Company amended its commitment to purchase additional photovoltaic modules to be delivered until December 2016, for a total commitment of $146.0 million. As of December 31, 2015, the Company had $78.0 million of purchase commitments remaining.

In June 2015, the Company entered into a purchase commitment with one of its suppliers to purchase $32.0 million of photovoltaic modules through December 2016. As of December 31, 2015, the Company had $8.0 million of purchase commitments remaining.

Guarantees

The Company guarantees one of its investors in one of its Funds an internal rate of return, calculated on an after-tax basis, in the event that it purchases the investor's interest or the investor sells its interest to the Company. The Company does not expect the internal rate of return to fall below the guaranteed amount; however, due to uncertainties associated with estimating the timing and amount of distributions to the investor and the possibility for and timing of the liquidation of the Fund, the Company is unable to determine the potential maximum future payments that it would have to make under this guarantee.

ITC Indemnification

The Company is contractually committed to compensate certain investors for any losses that they may suffer in certain limited circumstances resulting from reductions in ITCs. Generally, such obligations would arise as a result of reductions to the value of the underlying solar energy systems as assessed by the IRS. At each balance sheet date, the Company assesses and recognizes, when applicable, the potential exposure from this obligation based on all the information available at that time, including any audits undertaken by the IRS. The Company believes that any payments to the investors in excess of the amount already recognized by the Company for this obligation are not probable based on the facts known at the reporting date. The maximum potential future payments that the Company could have to make under this obligation would depend on the difference between the fair values of the solar energy systems sold or transferred to the Funds as determined by the Company and the values the IRS would determine as the fair value for the systems for purposes of claiming ITCs. ITCs are claimed based on the statutory regulations from the IRS. The Company uses fair values determined with the assistance of an independent third-party appraisal as the basis for determining the ITCs that are passed-through to and claimed by the Fund investors. Since the Company cannot determine how the IRS will evaluate system values used in claiming ITCs, the Company is unable to reliably estimate the maximum potential future payments that it could have to make under this obligation as of each balance sheet date.

Litigation

The Company is subject to certain legal proceedings, claims, investigations and administrative proceedings in the ordinary course of its business. The Company records a provision for a liability when it is both probable that the liability has been incurred and the amount of the liability can be reasonably estimated. These provisions, if any, are reviewed at least quarterly and adjusted to reflect the impacts of negotiations, settlements, rulings, advice of legal counsel and other information and events pertaining to a particular case. Depending on the nature and timing of any such proceedings that may arise, an unfavorable resolution of a matter could materially affect the Company's future consolidated results of operations, cash flows, or financial position in a particular period.

In July 2012, the Department of Treasury and the Department of Justice (together, the "Government") opened a civil investigation into the participation by residential solar developers in the Section 1603 grant program. The Government served subpoenas on several developers, including Sunrun, along with their investors and valuation firms. The focus of the investigation is the claimed fair market value of the solar systems the developers submitted to the Government in their grant applications. We have cooperated fully with the Government and plan to continue to do so. No claims have been brought against us. The Company is not able to estimate the ultimate outcome or a range of possible loss at this point.

Net Loss Per Share	12 Months Ended Dec. 31, 2015

Earnings Per Share [Abstract]

Net Loss Per Share

Note 22. Net Loss Per Share

Prior to the Company's initial public offering and conversion of all preferred stock, the Company calculated net income (loss) per share (EPS) available to common stockholders using the two-class method. The two-class method allocates net income that otherwise would have been available to common shareholders to holders of participating securities. In connection with the Company's initial public offering, the Company recognized a deemed dividend of $24.9 million to Series D and E convertible preferred shareholders, as further discussed in Note 16, Shareholders' *Equity.*

Basic net income (loss) per share is computed by dividing net income (loss) available to common stockholders by the weighted-average number of common shares outstanding during the period. Diluted net income (loss) per share is computed by dividing net income (loss) available to common stockholders by the weighted-average number of common shares outstanding during the period adjusted to include the effect of potentially dilutive securities. Potentially dilutive securities are excluded from the computation of dilutive EPS in periods in which the effect would be antidilutive.

The computation of the Company's basic and diluted net loss per share are as follows (in thousands, except share and per share amounts):

	Years Ended December 31,		
	2015	2014	2013
Numerator:			
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Deemed dividend to convertible preferred stockholders	(24,890)	—	—
Net loss available to common stockholders	(53,136)	(70,852)	(1,201)
Denominator:			
Weighted average shares used to compute net loss per share available to common stockholders, basic and diluted	55,091	22,795	9,780

Basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)

The following shares were excluded from the computation of diluted net loss per share as the impact of including those shares would be anti-dilutive:

	Year Ended December 31,		
	2015	2014	2013
Preferred stock	—	54,841	43,998
Warrants	1,251	—	—
Outstanding stock options	12,615	11,408	8,127
Unvested restricted stock units	723	—	—
ESPP	79	—	—
Total	14,668	66,249	52,125

Related Party Transactions — 12 Months Ended Dec. 31, 2015

Related Party Transactions [Abstract]

Related Party Transactions

Note 23. Related Party Transactions

An individual who serves as one of the Company's directors has direct and indirect ownership interests in Enphase Energy, Inc. For the years ended December 31, 2015 and 2014, the Company recorded $11.9 million and $8.9 million, respectively, in purchases from Enphase Energy, Inc. and had outstanding payables of $0.7 million and $1.1 million as of December 31, 2015 and 2014.

An individual who served as one of the Company's directors until March 2015 and his spouse have a direct material ownership interest in REC Solar Commercial Corporation (RECC). For the years ended December 31, 2015 and 2014, the Company recorded $0.3 million and $7.6 million, respectively, in solar energy systems and products sales revenue from sales to RECC and had outstanding receivables of $0.0 million and $0.1 million as of December 31, 2015 and 2014, respectively.

Subsequent Events — 12 Months Ended Dec. 31, 2015

Subsequent Events [Abstract]

Subsequent Events

Note 24. Subsequent Events

In January 2016, certain subsidiaries of the Company entered into secured credit facilities agreements with a syndicate of banks for up to $250.0 million in committed facilities. The facilities include a $220.0 million aggregate facility ("Aggregate Facility"), $23.0 million term loan ("Term Loan") and a $7.0 million letter of credit facility. The Aggregate Facility and letter of credit bear an interest rate of LIBOR + 250 basis points for the initial three-year revolving availability period, stepping up to LIBOR + 275 basis points in the following two-year period. The Term Loan bears an interest rate of LIBOR + 500 basis points (with a LIBOR floor of 100 basis points) in the first three years, stepping up to LIBOR plus 650 basis points in the following two-year period. The principal and accrued interest on any outstanding loans mature on December 31, 2020.

The facilities are non-recourse to Sunrun and are secured by net cash flows of certain subsidiaries from power purchase agreements and leases, less certain operating, maintenance and other expenses which are available to the borrowers after distributions to tax equity investors. The facilities contain customary covenants including the requirement to maintain certain financial measurements and provide lender reporting. The credit facilities also contain certain provisions in the event of default which entitle lenders to take certain actions including acceleration of amounts due under the facilities.

In March 2016, a subsidiary of the Company entered into a $24.5 million secured, non-recourse loan agreement. The loan will be repaid through cashflows from a lease pass-through arrangement previously entered into by the Company. The loan matures in September 2022 and has an interest rate of LIBOR + 2.25%. The loan agreement contains customary covenants including the requirement to maintain certain financial measurements and provide lender reporting. The loan also contains certain provisions in the event of default which entitles the lender to take certain actions including acceleration of amounts due under the loan.

Summary of Significant Accounting Policies (Policies) — 12 Months Ended Dec. 31, 2015

Accounting Policies [Abstract]

Basis of Presentation and Principles of Consolidation

Basis of Presentation and Principles of Consolidation

The consolidated financial statements have been prepared in conformity with U.S. generally accepted accounting principles ("GAAP") and reflect the accounts and operations of the Company and those of its subsidiaries, including Funds, in which the Company has a controlling financial interest. The typical condition for a controlling financial interest ownership is holding a majority of the voting interests of an entity. However, a controlling financial interest may also exist in entities, such as variable interest entities ("VIEs"), through arrangements that do not involve controlling financial interests. In accordance with the provisions of Financial Accounting Standards Board ("FASB") Accounting Standards Codification Topic 810 ("ASC 810") Consolidation, the Company consolidates any VIE of which it is the primary beneficiary. The primary beneficiary, as defined in ASC 810, is the party that has (1) the power to direct the activities of a VIE that most significantly impact the VIE's economic performance and (2) the obligation to absorb the losses of the VIE or the right to receive benefits from the VIE that could potentially be significant to the VIE. The Company evaluates its relationships with its VIEs on an ongoing basis to determine whether it continues to be the primary beneficiary. The consolidated financial statements reflect the assets and liabilities of VIEs that are consolidated. All intercompany transactions and balances have been eliminated in consolidation.

Reclassifications

Reclassifications

Certain prior period amounts have been reclassified to conform to current period presentation.

Use of Estimates

Use of Estimates

The preparation of the consolidated financial statements requires management to make estimates and assumptions that affect the amounts reported in the consolidated financial statements and accompanying notes. The Company regularly makes significant estimates and assumptions, including, but not limited to, the estimates that affect the collectability of accounts receivable, the valuation of inventories, the useful lives and estimated residual values of solar energy systems, the useful lives of property and equipment, the valuation and useful lives of intangible assets, the fair value of assets acquired and liabilities assumed in business combinations, the effective interest rate used to amortize lease pass-through financing obligations, the valuation of stock-based compensation, the valuation of the Company's common stock, the determination of valuation allowances associated with deferred tax assets, fair value of debt instruments disclosed and the redemption value of redeemable noncontrolling interests. The Company bases its estimates on historical experience and on various other assumptions believed to be reasonable. Actual results may differ from such estimates.

Segment Information

Segment Information

The Company has one operating segment with one business activity, providing solar energy services and products to customers. The Company's chief operating decision maker ("CODM") is its Chief Executive Officer, who manages operations on a consolidated basis for purposes of allocating resources. When evaluating performance and allocating resources, the CODM reviews financial information presented on a consolidated basis.

Revenues from external customers for each group of similar products and services are as follows (in thousands):

	Year Ended December 31,		
	2015	2014	2013
Operating leases	$ 86,332	$ 63,962	$ 44,249
Incentives	31,672	20,044	10,491
Operating leases and incentives	118,004	84,006	54,740
Solar energy systems	50,191	23,687	—
Products	136,411	90,864	—
Solar energy systems and product sales	186,602	114,551	—
Total revenue	$ 304,606	$ 198,557	$ 54,740

Cash

Cash

Cash consists of bank deposits held in checking and savings accounts. The Company considers all highly liquid investments purchased with an original maturity of three months or less to be cash equivalents. The Company has exposure to credit risk to the extent cash balances exceed amounts covered by federal deposit insurance. The Company believes that its credit risk is not significant.

Restricted Cash

Restricted Cash

Restricted cash represents balances collateralizing standby letters of credit, amounts related to replacement of solar energy systems and obligations under certain financing transactions.

Accounts Receivable

Accounts Receivable

Accounts receivable consist of amounts due from customers as well as state and utility rebates due from government agencies and utility companies. Under arrangements with customers, the customers typically assign incentive rebates to the Company.

Accounts receivable are recorded at net realizable value. The Company maintains allowances for the applicable portion of receivables when collection becomes doubtful. The Company estimates anticipated losses from doubtful accounts based upon the expected collectability of all accounts receivables, which takes into account the number of days past due, collection history, identification of specific customer exposure, and current economic trends. Once a receivable is deemed to be uncollectible, it is written off. In 2015, 2014 and 2013, the Company recorded provision for bad debt expense of $2.0 million, $0.5 million and $0.2 million, respectively, and wrote-off uncollectible receivables of $1.1 million, $0.1 million and $0.0 million, respectively.

Accounts receivable, net consists of the following (in thousands):

	December 31,	
	2015	2014
Customer receivables	$ 46,169	$ 24,477
Customer deposits	10,150	11,135
Other receivables	4,376	5,936
Rebates receivable	1,221	2,344
Allowance for doubtful accounts	(1,641)	(703)
Total	$ 60,275	$ 43,189

State Tax Credits Receivable

State Tax Credits Receivable

State tax credits receivable are recognized upon submission of the state income tax return.

Inventories

Inventories

Inventories are stated at the lower of cost or market on a first-in, first-out basis. Inventories consist of raw materials such as photovoltaic panels, inverters and mounting hardware as well as miscellaneous electrical components that are sold as-is by the distribution operations and used in installations and work-in-process. Work-in-process primarily relates to solar energy systems that will be sold to customers, which are partially installed and have yet to pass inspection by the responsible city or utility department. For solar energy systems where the Company performs the installation, the Company commences transferring component parts from inventories to construction in progress, a component of solar energy systems, once a lease contract with a lease customer has been executed and the component parts have been assigned to a specific project. Additional costs incurred including labor and overhead are recorded within construction in progress.

The Company periodically reviews inventories for unusable and obsolete items based on assumptions about future demand and market conditions. Based on this evaluation, provisions are made to write inventories down to their market value.

Solar Energy Systems, net

Solar Energy Systems, net

The Company records solar energy systems leased to customers and solar energy systems that are under installation as solar energy systems, net on its consolidated balance sheet. Solar energy systems, net is comprised of system equipment costs and initial direct costs related to solar energy systems, less accumulated depreciation and amortization. Depreciation on solar energy systems is calculated on a straight-line basis to their estimated residual values over the estimated useful lives of the systems to the Company, which is the expected holding period of typically 20 years, coinciding with the initial lease term of the Company's Customer Agreements. The Company has determined that it is more likely that the customer will elect to purchase the solar energy system at the end of the initial lease period rather than renew their customer agreement, due to the cost of purchasing the solar energy system being significantly lower than it was at the initiation of the customer agreement, in order to reduce electricity costs, as well as increase the value and marketing attributes of their home. If a customer elects to renew their lease at the end of the initial lease term, the residual value will be depreciated over a revised estimated remaining useful life to the Company. The Company periodically reviews its estimates of residual value and its estimated useful life and recognizes changes in estimates by prospectively adjusting depreciation expense. Inverters are depreciated over their estimated useful life of 10 years.

Solar energy systems under installation will be depreciated as solar energy systems leased to customers when the respective systems are completed and interconnected.

Initial direct costs from the origination of Customer Agreements are capitalized and amortized over the initial term of the related Customer Agreement and are included within solar energy systems, net in the consolidated balance sheets. Amortization of these costs is recorded in cost of operating leases and incentives in the accompanying consolidated statements of operations.

Property and Equipment, net

Property and Equipment, net

Property and equipment, net consists of leasehold improvements, furniture, computer hardware and software, machinery and equipment, and automobiles. All property and equipment are stated at historical cost net of accumulated depreciation. Repairs and maintenance are expensed as incurred.

Property and equipment is depreciated on a straight-line basis over the following periods:

Leasehold improvements	Lesser of estimated useful life of the asset or lease term, which is typically 2 to 6 years
Furniture	5 years
Computer hardware and software	3 years
Machinery and equipment	5-7 years
Automobiles	4-5 years

Capitalization of Software Costs

Capitalization of Software Costs

For costs incurred in the development of internal use software, the Company capitalizes costs incurred during the application development stage. Costs related to preliminary project activities and post implementation activities are expensed as incurred. Internal use software is amortized on a straight-line basis over its estimated useful life.

Intangible Assets, net

Intangible Assets, net

Finite-lived intangible assets are initially recorded at fair value and presented net of accumulated amortization. Intangible assets are amortized on a straight-line basis over their estimated useful lives as follows:

Customer relationships	6-10 years
Backlog	1 year
Developed technology	5 years
Trade names	4 months to 5 years

Impairment of Long-Lived Assets

Impairment of Long-Lived Assets

The carrying amounts of the Company's long-lived assets, including solar energy systems and intangible assets subject to depreciation and amortization, are periodically reviewed for impairment whenever events or changes in circumstances indicate that the carrying value of these assets may not be recoverable or that the useful life is shorter than originally estimated. Factors that are considered in deciding when to perform an impairment review would include significant negative industry or economic trends and significant changes or planned changes in the use of the assets. Recoverability of these assets is measured by comparison of the carrying amount of each asset to the future undiscounted cash flows the asset is expected to generate over its remaining life. If the asset is considered to be impaired, the amount of any impairment is measured as the difference between the carrying value and the fair value of the impaired asset. If the useful life is shorter than originally estimated, the Company amortizes the remaining carrying value over the new shorter useful life. No impairment of long-lived assets has been recorded for the years ended December 31, 2015, 2014 and 2013.

Business Combinations

Business Combinations

Acquisitions of entities and certain solar projects with the associated leases that meet the definition of a business are accounted for as business combinations in accordance with ASC 805, *Business Combinations*. The Company records assets acquired and liabilities assumed based on their estimated fair values at the acquisition date. The excess of the purchase price over those fair values is recorded as goodwill. Acquisition-related expenses are expensed as incurred.

Goodwill

Goodwill

Goodwill represents the excess of the purchase price over the fair value of assets acquired and liabilities assumed of MEC in February 2014 and CEE in April 2015. Goodwill is reviewed for impairment at least annually or whenever events or changes in circumstances indicate that the carrying amount may be impaired. The Company has determined that it operates as one reporting unit and the Company's goodwill is recorded at the enterprise level. The Company performs its annual impairment test of goodwill on October 1 of each fiscal year or whenever events or circumstances change or occur that would indicate that goodwill might be impaired. When assessing goodwill for impairment, the Company uses qualitative and if necessary, quantitative methods in accordance with FASB ASC Topic 350 ("ASC 350"), *Goodwill*. The Company also considers its enterprise value and if necessary, discounted cash flow model, which involves assumptions and estimates, including the Company's future financial performance, weighted-average cost of capital and interpretation of currently enacted tax laws.

Circumstances that could indicate impairment and require the Company to perform a quantitative impairment test include a significant decline in the Company's financial results, a significant decline in the Company's enterprise value relative to its net book value, an unanticipated change in competition or the Company's market share and a significant change in the Company's strategic plans. The Company did not note any indicators of impairment in the qualitative assessment that would require a quantitative analysis in 2015. The Company did not have any goodwill prior to 2014, and no impairment charges have been recorded to date.

Deferred Revenue

Deferred Revenue

Deferred revenue consists of amounts for which the criteria for revenue recognition have not yet been met and includes a) amounts that are collected from customers, including upfront deposits and lease prepayments; b) rebates and incentives received and receivables from utility companies and various local and state government agencies; c) amounts related to investment tax credits ("ITC") that the Company monetized in connection with its lease-pass through financing obligations; and d) amounts received related to the sales of solar renewable energy credits ("SRECs").

Deferred revenue consists of the following (in thousands):

	December 31,	
	2015	2014
Customer payments	$ 370,754	$ 311,193
Rebates and incentives	102,827	101,318
ITCs	126,853	85,767
SRECs	18,358	13,846
Total	$ 618,792	$ 512,124

Deferred Grants

Deferred Grants

Deferred grants consist of U.S. Treasury grants and State Grants. The Company applied for a renewable energy technologies income tax credit offered by one of the states in the form of a cash payment and deferred the tax credit as a grant on the consolidated balance sheets. The Company initially recorded the grants as deferred grant income and recognizes the benefit on a straight-line basis over the estimated depreciable life of the associated assets as a reduction in cost of operating leases and incentives.

Warranty Accrual

Warranty Accrual

The Company provides warranty service and replacement on the majority of all solar energy systems sold and installed. The major components are generally covered under a manufacturer's limited warranty.

In resolving claims under warranty services, the Company has the option of remedying the defect to the warranted level through repair, refurbishment, or replacement. The warranty accrual is estimated and is re-evaluated regularly by management based upon the Company's warranty policy, applicable contractual warranty obligations, an analysis of historical costs and age of installed systems and management's evaluation of current claims in process. The warranty accrual is recorded as a component of accrued expenses and other liabilities in the Company's consolidated balance sheets. Prior to the Company's acquisition of the residential business from MEC in February 2014, no warranty accrual was necessary. The Company recorded a warranty accrual of $1.1 million and $0.9 million as of December 31, 2015 and 2014, respectively.

Solar Energy Performance Guarantees

Solar Energy Performance Guarantees

The Company guarantees to customers certain specified minimum solar energy production output for solar facilities over the initial term of the Customer Agreements. The Company monitors the solar energy systems to determine whether these specified minimum outputs are being achieved. If the Company determines that the guaranteed minimum energy output is not achieved, it records a liability for the estimated amounts payable. As of December 31, 2015 and 2014, the Company recorded liabilities of $0.3 million and $0.4 million, respectively, as accrued expenses and other liabilities in the consolidated balance sheets relating to these guarantees based on the Company's assessment of its exposure.

Derivative Financial Instruments

Derivative Financial Instruments

The Company recognizes all derivative instruments on the balance sheet at their fair value. Changes in the fair value of derivatives are recorded each period in current earnings or other comprehensive loss if a derivative is designated as part of a hedge transaction. The ineffective portion of the hedge, if any, is immediately recognized in earnings.

Beginning in 2015, the Company uses derivative financial instruments, primarily interest rate swaps, to manage its exposure to interest rate risks on its syndicated term loans, which are recognized on the balance sheet at their fair values. On the date that the Company enters into a derivative contract, the Company formally documents all relationships between the hedging instruments and the hedged items, as well as its risk management objective and strategy for undertaking each hedge transaction. Derivative instruments designated in a hedge relationship to mitigate exposure to variability in expected future cash flows, or other types of forecasted transactions, are considered cash flow hedges. Cash flow hedges are accounted for by recording the fair value of the derivative instrument on the balance sheet as either a freestanding asset or liability. Changes in the fair value of a derivative that is designated and qualifies as an effective cash flow hedge are recorded in accumulated other comprehensive loss, net of tax, until earnings are affected by the variability of cash flows of the hedged item. Any derivative gains and losses that are not effective in hedging the variability of expected cash flows of the hedged item or that do not qualify for hedge accounting treatment are recognized directly into income. At the hedge's inception and at least quarterly thereafter, a formal assessment is performed to determine whether changes in cash flows of the derivative instrument have been highly effective in offsetting changes in the cash flows of the hedged items and whether they are expected to be highly effective in the future. The Company discontinues hedge accounting prospectively when (i) it determines that the derivative is no longer effective in offsetting changes in the cash flows of a hedged item; (ii) the derivative expires or is sold, terminated, or exercised; or (iii) management determines that designating the derivative as a hedging instrument is no longer appropriate. In all situations in which hedge accounting is discontinued and the derivative remains outstanding, the derivative instrument is carried at its fair market value on the balance sheet with the changes in fair value recognized in current-period earnings. The remaining balance in accumulated other comprehensive loss associated with the derivative that has been discontinued is not recognized in the income statement unless it is probable that the forecasted transaction will not occur. Such amounts are recognized in earnings when earnings are affected by the hedged transaction.

The Company recognized warrants with former preferred stockholders as an inducement to convert their shares of convertible preferred stock into shares of common stock immediately prior to the Company's initial public offering as derivative liabilities. Such liabilities were valued when the financial instruments were initially issued, with the change in their respective fair values recorded as a gain or loss on revaluation within other expenses in the Company's statement of operations. The Company determines the fair value of its warrant derivative liabilities using the Black-Scholes option-pricing model.

Fair Value of Financial Instruments

Fair Value of Financial Instruments

The Company defines fair value as the exchange price that would be received for an asset or an exit price that would be paid to transfer a liability in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants on the measurement date. The Company uses valuation techniques to measure fair value that maximize the use of observable inputs and minimize the use of unobservable inputs. FASB establishes a three-tier fair value hierarchy for disclosure of fair value measurements as follows:

- Level 1—Inputs are unadjusted, quoted prices in active markets for identical assets or liabilities at the measurement date;
- Level 2—Inputs are observable, unadjusted quoted prices in active markets for similar assets or liabilities, unadjusted quoted prices for identical or similar assets or liabilities in markets that are not active, or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the related assets or liabilities; and
- Level 3—Inputs that are unobservable, significant to the measurement of the fair value of the assets or liabilities and are supported by little or no market data.

The Company's financial instruments include cash, receivables, accounts payable, accrued expenses, distributions payable to noncontrolling interests, derivatives, borrowings on the line of credit, long-term debt and solar asset-backed notes.

Revenue Recognition

Revenue Recognition

The Company recognizes revenue when (i) persuasive evidence of an arrangement exists, (ii) delivery has occurred or services have been rendered, (iii) the sales price is fixed and determinable, and (iv) collection of the related receivable is reasonably assured.

Operating leases and incentives

Operating leases and incentives revenue is primarily comprised of revenue from customer agreements, revenue from solar energy system rebate incentives, revenue associated with ITCs assigned to investment funds that are classified as lease pass-through arrangements and revenue from the sales of SRECs generated by the Company's solar energy systems to third parties.

The Company begins to recognize revenue on Customer Agreements when permission to operate ("PTO") is given by the local utility company or on the date daily operation commences if utility approval is not required. The Company recognizes revenue on a straight-line basis over the initial term of the Customer Agreements (typically 20 years) that have minimum lease payments, or as earned when the customers are billed based on the actual electricity generated at a specific rate under the terms of the Customer Agreements.

The Company considers upfront rebate incentives received from states and utilities for solar energy systems subject to Customer Agreements to be minimum lease payments. Rebate revenue is recognized on a straight-line basis over the life of the initial contract term of the Customer Agreement beginning when a PTO letter is issued by the local utility company or on the date daily operation commences if utility approval is not required.

The Company monetizes the ITCs associated with the leased systems on its lease pass-through financing obligations by assigning them to the investor together with the future customer lease payments. A portion of the cash consideration received from the investors is allocated to the estimated fair value of the assigned ITCs. The estimated fair value of the ITCs is determined by applying the expected internal rate of return to the investor on this structure to the gross amount of the ITCs that may be claimed by the investor.

The ITCs are subject to recapture under the Internal Revenue Code ("Code") if the underlying solar energy system either ceases to be a qualifying property or undergoes a change in ownership within five years of its placed in service date. The recapture amount decreases by 20% on each anniversary of the PTO date. As the Company has an obligation to ensure the solar energy systems is in service and operational for a term of five years to avoid any recapture of the ITCs, the Company recognizes revenue as the recapture provisions lapse assuming the other aforementioned revenue recognition criteria have been met. The monetized ITCs are initially recorded within deferred revenue on the consolidated balance sheets, and subsequently, one-fifth of the monetized ITCs are recognized as revenue in the consolidated statements of operations on each anniversary of the solar energy systems' PTO date over the following five years.

SREC revenue arises from the sale of environmental credits generated by solar energy systems. SREC revenue is recorded in operating leases and incentives revenue. We recognize revenue related to the sale of SRECs to the extent the cumulative value of delivered SRECs per contract exceeds any possible liquidated damages for non-delivery, if any.

The Company has determined that Customer Agreements are operating leases as opposed to capital leases pursuant to ASC 840, *Leases*. Management estimates the estimated useful life of solar energy systems to be 20 years, which coincides with the expected holding period and initial lease term of 20 years, as discussed in Note 2, *Summary of Significant Accounting Policies*, above. However, since the estimated economic life of solar energy systems is estimated to be at least 30 years, the lease term is less than 75% of its estimated economic life. Additionally, the Company evaluated the following lease classification criteria: (i) whether there is a transfer of ownership or bargain purchase option at the end of the lease and (ii) whether the present value of minimum lease payments exceeds 90% of the fair value at lease inception and determined that these criteria were not met.

Solar energy systems and product sales

For solar energy systems sold to customers, the Company recognizes revenue when the solar energy system passes inspection by the authority having jurisdiction, provided all other revenue recognition criteria have been met. The Company's installation projects are typically completed in a short period of time.

Product sales consist of solar panels, racking systems, inverters, other solar energy products sold to resellers and customer leads. Product sales revenue is recognized at the time when title is transferred, generally upon shipment. Shipping and handling fees charged to customers are included in net sales. Total shipping and handling fees charged to customers were $2.6 million and $2.4 million for the year ended December 31, 2015 and 2014, respectively. Volume discounts given to customers are recorded as a reduction of revenue, since the Company does not receive goods or services in exchange for the discounts offered. Customer lead revenue, included in product sales, is recognized at the time the lead is delivered.

Taxes assessed by government authorities that are directly imposed on revenue producing transactions are excluded from product revenue.

Cost of Revenue

Cost of Revenue

Operating leases and incentives

Cost of revenue for operating leases and incentives is primarily comprised of the (1) depreciation of the cost of the solar energy systems, as reduced by amortization of U.S. Treasury grants, (2) amortization of initial direct costs, (3) lease operations, monitoring and maintenance costs including associated personnel costs, and (4) allocated corporate overhead costs.

Solar energy systems and product sales

Cost of revenue for solar energy systems and non-lead generation product sales consist of direct and indirect material and labor costs for solar energy systems installations and product sales. Also included are engineering and design costs, estimated warranty costs, freight costs, allocated corporate overhead costs, vehicle depreciation costs and personnel costs associated with supply chain, logistics, operations management, safety and quality control. Cost of revenue for lead generations consists of costs related to direct-response advertising activities associated with generating customer leads.

Research and Development Expense

Research and development expenses include personnel costs, allocated overhead costs, and other costs related to the development of the Company's BrightPath software suite as well as its racking equipment.

Advertising Costs

Advertising Costs

Advertising costs are expensed as incurred in the consolidated statements of operations. The Company incurred advertising costs of $34.8 million, $16.9 million and $7.7 million for the years ended December 31, 2015, 2014 and 2013, respectively.

Stock-Based Compensation

Stock-Based Compensation

The Company grants stock-based compensation for its equity incentive plan and employee stock purchase plan. Stock-based compensation to employees is measured based on the grant date fair value of the awards and recognized over the period during which the employee is required to perform services in exchange for the award (generally the vesting period of the award). The Company estimates the fair value of stock based awards granted using the Black-Scholes option-valuation model. Compensation cost is recognized over the vesting period of the applicable award using the straight-line method for those options expected to vest.

The Company also grants restricted stock units ("RSUs") to non-employees that vest upon the satisfaction of both performance and service conditions. The Company starts recognizing expense on the RSUs when the performance condition is met.

Noncontrolling Interests and Redeemable Noncontrolling Interests

Noncontrolling Interests and Redeemable Noncontrolling Interests

Noncontrolling interests represent investors' interests in the net assets of the Funds that the Company has created to finance the cost of its solar energy systems subject to the Company's Customer Agreements. The Company has determined that the contractual provisions in the funding arrangements represent substantive profit sharing arrangements. The Company has further determined that the appropriate methodology for attributing income and loss to the noncontrolling interests and redeemable noncontrolling interests each period is a balance sheet approach referred to as the hypothetical liquidation at book value ("HLBV") method.

Under the HLBV method, the amounts of income and loss attributed to the noncontrolling interests and redeemable noncontrolling interests in the consolidated statements of operations reflect changes in the amounts the investors would hypothetically receive at each balance sheet date under the liquidation provisions of the contractual agreements of these arrangements, assuming the net assets of these Funding structures were liquidated at recorded amounts. The Company's initial calculation of the investor's noncontrolling interest in the results of operations of these Funding arrangements is determined as the difference in the noncontrolling interests' claim under the HLBV method at the start and end of each reporting period, after taking into account any capital transactions, such as contributions or distributions, between the Fund and the investors.

The Company classifies certain noncontrolling interests with redemption features that are not solely within the control of the Company outside of permanent equity on its consolidated balance sheets. Redeemable noncontrolling interests are reported using the greater of their carrying value as determined by the HLBV method or their estimated redemption value at each reporting date.

Income Taxes

Income Taxes

During November 2015, the FASB issued ASU 2015-17, *Balance Sheet Classification of Deferred Taxes*, which simplifies the presentation of deferred income taxes. ASU 2015-17 provides presentation requirements to classify deferred tax assets and liabilities as noncurrent in a classified statement of financial position. The standard is effective for fiscal years beginning after December 15, 2016, including interim periods within that reporting period. Early adoption is permitted for any interim and annual financial statements that have not yet been issued. We early adopted ASU 2015-17 effective December 31, 2015, retrospectively. Adoption resulted $3.0 million decrease in deferred tax assets, current and a $3.0 million decrease in deferred tax liabilities in our Consolidated Balance Sheets at December 31, 2014. Adoption had no impact on our results of operations.

The Company recognizes deferred tax assets and liabilities for the expected future tax consequences of events that have been included in the consolidated financial statements and tax returns. Under this method, deferred tax assets and liabilities are determined based on the difference between the financial statement and tax basis of assets and liabilities using enacted tax rates in effect for the year in which the differences are expected to reverse. Valuation allowances are provided against deferred tax assets to the extent that it is more likely than not that the deferred tax asset will not be realized. The Company is subject to the provisions of ASC 740, *Income Taxes*, which establishes consistent thresholds as it relates to accounting for income taxes. It defines the threshold for recognizing the benefits of tax return positions in the financial statements as "more likely than not" to be sustained by the taxing authority and requires measurement of a tax position meeting the more-likely-than-not criterion, based on the largest benefit that is more than 50% likely to be realized. Management has analyzed the Company's inventory of tax positions with respect to all applicable income tax issues for all open tax years (in each respective jurisdiction).

The Company sells solar energy systems to the Funds. As the Funds are consolidated by the Company, the gain on the sale of the solar energy systems is not recognized in the consolidated financial statements. However, this gain is recognized for tax reporting purposes. Since these transactions are intercompany sales, any tax expense incurred related to these intercompany sales is deferred and recorded as a prepaid tax asset and amortized over the depreciable life of the underlying solar energy systems which has been estimated to be 20 years in accordance with ASC Topic 810.

The Company files tax returns as prescribed by the tax laws of the jurisdictions in which it operates. In the normal course of business, the Company is subject to examination by federal, state and local jurisdictions, where applicable. The statute of limitations for the tax returns varies by jurisdiction.

Concentrations of Credit and Supplier Risk

Concentrations of Credit and Supplier Risk

Financial instruments which potentially subject the Company to concentrations of credit risk consist primarily of cash and accounts receivable, which includes rebates receivable. The associated risk of concentration for cash is mitigated by banking with institutions with high credit ratings. At certain times, amounts on deposit exceed Federal Deposit Insurance Corporation insurance limits. The Company does not require collateral or other security to support accounts receivable. To reduce credit risk, management performs periodic credit evaluations and ongoing evaluations of its customers' financial condition. Rebates receivable are due from various states and local governments as well as various utility companies. The Company considers the collectability risk of such amounts to be low. The Company is not dependent on any single customer or installer. The loss of a customer or an installer would not adversely impact the Company's operating results or financial position. The Company's customers under Customer Agreements are primarily located in California, Hawaii, Maryland, Massachusetts, New Jersey and New York. During the year ended December 31, 2015 and 2014, the solar materials purchases from the top five suppliers were approximately $160.5 million and $69.1 million, respectively.

Recently Issued Accounting Standards

Recently Issued Accounting Standards

In May 2014, the FASB issued Accounting Standards Update ("ASU") No. 2014-09 *Revenue from Contracts with Customers* (Topic 606), to replace the existing revenue recognition criteria for contracts with customers and to establish the disclosure requirements for revenue from contracts with customers. The core principle of this standard is to recognize revenue when promised goods or services are transferred to customers in an amount that reflects the consideration that is expected to be received for those goods or services. This ASU is effective for the Company for Annual Reporting periods beginning after December 15, 2017 including the interim reporting periods within that fiscal year, and early adoption is permitted. Adoption of the ASU is either retrospective to each prior period presented or retrospective with a cumulative adjustment to retained earnings or accumulated deficit as of the adoption date. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

In November 2014, the FASB issued ASU 2014-16 *Determining Whether the Host Contract in a Hybrid Financial Instrument Issued in the Form of a Share is More Akin to Debt or to Equity.* This guidance requires issuers and investors to consider all of a hybrid instrument's stated and implied substantive terms and features, including any embedded derivative features being evaluated for bifurcation. The guidance eliminates the "chameleon approach", under which all embedded features except the feature being analyzed are considered. The guidance is effective for the year beginning after December 15, 2015 and for interim periods within fiscal years beginning after December 15, 2016. Early adoption is permitted. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In November 2014, the FASB issued ASU 2014-15, *Disclosure of Uncertainties About an Entity's Ability to Continue as a Going Concern*, which provides guidance on determining when and how to disclose going-concern uncertainties in the financial statements. The new standard requires management to perform interim and annual assessments of an entity's ability to continue as a going concern within one year of the date of issuance of the entity's financial statements and provide certain disclosures when there is substantial doubt about the entity's ability to continue as a going concern. This guidance applies to all entities and is effective for annual periods beginning after December 15, 2016, and interim periods thereafter, with early adoption permitted. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In February 2015, the FASB issued ASU 2015-02 *Amendments to the Consolidation Analysis*, which provides consolidation guidance and changes the way reporting enterprises evaluate consolidation for limited partnerships, investment companies and similar entities, as well as variable interest entities. The ASU is effective for annual and interim periods in fiscal years beginning after December 15, 2015. The Company believes the adoption of this guidance will have no impact on its consolidated financial statements.

In April 2015, the FASB issued ASU 2015-03, *Interest—Imputation of Interest (Subtopic 835-30) Simplifying the Presentation of Debt Issuance Costs*, to simplify the presentation of debt issuance costs. In August 2015, the FASB issued ASU 2015-15, *Interest—Imputation of Interest (Subtopic 835-30) Presentation and Subsequent Measurement of Debt Issuance Costs Associated with Line-of-Credit Arrangement.* Prior to ASU 2015-03 and ASU 2015-15, issuance costs were presented as an asset on the balance sheet. Under ASU 2015-03 and ASU 2015-15, debt issuance costs related to a recognized debt liability are required to be presented in the balance sheet as a direct deduction from the carrying amount of that debt liability, consistent with debt discounts. ASU 2015-15 clarified that the SEC will not object to an entity presenting the cost of securing a revolving line of credit as an asset regardless of whether a balance is outstanding. The recognition and measurement guidance for debt issuance costs are not affected by the amendments in these updates. The ASUs are effective for annual and interim periods in fiscal years beginning after December 15, 2015 and interim periods within those fiscal years. The effect on the Company's consolidated balance sheet for the year ended December 31, 2015 will be to reclassify $3.6 million in debt issuance costs from assets to a reduction in liabilities.

In July 2015, the FASB issued ASU No. 2015-11, *Simplifying the Measurement of Inventory*, to specify that inventory should be subsequently measured at the lower of cost or net realizable value, which is the ordinary selling price less any completion, transportation and disposal costs. However, the ASU does not apply to inventory measured using the last-in-first-out or retail methods. The ASU is effective for interim and annual periods beginning after December 15, 2016. Adoption of the ASU is prospective. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

In February 2016, the FASB issued ASU No. 2016-02, *Leases.* Under the new guidance, lessees will be required to recognize for all leases (with the exception of short-term leases) a lease liability, which is a lessee's obligation to make lease payments arising from a lease, measured on a discounted basis and a right-of-use asset, which is an asset that represents the lessee's right to use, or control the use of, a specified asset for the lease term. The ASU is effective for fiscal years beginning after December 15, 2018 and interim periods within those fiscal years. The Company is currently evaluating this guidance and the impact it may have on its consolidated financial statements.

Summary of Significant Accounting Policies (Tables)	12 Months Ended Dec. 31, 2015
Accounting Policies [Abstract]	
Schedule of Revenue from External Customers	Revenues from external customers for each group of similar products and services are as follows (in thousands):

	Year Ended December 31, 2015	2014	2013
Operating leases	$ 86,332	$ 63,962	$ 44,249
Incentives	31,672	20,044	10,491
Operating leases and incentives	118,004	84,006	54,740
Solar energy systems	50,191	23,687	—
Products	136,411	90,864	—
Solar energy systems and product sales	186,602	114,551	—
Total revenue	$ 304,606	$ 198,557	$ 54,740

Schedule of Accounts Receivable

Accounts receivable, net consists of the following (in thousands):

	December 31, 2015	December 31, 2014
Customer receivables	$ 46,169	$ 24,477
Customer deposits	10,150	11,135
Other receivables	4,376	5,936
Rebates receivable	1,221	2,344
Allowance for doubtful accounts	(1,641)	(703)
Total	$ 60,275	$ 43,189

Depreciated Property and Equipment, Net Estimated Useful Lives

Property and equipment is depreciated on a straight-line basis over the following periods:

Leasehold improvements	Lesser of estimated useful life of the asset or lease term, which is typically 2 to 6 years
Furniture	5 years
Computer hardware and software	3 years
Machinery and equipment	5-7 years
Automobiles	4-5 years

Amortized Finite-Lived Intangible Assets Estimated Useful lives

Finite-lived intangible assets are initially recorded at fair value and presented net of accumulated amortization. Intangible assets are amortized on a straight-line basis over their estimated useful lives as follows:

Customer relationships	6-10 years
Backlog	1 year
Developed technology	5 years
Trade names	4 months to 5 years

Schedule of Deferred Revenue

Deferred revenue consists of the following (in thousands):

	December 31, 2015	December 31, 2014
Customer payments	$ 370,754	$ 311,193
Rebates and incentives	102,827	101,318
ITCs	126,853	85,767
SRECs	18,358	13,846
Total	$ 618,792	$ 512,124

Acquisitions (Tables)

12 Months Ended Dec. 31, 2015

Summary of Unaudited Pro Forma Information for Acquisition Occurred

The following table summarizes the unaudited pro forma total revenue and net loss of the combined company for the years ended December 31, 2014 and 2013 assuming that the acquisition occurred as of January 1, 2013 (in thousands, except per share):

	For the year ended December 31, 2014	For the year ended December 31, 2013
Revenue	$ 205,355	$ 143,614
Net loss	(164,974)	(88,326)
Net loss attributable to common stockholders	(78,336)	(24,032)
Net loss per share attributable to common stockholders, basic and diluted	(3.44)	(1.07)

Fair Value of Acquired Intangible Assets and Estimated Useful Life

The fair value of acquired intangible assets and their estimated useful life are as follows (in thousands, except estimated useful life):

	Fair Value	Estimated Useful Life
Developed technology	$ 5,910	5
Customer relationships	4,390	8
Trade names	2,990	8
Total	$ 13,290	

Mainstream Energy Corporation

Fair Value of Assets Acquired and Liabilities Assumed

The following table summarizes the fair value of assets acquired and liabilities assumed (in thousands):

Cash	$ 5,440
Accounts receivable	8,881
Inventory	23,886
Prepaid expenses	2,028
Property and equipment	6,113
Intangible assets	15,380
Other long-term assets	200
Accounts payable and accrued liabilities	(24,975)
Deferred revenue	(768)
Capital lease obligation	(2,869)
Other liabilities	(1,509)
Deferred tax liabilities	(4,843)
Indentifiable assets and liabilities assumed	26,964
Goodwill	51,786
Total	$ 78,750

Clean Energy Experts, LLC

Fair Value of Assets Acquired and Liabilities Assumed

The following table summarizes the fair value of assets acquired and liabilities assumed (in thousands):

Cash	$	424
Accounts receivable		639
Intangible assets		13,290
Accounts payable and accrued liabilities		(1,247)
Deferred tax liability		(5,146)
Identifiable assets and liabilities assumed		7,960
Goodwill		35,757
Total	$	43,717

Fair Value Measurement (Tables) — **12 Months Ended Dec. 31, 2015**

Fair Value Disclosures [Abstract]

Schedule of Fair Value Measurement of Debt Instrument

The carrying values and fair values of debt instruments are as follows (in thousands):

	December 31, 2015		December 31, 2014	
	Carrying Value	Fair Value	Carrying Value	Fair Value
Line of credit	194,975	194,975	$ 48,597	$ 48,597
Non-bank term loans	—	—	3,138	3,853
Syndicated term loans	170,664	170,664	124,571	124,571
Bank term loan	30,740	32,692	33,382	35,653
Note payable	33,059	32,568	29,563	28,900
Solar asset-backed notes	108,880	110,103	—	—
Total	$ 538,318	$ 541,002	$ 239,251	$ 241,574

Schedule of Fair Value, Financial Instruments Measured on Recurring Basis

At December 31, 2015, financial instruments measured at fair value on a recurring basis, based upon the fair value hierarchy are as follows (in thousands):

	December 31, 2015			
	Level 1	Level 2	Level 3	Total
Derivative liabilities:				
Interest rate swaps	$ —	$ 921	$ —	$ 921
Warrants	—	—	557	557
Total	$ —	$ 921	$ 557	$ 1,478

Inventories (Tables) — **12 Months Ended Dec. 31, 2015**

Inventory Disclosure [Abstract]

Schedule of Inventories

Inventories consist of the following (in thousands):

	December 31,	
	2015	2014
Raw materials	62,967	$21,531
Work-in-process	8,291	2,383
Total	$71,258	$23,914

Solar Energy Systems, Net (Tables) — **12 Months Ended Dec. 31, 2015**

Solar Energy Systems Disclosure [Abstract]

Solar Energy Systems, Net

Solar energy systems, net consists of the following (in thousands):

	December 31,	
	2015	2014
Solar energy system equipment costs	$1,846,103	$1,406,478
Inverters	177,202	123,910
Initial direct costs	68,280	40,307
Total solar energy systems	2,091,585	1,570,695
Less: accumulated depreciation and amortization	(212,671)	(143,028)
Add: construction-in-progress	113,107	56,584
Total solar energy systems, net	$1,992,021	$1,484,251

Property and Equipment, net (Tables) | **12 Months Ended Dec. 31, 2015**

Property Plant And Equipment [Abstract]

Schedule of Property and Equipment, net

Property and equipment, net consists of the following (in thousands):

	December 31, 2015	December 31, 2014
Machinery and equipment	$ 2,808	$ 1,031
Leasehold improvements, furniture, and computer hardware	10,669	6,386
Vehicles	33,048	8,942
Computer software	19,883	16,431
Total property and equipment	66,408	32,790
Less: accumulated depreciation and amortization	(21,542)	(10,595)
Total solar energy systems, net	$ 44,866	$ 22,195

Goodwill and Intangible Assets, Net (Tables) | **12 Months Ended Dec. 31, 2015**

Goodwill And Intangible Assets Disclosure [Abstract]

Carrying Value of Goodwill

The change in the carrying value of goodwill is as follows (in thousands):

Balance—January 1, 2014	$ —
Acquisition of MEC (Note 3)	51,786
Balance—December 31, 2014	$ 51,786
Acquisition of CEE (Note 3)	35,757
Balance—December 31, 2015	$ 87,543

Summary of Intangible Assets, Net

Intangible assets, net as of December 31, 2015 consist of the following (in thousands):

	Cost	Accumulated amortization	Carrying value	Weighted average remaining life (in years)
Backlog	$ 200	$ (200)	$ —	—
Customer relationships	14,660	(2,618)	12,042	7.4
Developed technology	6,820	(1,235)	5,585	4.1
Trade names	6,990	(1,912)	5,078	5.3
Total	$ 28,670	$ (5,965)	$ 22,705	

Intangible assets, net as of December 31, 2014 consist of the following (in thousands):

	Cost	Accumulated amortization	Carrying value	Weighted average remaining life (in years)
Backlog	$ 200	$ (183)	$ 17	0.1
Customer relationships	10,270	(1,055)	9,215	8.4
Developed technology	910	(167)	743	4.1
Trade names	4,000	(864)	3,136	4.1
Total	$ 15,380	$ (2,269)	$ 13,111	

Schedule of Expected Amortization of Intangible Assets

As of December 31, 2015, expected amortization of intangible assets for each of the five succeeding fiscal years and thereafter is as follows (in thousands):

2016	$ 4,205
2017	4,205
2018	4,205
2019	3,335
2020	2,143
Thereafter	4,612
Total	$ 22,705

Prepaid Expense and Other Current Assets (Tables) | **12 Months Ended Dec. 31, 2015**

Deferred Costs Capitalized Prepaid And Other Assets Disclosure [Abstract]

Schedule of Prepaid Expenses and Other Current Assets

Prepaid expenses and other current assets consist of the following (in thousands):

	December 31, 2015	December 31, 2014
Prepaid expenses	$5,134	$ 4,564
Reimbursement receivable	337	2,808
State tax receivable	427	1,117

Other current assets	798	1,071
Total	$6,696	$ 9,560

Accrued Expenses and Other Liabilities (Tables) — **12 Months Ended Dec. 31, 2015**

Payables And Accruals [Abstract]

Schedule of Accrued Expenses and Other Liabilities

Accrued expenses and other liabilities consist of the following (in thousands):

	December 31, 2015	December 31, 2014
Accrued employee compensation	$21,353	$12,588
Other accrued expenses	19,313	9,526
CEE acquisition consideration	5,000	—
Accrued professional fees	3,480	3,331
Total	$49,146	$25,445

Indebtedness (Tables) — **12 Months Ended Dec. 31, 2015**

Debt Disclosure [Abstract]

Schedule of Debt

As of December 31, 2015, debt consisted of the following (in thousands):

	Carrying Values, net of debt discount			Unused Borrowing Capacity	Annual Contractual Interest Rate	Interest Rate	Maturity Date
	Current	Long Term	Total				
Recourse debt:							
Bank line of credit	$ —	$ 194,975	$194,975	$ 6,571	Varies1	3.67%	April 2018
Total recourse debt	$ —	$ 194,975	$194,975	$ 6,571			
Non-recourse debt:							
Syndicated term loans	926	169,739	170,665	5,600	LIBOR + 2.75% - Term A	3.07%	December 2021
					LIBOR + 5.00% - Term B	6.00%	December 2021
Bank term loans	1,159	29,580	30,739	—	6.25%	6.25%	April 2022
Note payable	—	33,059	33,059	—	12.00%	12.00%	December 2018
Solar asset-backed notes	3,323	105,557	108,880	—	4.40% - Class A	4.40%	July 2024
					5.38% - Class B	5.38%	July 2024
Total non-recourse debt	5,408	337,935	343,343	5,600			
Total debt	$ 5,408	$ 532,910	$538,318	$ 12,171			

1 Loans under the facility bear interest at LIBOR + 3.25% or the Base Rate + 2.25%. The Base Rate is the highest of the Federal Funds Rate + 0.50%, the Prime Rate, or LIBOR + 1.00%.

As of December 31, 2014, debt consisted of the following (in thousands):

	Carrying Values, net of debt discount			Unused Borrowing Capacity	Annual Contractual Interest Rate	Interest Rate	Maturity Date
	Current	Long Term	Total				
Recourse debt:							
Bank line of credit	$ —	$ 48,597	$ 48,597	$ —	Prime Rate + 1.00%	4.25%	December 2016
Total recourse debt	$ —	$ 48,597	$ 48,597	$ —			
Non-recourse debt:							
Non-bank term loans	207	2,931	3,138	—	9.08%	9.08%	December 2024
Syndicated term loans	958	123,613	124,571	5,000	LIBOR + 2.75% - Term A	3.01%	December 2021
					LIBOR + 5.00% - Term B	6.00%	December 2021
Bank term loans	1,437	31,945	33,382	—	6.25%	6.25%	April 2022
Note payable	—	29,563	29,563	—	12.00%	12.00%	December 2018
Total non-recourse debt	2,602	188,052	190,654	5,000			
Total debt	$ 2,602	$ 236,649	$239,251	$ 5,000			

Schedule of Maturities of Debt, Excluding Debt Discount

The schedules maturities of debt, excluding debt discount, as of December 31, 2015 are as follows (in thousands:

2016	$ 6,330
2017	7,392
2018	238,250
2019	9,253
2020	11,414
Thereafter	273,693
Subtotal	$ 546,332
Less: Debt Discount	(8,014)
Total	$ 538,318

Derivatives (Tables) — **12 Months Ended Dec. 31, 2015**

Derivative Instruments And Hedging Activities Disclosure [Abstract]

Summary of Designated Derivative Instruments Classified as Derivative Liabilities

At December 31, 2015, the Company had the following designated derivative instruments classified as derivative liabilities as reported in other liabilities in the Company's balance sheet (in thousands, other than quantity and interest rates):

Type	Quantity	Maturity Dates	Hedge Interest Rates	Notional Amount	Fair Market Value	Credit Risk Adjustment	Adjusted Fair Market Value	Deferred Tax Benefit	Loss Recognized in Accumulated Comprehensive Loss	Interest Expense Recognized into Earnings
Interest rate swaps	4	10/31/2028	2.17% -2.18%	$109,143	$ 384	$ 537	$ 921	$ —	$ 921	$ 1,521

Lease Passthrough Financing Obligations (Tables)

12 Months Ended Dec. 31, 2015

Property Subject To Or Available For Operating Lease Net [Abstract]

Schedule of Future Minimum Lease Payments Expected Under Lease Pass-Fund Arrangement

At December 31, 2015, future minimum lease payments expected to be made by the investor under the lease pass-through fund arrangement for each of the next five years and thereafter are as follows (in thousands):

2016	$ 524
2017	524
2018	524
2019	524
2020	524
Thereafter	3,516
Total	$ 6,136

VIE Arrangements (Tables)

12 Months Ended Dec. 31, 2015

Variable Interest Entity Disclosure [Abstract]

Carrying Amounts and Classification of the VIEs' Assets and Liabilities Included in the Consolidated Balance Sheets

The carrying amounts and classification of the VIEs' assets and liabilities included in the consolidated balance sheets are as follows (in thousands):

	December 31, 2015	December 31, 2014
Assets		
Current assets		
Cash	$ 44,407	$ 29,099
Restricted cash	757	228
Accounts receivable, net	12,965	14,351
Prepaid expenses and other current assets	66	180
Total current assets	58,195	43,858
Restricted cash	$ —	$ 365
Solar energy systems, net	1,305,420	942,655
Total Assets	$1,363,615	$986,878
Liabilities		
Current liabilities		
Accounts payable	$ 11,025	$ 9,057
Distribution payable to noncontrolling interests and redeemable noncontrolling interests	8,063	6,426
Accrued expenses and other liabilities	175	340
Deferred revenue, current portion	21,344	16,991
Deferred grants, current portion	7,198	7,225
Long-term debt, current portion	1,159	1,437
Total current liabilities	48,964	41,476
Deferred revenue, net of current portion	353,392	284,801
Deferred grants, net of current portion	108,528	116,126
Long-term debt, net of current portion	29,580	$ 31,945
Total liabilities	$ 540,464	$474,348

Stockholders' Equity (Tables)

12 Months Ended Dec. 31, 2015

Equity [Abstract]

Schedule of Company's Series of Convertible Preferred Stock

The Company had five series of convertible preferred stock as follows as of December 31, 2014 (in thousands, except per share amounts):

	Shares Authorized	Shares Issued and Outstanding	Aggregate Liquidation Preference	Noncumulative Dividend Per Share Per Annum
Series A	12,043	12,007	$ 12,007	$ 0.08
Series B	10,758	10,758	18,420	0.14
Series C	13,613	13,613	55,000	0.32
Series D	7,584	7,584	70,000	0.74
Series E	13,030	10,879	150,456	1.11
Total	57,028	54,841	$ 305,883	

Schedule of Reserve Share of Common Stock for Issuance

The Company has reserved shares of common stock for issuance as follows (in thousands):

	December 31, 2015	December 31, 2014
Series A Convertible Preferred Stock	—	12,007
Series B Convertible Preferred Stock	—	10,758
Series C Convertible Preferred Stock	—	13,613
Series D Convertible Preferred Stock	—	7,584
Series E Convertible Preferred Stock	—	10,879
Stock option plans		
Shares available for grant		
2013 Equity Incentive Plan	—	694
2015 Equity Incentive Plan	12,006	—
2015 Employee Stock Purchase Plan	1,000	—
Options outstanding	12,795	11,408
Restricted stock units outstanding	1,506	947
Total	27,307	67,890

Stock-Based Compensation (Tables) — **12 Months Ended Dec. 31, 2015**

Disclosure Of Compensation Related Costs Sharebased Payments [Abstract]

Summary of Stock Option Activity

The following table summarizes the activity for all stock options under the Company's equity incentive plans for the year ended December 31, 2015 (shares in thousands):

	Options Outstanding	Weighted Average Exercise Price Outstanding	Weighted Average Remaining Contractual Life
Outstanding at December 31, 2014	11,408	$ 4.42	8.20
Granted	3,806	9.50	
Exercised	(1,210)	2.96	
Cancelled / forfeited	(1,209)	6.27	
Outstanding at December 31, 2015	12,795	$ 5.89	7.82
Options vested and exercisable at December 31, 2015	6,409	$ 3.88	6.80
Options vested and expected to vest at December 31, 2015	10,460	$ 5.69	7.65

Estimated Fair Value of Stock Options

The Company estimated the fair value of stock options with the following assumptions:

	Year Ended December 31, 2015	2014	2013
Risk-free interest rate	1.55%-1.95%	1.68%-2.01%	0.82%-2.06%
Volatility	36.30%-39.63%	37.41%-46.68%	54.36%-55.80%
Expected term (in years)	5.50-6.23	5.34-6.08	5.54-6.08
Expected dividend yield	0.00%	0.00%	0.00%

Summary of Activity for All RSUs

The following table summarizes the activity for all RSUs under all the Company's equity incentive plans for the year ended December 31, 2015 (shares in thousands):

	Shares	Weighted Average Grant Date Fair Value
Unvested balance at December 31, 2014	947	$ 9.40
Granted	808	11.13
Issued	(182)	9.58
Cancelled / forfeited	(67)	11.37
Unvested balance at December 31, 2015	1,506	$ 10.44

Summary of Stock-Based Compensation Expense

The Company recognized stock-based compensation expense, including the compensation expense resulting from the sales of common stock by employees and former employees to existing investors and ESPP expenses, in the consolidated statements of operations as follows (in thousands):

	Year Ended December 31, 2015	2014	2013
Cost of operating leases and incentives	$ 1,649	$ 155	$ 116
Cost of solar energy systems and product sales	236	682	—
Sales and marketing	5,242	897	474
Research and development	205	270	379
General and administration	8,491	7,214	1,686
Total	$ 15,823	$ 9,218	$ 2,655

Operating Revenues under Customer Agreements (Tables) — **12 Months Ended Dec. 31, 2015**

Leases Operating [Abstract]

Schedule of Future Minimum Lease Payments

Future minimum lease payments to be received from customers whose Customer Agreements represent non-cancelable leases are as follows (in thousands):

2016	$ 13,557
2017	13,697
2018	13,817
2019	13,939
2020	14,065
Thereafter	199,278
Total	$ 268,353

Income Taxes (Tables)

12 Months Ended Dec. 31, 2015

Income Tax Disclosure [Abstract]

Schedule of Loss Before Income Taxes

The following table presents the loss before income taxes for the periods presented (in thousands):

	For the year ended December 31, 2015	2014	2013
Loss attributable to common stockholders	$ 33,545	$ 80,895	$ 1,792
Loss attributable to noncontrolling interest and redeemable noncontrolling interests	220,660	86,638	64,294
Total	$ 254,205	$ 167,533	$ 66,086

Schedule of Components of Income Tax Provision (Benefit)

The income tax provision (benefit) consists of the following (in thousands):

	For the year ended December 31, 2015	2014	2013
Current:			
Federal	$ —	$ —	$ —
State	—	—	169
Total current expense	—	—	169
Deferred:			
Federal	(7,516)	(8,196)	(1,114)
State	2,217	(1,847)	354
Total deferred provision	(5,299)	(10,043)	(760)
Total	$ (5,299)	$ (10,043)	$ (591)

Schedule of Reconciliation of Effective Tax Rate

The following table represents a reconciliation of the statutory federal rate and the Company's effective tax rate for the periods presented:

	For the year ended December 31, 2015	2014	2013
Tax provision (benefit) at federal statutory rate	(34.00)%	(34.00)%	(34.00)%
State income taxes, net of federal benefit	0.87	(1.10)	0.79
Effect of noncontrolling and redeemable noncontrolling interests	29.53	17.59	34.10
Stock-based compensation	1.06	1.37	0.94
Effect of prepaid tax asset	0.04	9.39	—
Tax credits	(0.43)	(0.22)	(2.16)
Other	0.85	0.98	(0.56)
Total	(2.08)%	(5.99)%	(0.89)%

Schedule of Deferred Tax Assets and Liabilities

The following table represents significant components of the Company's deferred tax assets and liabilities for the periods presented (in thousands):

	December 31, 2015	2014
Deferred tax assets:		
Accruals and prepaids	$ 12,904	$ 4,302
Deferred revenue	34,710	44,359
Net operating loss carryforwards	229,464	176,555
Stock-based Compensation	3,748	1,612
Investment tax and other credits	11,261	7,369
Gross deferred tax assets	292,087	234,197
Deferred tax liabilities:		
Capitalized initial direct costs	27,539	16,640
Fixed asset depreciation	178,511	142,866
Deferred tax on investment in partnerships	276,183	184,240
Gross deferred tax liabilities	482,233	343,746
Net deferred tax liabilities	$ (190,146)	$ (109,549)

Schedule of Analysis of Deferred Tax Liabilities

An analysis of deferred tax liabilities is as follows (in thousands):

	December 31, 2015	2014
Deferred tax assets	$ 292,087	$ 234,197
Deferred tax liabilities	(482,233)	(343,746)
Net deferred tax liabilities	$ (190,146)	$ (109,549)

Schedule of Unrecognized Tax Benefits

A reconciliation of the beginning and ending amounts of unrecognized tax benefits is as follows (in thousands):

Balance at January 1, 2014 and December 31, 2014	$ —
Acquired from CEE	1,525
Balance at December 31, 2015	$ 1,525

Schedule of Summarization of Tax Years And Examination by The Tax Authorities

The following table summarizes the tax years that remain open and subject to examination by the tax authorities in the most significant jurisdictions in which the Company operates:

	Tax Years
U.S. Federal	2011 - 2015
State	2010 - 2015

Commitments and Contingencies (Tables)	12 Months Ended Dec. 31, 2015
Commitments And Contingencies Disclosure [Abstract]	
Schedule of Future Minimum Lease Payments Under Non-Cancelable Operating Lease Agreements	Future minimum lease payments expected to be made under non-cancelable operating lease agreements as of December 31, 2015 for each of the years ending December 31, are as follows (in thousands):

2016	$ 7,019
2017	6,669
2018	5,906
2019	2,521
2020	879
Thereafter	53
Total	$ 23,047

Schedule of Future Lease Payments Under Capital Lease Obligations

The following is a schedule of future lease payments as of December 31, 2015 (in thousands):

2016	$ 9,727
2017	7,444
2018	5,321
2019	2,799
2020	219
Thereafter	200
Total future lease payments	25,710
Less: amount representing estimated executory costs included in future lease payments	537
Net minimum future lease payments	25,173
Amount representing interest	1,180
Present value of future payments	23,993
Less: current portion	8,951
Long term portion	$ 15,042

Net Loss Per Share (Tables)	12 Months Ended Dec. 31, 2015
Earnings Per Share [Abstract]	
Computation of Basic and Diluted Net Loss Per Share	The computation of the Company's basic and diluted net loss per share are as follows (in thousands, except share and per share amounts):

	Years Ended December 31,		
	2015	2014	2013
Numerator:			
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Deemed dividend to convertible preferred stockholders	(24,890)	—	—
Net loss available to common stockholders	(53,136)	(70,852)	(1,201)
Denominator:			
Weighted average shares used to compute net loss per share available to common stockholders, basic and diluted	55,091	22,795	9,780
Basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)

Schedule of Shares Excluded from Computation of Earnings Per Share

The following shares were excluded from the computation of diluted net loss per share as the impact of including those shares would be anti-dilutive:

	Year Ended December 31,		
	2015	2014	2013
Preferred stock	—	54,841	43,998
Warrants	1,251	—	—
Outstanding stock options	12,615	11,408	8,127
Unvested restricted stock units	723	—	—
ESPP	79	—	—
Total	14,668	66,249	52,125

Organization - Additional Information (Details)	12 Months Ended Dec. 31, 2015 InvestmentFund
Organization Consolidation And Presentation Of Financial Statements [Abstract]	
Power purchase or lease agreement term	20 years
Number of types of investment funds used by the company	3

Summary of Significant Accounting Policies - Additional Information (Details)	12 Months Ended		
	Dec. 31, 2015 USD ($) Segment BusinessActivity	Dec. 31, 2014 USD ($)	Dec. 31, 2013 USD ($)
Summary Of Significant Accounting Policies [Line Items]			
Number of operating segments | Segment	1		
Number of business activities | BusinessActivity	1		
Bad debt expense	$ 1,998,000	$ 546,000	$ 172,000
Uncollectible receivables written off	$ 1,100,000	100,000	0
Property plant and equipment depreciation method	Straight-line basis		
Intangible assets amortization method	Straight-line basis		
Impairment of long-lived assets	$ 0	0	0
Goodwill impairment charges	0	0	0
Warranty accrual	$ 1,100,000	900,000	
Percentage of lesser lease term than estimated economic life	75.00%		
Percentage of minimum lease payments exceeds fair value under lease classification criteria	90.00%		
Shipping and handling fees charged to customers	$ 2,600,000	2,400,000	
Advertising costs	34,800,000	16,900,000	$ 7,700,000
Increase (decrease) in deferred tax assets current		(3,000,000)	
Increase (decrease) in deferred tax liabilities		(3,000,000)	
Solar materials purchases from top five suppliers	160,500,000	69,100,000	
Impact of new accounting standards on balance sheet, reclassification of debt issuance cost	3,600,000		
Guarantee Obligations			
Summary Of Significant Accounting Policies [Line Items]			
Performance guarantees included in accrued expenses and other liabilities	$ 300,000	$ 400,000	
Inverters			
Summary Of Significant Accounting Policies [Line Items]			
Estimated useful life	10 years		
Solar Energy Systems			
Summary Of Significant Accounting Policies [Line Items]			
Estimated useful life	20 years		
Solar Energy Systems | Minimum			
Summary Of Significant Accounting Policies [Line Items]			
Estimated useful life	30 years		

Summary of Significant Accounting Policies - Schedule of Revenues from External Customers (Details) - USD ($) $ in Thousands	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Entity Wide Revenue Major Customer [Line Items]			
Operating leases	$ 86,332	$ 63,962	$ 44,249
Incentives	31,672	20,044	10,491
Operating leases and incentives	118,004	84,006	54,740
Solar energy systems and product sales	186,602	114,551	
Total revenue	304,606	198,557	$ 54,740
Solar Energy Systems			
Entity Wide Revenue Major Customer [Line Items]			
Solar energy systems and product sales	50,191	23,687	
Products			
Entity Wide Revenue Major Customer [Line Items]			
Solar energy systems and product sales	$ 136,411	$ 90,864	

Summary of Significant Accounting Policies - Schedule of Accounts Receivable Net (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Accounting Policies [Abstract]		
Customer receivables	$ 46,169	$ 24,477
Customer deposits	10,150	11,135
Other receivables	4,376	5,936
Rebates receivable	1,221	2,344
Allowance for doubtful accounts	(1,641)	(703)
Total	$ 60,275	$ 43,189

Summary of Significant Accounting Policies - Depreciated Property and Equipment, Net Estimated Useful Lives (Details)	12 Months Ended Dec. 31, 2015
Property Plant And Equipment [Line Items]	
Leasehold improvements	Lesser of estimated useful life of the asset or lease term, which is typically 2 to 6 years
Leasehold Improvements | Minimum	
Property Plant And Equipment [Line Items]	
Estimated useful life	2 years
Leasehold Improvements | Maximum	
Property Plant And Equipment [Line Items]	
Estimated useful life	6 years
Furniture	
Property Plant And Equipment [Line Items]	
Estimated useful life	5 years
Computer Hardware and Software	
Property Plant And Equipment [Line Items]	
Estimated useful life	3 years
Machinery and Equipment | Minimum	
Property Plant And Equipment [Line Items]	
Estimated useful life	5 years
Machinery and Equipment | Maximum	
Property Plant And Equipment [Line Items]	
Estimated useful life	7 years
Automobiles | Minimum	
Property Plant And Equipment [Line Items]	
Estimated useful life	4 years
Automobiles | Maximum	
Property Plant And Equipment [Line Items]	
Estimated useful life	5 years

Summary of Significant Accounting Policies - Amortized Finite-Lived Intangible Assets Estimated Useful lives (Details)	12 Months Ended Dec. 31, 2015
Customer Relationships | Minimum	
Finite Lived Intangible Assets [Line Items]	
Estimated useful lives	6 years
Customer Relationships | Maximum	
Finite Lived Intangible Assets [Line Items]	
Estimated useful lives	10 years
Backlog	
Finite Lived Intangible Assets [Line Items]	
Estimated useful lives	1 year
Developed Technology	
Finite Lived Intangible Assets [Line Items]	
Estimated useful lives	5 years
Trade Names | Minimum	
Finite Lived Intangible Assets [Line Items]	
Estimated useful lives	4 months
Trade Names | Maximum	
Finite Lived Intangible Assets [Line Items]	
Estimated useful lives	5 years

Summary of Significant Accounting Policies - Schedule of Deferred Revenue (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Entity Wide Revenue Major Customer [Line Items]		
Deferred revenue	$ 618,792	$ 512,124
Customer Payments		
Entity Wide Revenue Major Customer [Line Items]		
Deferred revenue	370,754	311,193
Rebates and Incentives		
Entity Wide Revenue Major Customer [Line Items]		
Deferred revenue	102,827	101,318
SRECs		

Entity Wide Revenue Major Customer [Line Items]		
Deferred revenue	18,358	13,846
ITCs		
Entity Wide Revenue Major Customer [Line Items]		
Deferred revenue	$ 126,853	$ 85,767

Acquisitions - Additional Information (Details)		1 Months Ended			12 Months Ended			
	Apr. 01, 2017 USD ($) shares	Apr. 30, 2015 USD ($) Installment shares	Mar. 31, 2014 USD ($) Project	Feb. 28, 2014 USD ($) shares	Dec. 31, 2015 USD ($)	Dec. 31, 2014 USD ($)	Apr. 30, 2016 USD ($) shares	Oct. 31, 2015 USD ($) shares
Business Acquisition [Line Items]								
Power purchase or lease agreement term					20 years			
Goodwill					$ 87,543,000	$ 51,786,000		
Scenario Forecast								
Business Acquisition [Line Items]								
Business acquisition contingent cash payment	$ 9,100,000							
Business acquisition contingent share issuance | shares	600,000							
Business acquisition of compensation expenses	2 years							
Mainstream Energy Corporation								
Business Acquisition [Line Items]								
Purchase consideration for assets acquired and liabilities assumed				$ 78,800,000	78,750,000			
Cash payment				1,800,000				
Purchase consideration amount of settlement on pre existing relationship				1,800,000				
Business acquisition acquired business to total revenue						$ 114,200,000		
Goodwill					51,786,000			
Mainstream Energy Corporation | Stock Options								
Business Acquisition [Line Items]								
Purchase consideration amount on issuance of shares				$ 200,000				
Business acquisition, shares issued | shares				576,878				
Mainstream Energy Corporation | Common Stock								
Business Acquisition [Line Items]								
Purchase consideration amount on issuance of shares				$ 75,000,000				
Business acquisition, shares issued | shares				12,762,894				
Clean Energy Experts, LLC								
Business Acquisition [Line Items]								
Purchase consideration for assets acquired and liabilities assumed					43,717,000			
Purchase consideration amount on issuance of shares		$ 19,100,000						
Business acquisition, shares issued | shares		1,400,000						
Cash payment		$ 25,000,000						
Business acquisition acquired business to total revenue					16,900,000			
Business acquisition shares of common stock | shares		1,900,000						
Business acquisition payment of cash		$ 15,000,000						
Remaining cash of business acquisition		$ 10,000,000						
Remaining shares of business acquisition | shares		500,000						
Number of installment | Installment		2						
Business acquisition cash to be paid in October 2015 and in April 2016								$ 5,000,000
Business acquisition shares to be issued in October 2015 and in April 2016 | shares								250,000
Goodwill					$ 35,757,000			
Clean Energy Experts, LLC | Scenario Forecast								
Business Acquisition [Line Items]								
Business acquisition cash to be paid in October 2015 and in April 2016							$ 5,000,000	
Business acquisition shares to be issued in October 2015 and in April 2016 | shares							250,000	
Solar Projects								
Business Acquisition [Line Items]								
Payments to acquire solar projects and the associated leases			$ 39,400,000					
Number of projects | Project			2,924					
Power purchase or lease agreement term			20 years					

Lease premiums or discounts	$ 0
Goodwill	$ 0

Acquisitions - Summary of Fair Value Assets and Liabilities Assumed (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014	Feb. 28, 2014	Dec. 31, 2013	Dec. 31, 2012
Business Acquisition [Line Items]					
Cash	$ 203,864	$ 152,154		$ 99,699	$ 89,785
Goodwill	87,543	$ 51,786			
Mainstream Energy Corporation					
Business Acquisition [Line Items]					
Cash	5,440				
Accounts receivable	8,881				
Inventory	23,886				
Prepaid expenses	2,028				
Property and equipment	6,113				
Intangible assets	15,380				
Other long-term assets	200				
Accounts payable and accrued liabilities	(24,975)				
Deferred revenue	(768)				
Capital lease obligation	(2,869)				
Other liabilities	(1,509)				
Deferred tax liabilities	(4,843)				
Indentifiable assets and liabilities assumed	26,964				
Goodwill	51,786				
Total	78,750		$ 78,800		
Clean Energy Experts, LLC					
Business Acquisition [Line Items]					
Cash	424				
Accounts receivable	639				
Intangible assets	13,290				
Accounts payable and accrued liabilities	(1,247)				
Deferred tax liabilities	(5,146)				
Indentifiable assets and liabilities assumed	7,960				
Goodwill	35,757				
Total	$ 43,717				

Acquisitions - Summary of Unaudited Pro Forma Information for Acquisition Occurred (Details) - USD ($) $ / shares in Units, $ in Thousands	12 Months Ended	
	Dec. 31, 2014	Dec. 31, 2013
Business Combinations [Abstract]		
Revenue	$ 205,355	$ 143,614
Net loss	(164,974)	(88,326)
Net loss attributable to common stockholders	$ (78,336)	$ (24,032)
Net loss per share attributable to common stockholders, basic and diluted	$ (3.44)	$ (1.07)

Acquisitions - Summary of Fair Value of Acquired Intangible Assets and Estimated Useful Life (Details) - Clean Energy Experts, LLC $ in Thousands	12 Months Ended
	Dec. 31, 2015 USD ($)
Acquired Finite Lived Intangible Assets [Line Items]	
Fair Value	$ 13,290
Developed Technology	
Acquired Finite Lived Intangible Assets [Line Items]	
Fair Value	$ 5,910
Estimated Useful Life	5 years
Customer Relationships	
Acquired Finite Lived Intangible Assets [Line Items]	
Fair Value	$ 4,390
Estimated Useful Life	8 years
Trade Names	
Acquired Finite Lived Intangible Assets [Line Items]	

Fair Value	$ 2,990
Estimated Useful Life	8 years

Fair Value Measurements - Schedule of Fair Value Measurement of Debt Instrument (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Carrying Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	$ 538,318	$ 239,251
Fair Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	541,002	241,574
Line of Credit | Carrying Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	194,975	48,597
Line of Credit | Fair Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	194,975	48,597
Non Bank Term Loans | Carrying Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value		3,138
Non Bank Term Loans | Fair Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value		3,853
Syndicated Term Loans | Carrying Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	170,664	124,571
Syndicated Term Loans | Fair Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	170,664	124,571
Bank Term Loan | Carrying Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	30,740	33,382
Bank Term Loan | Fair Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	32,692	35,653
Notes Payable | Carrying Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	33,059	29,563
Notes Payable | Fair Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	32,568	$ 28,900
Solar Asset-Backed Notes | Carrying Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	108,880	
Solar Asset-Backed Notes | Fair Value		
Fair Value Balance Sheet Grouping Financial Statement Captions [Line Items]		
Debt Instrument, Fair Value	$ 110,103	

Fair Value Measurement - Additional Information (Details)	12 Months Ended Dec. 31, 2015 $ / shares
Fair Value Disclosures [Abstract]	
Fair value assumptions, estimated fair value of common stock per share	$ 11.77
Fair value assumptions, risk-free interest rate	1.21%
Fair value assumptions, expected volatility rate	32.03%
Fair value assumptions, remaining contact life	2 years 6 months 22 days
Fair value assumptions, expected dividend yield rate	0.00%

Fair Value Measurement - Schedule of Fair Value, Financial Instruments Measured on Recurring Basis (Details) $ in Thousands	Dec. 31, 2015 USD ($)
Fair Value Assets And Liabilities Measured On Recurring And Nonrecurring Basis [Line Items]	

Derivative liabilities	$ 1,478
Level 2	
Fair Value Assets And Liabilities Measured On Recurring And Nonrecurring Basis [Line Items]	
Derivative liabilities	921
Level 3	
Fair Value Assets And Liabilities Measured On Recurring And Nonrecurring Basis [Line Items]	
Derivative liabilities	557
Interest Rate Swaps	
Fair Value Assets And Liabilities Measured On Recurring And Nonrecurring Basis [Line Items]	
Derivative liabilities	921
Interest Rate Swaps | Level 2	
Fair Value Assets And Liabilities Measured On Recurring And Nonrecurring Basis [Line Items]	
Derivative liabilities	921
Warrant	
Fair Value Assets And Liabilities Measured On Recurring And Nonrecurring Basis [Line Items]	
Derivative liabilities	557
Warrant | Level 3	
Fair Value Assets And Liabilities Measured On Recurring And Nonrecurring Basis [Line Items]	
Derivative liabilities	$ 557

Inventories - Schedule of Inventories (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Inventory Disclosure [Abstract]		
Raw materials	$ 62,967	$ 21,531
Work-in-process	8,291	2,383
Total	$ 71,258	$ 23,914

Solar Energy Systems, Net (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Property Subject To Or Available For Operating Lease [Line Items]		
Solar energy systems, gross	$ 2,091,585	$ 1,570,695
Less: accumulated depreciation and amortization	(212,671)	(143,028)
Add: construction-in-progress	113,107	56,584
Total solar energy systems, net	1,992,021	1,484,251
Solar Energy System Equipment Costs		
Property Subject To Or Available For Operating Lease [Line Items]		
Solar energy systems, gross	1,846,103	1,406,478
Inverters		
Property Subject To Or Available For Operating Lease [Line Items]		
Solar energy systems, gross	177,202	123,910
Initial Direct Costs		
Property Subject To Or Available For Operating Lease [Line Items]		
Solar energy systems, gross	$ 68,280	$ 40,307

Solar Energy Systems, Net - Additional Information (Details) - USD ($) $ in Millions	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Leases [Abstract]			
Depreciation expense	$ 70.7	$ 54.7	$ 40.0
Amortization of deferred grants	$ 14.2	$ 13.9	$ 13.4

Property and Equipment, net - Schedule of Property and Equipment, net (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Property Plant And Equipment [Line Items]		
Total property and equipment, gross	$ 66,408	$ 32,790
Less: accumulated depreciation and amortization	(21,542)	(10,595)
Total solar energy systems, net	44,866	22,195
Machinery and Equipment		
Property Plant And Equipment [Line Items]		
Total property and equipment, gross	2,808	1,031
Leasehold Improvements, Furniture and Computer hardware		

Property Plant And Equipment [Line Items]		
Total property and equipment, gross	10,669	6,386
Vehicles		
Property Plant And Equipment [Line Items]		
Total property and equipment, gross	33,048	8,942
Computer Software		
Property Plant And Equipment [Line Items]		
Total property and equipment, gross	$ 19,883	$ 16,431

Property and Equipment, net - Additional Information (Details) - USD ($) $ in Millions	**12 Months Ended**		
	Dec. 31, 2015	**Dec. 31, 2014**	**Dec. 31, 2013**
Capital Leased Assets [Line Items]			
Depreciation and amortization expense	$ 11.2	$ 6.4	$ 3.0
Vehicles			
Capital Leased Assets [Line Items]			
Accumulated depreciation for assets under capital leases	5.8	1.2	
Amortization of capital leased asset	$ 5.3	$ 1.2	

Goodwill and Intangible Assets, Net - Carrying Value of Goodwill (Details) - USD ($) $ in Thousands	**12 Months Ended**	
	Dec. 31, 2015	**Dec. 31, 2014**
Goodwill [Line Items]		
Beginning balance	$ 51,786	
Ending balance	87,543	$ 51,786
Mainstream Energy Corporation		
Goodwill [Line Items]		
Acquisition		$ 51,786
Ending balance	51,786	
Clean Energy Experts, LLC		
Goodwill [Line Items]		
Acquisition	35,757	
Ending balance	$ 35,757	

Goodwill and Intangible Assets, Net - Summary of Intangible Assets, Net (Details) - USD ($) $ in Thousands	**12 Months Ended**	
	Dec. 31, 2015	**Dec. 31, 2014**
Finite Lived Intangible Assets [Line Items]		
Cost	$ 28,670	$ 15,380
Accumulated amortization	(5,965)	(2,269)
Carrying value	22,705	13,111
Backlog		
Finite Lived Intangible Assets [Line Items]		
Cost	200	200
Accumulated amortization	(200)	(183)
Carrying value		$ 17
Weighted average remaining life (in years)		1 month 6 days
Customer Relationships		
Finite Lived Intangible Assets [Line Items]		
Cost	14,660	$ 10,270
Accumulated amortization	(2,618)	(1,055)
Carrying value	$ 12,042	$ 9,215
Weighted average remaining life (in years)	7 years 4 months 24 days	8 years 4 months 24 days
Developed Technology		
Finite Lived Intangible Assets [Line Items]		
Cost	$ 6,820	$ 910
Accumulated amortization	(1,235)	(167)
Carrying value	$ 5,585	$ 743
Weighted average remaining life (in years)	4 years 1 month 6 days	4 years 1 month 6 days
Trade Names		
Finite Lived Intangible Assets [Line Items]		
Cost	$ 6,990	$ 4,000
Accumulated amortization	(1,912)	(864)
Carrying value	$ 5,078	$ 3,136

Goodwill and Intangible Assets, Net - Additional Information (Details) - USD ($) $ in Thousands	12 Months Ended	
	Dec. 31, 2015	Dec. 31, 2014
Goodwill And Intangible Assets Disclosure [Abstract]		
Amortization of intangible assets	$ 3,695	$ 2,269

Goodwill and Intangible Assets, Net - Schedule of Expected Amortization of Intangible Assets (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Goodwill And Intangible Assets Disclosure [Abstract]		
2016	$ 4,205	
2017	4,205	
2018	4,205	
2019	3,335	
2020	2,143	
Thereafter	4,612	
Carrying value	$ 22,705	$ 13,111

Prepaid Expense and Other Current Assets - Schedule of Prepaid Expenses and Other Current Assets (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Deferred Costs Capitalized Prepaid And Other Assets Disclosure [Abstract]		
Prepaid expenses	$ 5,134	$ 4,564
Reimbursement receivable	337	2,808
State tax receivable	427	1,117
Other current assets	798	1,071
Total	$ 6,696	$ 9,560

Accrued Expenses and Other Liabilities - Schedule of Accrued Expenses and Other Liabilities (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Payables And Accruals [Abstract]		
Accrued employee compensation	$ 21,353	$ 12,588
Other accrued expenses	19,313	9,526
CEE acquisition consideration	5,000	
Accrued professional fees	3,480	3,331
Total	$ 49,146	$ 25,445

Indebtedness - Schedule of Debt (Details) - USD ($) $ in Thousands	12 Months Ended	
	Dec. 31, 2015	Dec. 31, 2014
Debt Instrument [Line Items]		
Unused Borrowing Capacity	$ 12,171	$ 5,000
Long term debt, Current	5,408	2,602
Long term debt, Noncurrent	532,910	236,649
Long term debt	538,318	239,251
Line of credit	$ 194,975	48,597
Base Rate		
Debt Instrument [Line Items]		
Annual Contractual Interest Rate	2.25%	
Basis point		
Debt Instrument [Line Items]		
Annual Contractual Interest Rate	3.25%	
Prime Rate		
Debt Instrument [Line Items]		
Annual Contractual Interest Rate	1.00%	
Bank Line of Credit		
Debt Instrument [Line Items]		
Line of credit	$ 194,975	48,597

Recourse debt, Total	194,975	48,597
Recourse Debt		
Debt Instrument [Line Items]		
Unused Borrowing Capacity	6,571	
Long term debt, Noncurrent	194,975	48,597
Long term debt	194,975	$ 48,597
Recourse Debt | Bank Line of Credit		
Debt Instrument [Line Items]		
Unused Borrowing Capacity	$ 6,571	
Interest Rate		4.25%
Maturity Date	Apr. 30, 2018	Dec. 31, 2016
Recourse Debt | Bank Line of Credit | Base Rate		
Debt Instrument [Line Items]		
Interest Rate	3.67%	
Recourse Debt | Bank Line of Credit | Prime Rate		
Debt Instrument [Line Items]		
Annual Contractual Interest Rate		1.00%
Non Recourse Debt		
Debt Instrument [Line Items]		
Unused Borrowing Capacity	$ 5,600	$ 5,000
Long term debt, Current	5,408	2,602
Long term debt, Noncurrent	337,935	188,052
Long term debt	343,343	190,654
Non Recourse Debt | Syndicated Term Loans		
Debt Instrument [Line Items]		
Unused Borrowing Capacity	$ 5,600	$ 5,000
Maturity Date	Dec. 31, 2021	Dec. 31, 2021
Long term debt, Current	$ 926	$ 958
Long term debt, Noncurrent	169,739	123,613
Long term debt	$ 170,665	$ 124,571
Non Recourse Debt | Syndicated Term Loans | Basis point | Term A		
Debt Instrument [Line Items]		
Interest Rate	3.07%	3.01%
Annual Contractual Interest Rate	2.75%	2.75%
Non Recourse Debt | Syndicated Term Loans | Basis point | Term B		
Debt Instrument [Line Items]		
Interest Rate	6.00%	6.00%
Annual Contractual Interest Rate	5.00%	5.00%
Non Recourse Debt | Bank Term Loans		
Debt Instrument [Line Items]		
Interest Rate	6.25%	6.25%
Maturity Date	Apr. 30, 2022	Apr. 30, 2022
Long term debt, Current	$ 1,159	$ 1,437
Long term debt, Noncurrent	29,580	31,945
Long term debt	$ 30,739	$ 33,382
Non Recourse Debt | Notes Payable		
Debt Instrument [Line Items]		
Interest Rate	12.00%	12.00%
Maturity Date	Dec. 31, 2018	Dec. 31, 2018
Long term debt, Noncurrent	$ 33,059	$ 29,563
Long term debt	$ 33,059	$ 29,563
Non Recourse Debt | Solar Asset Backed Securities Class A		
Debt Instrument [Line Items]		
Interest Rate	4.40%	
Maturity Date	Jul. 31, 2024	
Non Recourse Debt | Solar Asset Backed Securities Class B		
Debt Instrument [Line Items]		
Interest Rate	5.38%	
Maturity Date	Jul. 31, 2024	
Non Recourse Debt | Asset Backed Securities		
Debt Instrument [Line Items]		
Long term debt, Current	$ 3,323	
Long term debt, Noncurrent	105,557	
Long term debt	$ 108,880	
Non Recourse Debt | Non Bank Term Loans		
Debt Instrument [Line Items]		
Interest Rate		9.08%
Maturity Date		Dec. 31, 2024

Long term debt, Current	$ 207
Long term debt, Noncurrent	2,931
Long term debt	$ 3,138

Indebtedness - Schedule of Debt (Parenthetical) (Details)	12 Months Ended
	Dec. 31, 2015
Basis point	
Debt Instrument [Line Items]	
Annual Contractual Interest Rate	3.25%
Base Rate	
Debt Instrument [Line Items]	
Annual Contractual Interest Rate	2.25%
Federal Funds Rate	
Debt Instrument [Line Items]	
Annual Contractual Interest Rate	0.50%
Prime Rate	
Debt Instrument [Line Items]	
Annual Contractual Interest Rate	1.00%

Indebtedness - Additional Information (Details) - USD ($)		1 Months Ended			12 Months Ended		
	Jul. 31, 2015	Apr. 30, 2015	Dec. 31, 2014	Dec. 31, 2013	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Line Of Credit Facility [Line Items]							
Repayments of debt					$ 357,878,000	$ 120,054,000	$ 612,000
Loss on early extinguishment of debt					431,000	4,350,000	
Loan outstanding balance			$ 239,251,000		538,318,000	239,251,000	
Solar energy systems, gross			1,570,695,000		2,091,585,000	1,570,695,000	
Repayment of lease obligations					$ 4,854,000	1,181,000	
Basis point							
Line Of Credit Facility [Line Items]							
Annual Contractual Interest Rate					3.25%		
Subordinated Term Loan							
Line Of Credit Facility [Line Items]							
Repayments of debt			94,400,000				
Bank Line of Credit | Credit Facility Agreements with Syndicate of Banks							
Line Of Credit Facility [Line Items]							
Line of credit facility, maximum borrowing capacity			50,000,000			50,000,000	
Bank Line of Credit | Credit Facility Agreements with Syndicate of Banks | Letter of Credit Sub-Facility							
Line Of Credit Facility [Line Items]							
Line of credit facility, maximum borrowing capacity			1,000,000			1,000,000	
Bank Line of Credit | Syndicated Working Capital Facility							
Line Of Credit Facility [Line Items]							
Line of credit facility, maximum borrowing capacity		$ 205,000,000					
Minimum unencumbered liquid assets to be maintained					$ 25,000,000		
Bank Line of Credit | Syndicated Working Capital Facility | Minimum							
Line Of Credit Facility [Line Items]							
Interest coverage ratio					200.00%		
Non Bank Term Loans							
Line Of Credit Facility [Line Items]							
Aggregate amount of debt				$ 119,500,000			119,500,000
Repayments of debt		3,500,000					
Loss on early extinguishment of debt		$ 400,000					
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks							
Line Of Credit Facility [Line Items]							
Line of credit facility, maximum borrowing capacity			195,400,000			195,400,000	
Debt maturity date					Dec. 31, 2021		
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Senior Term Loan							
Line Of Credit Facility [Line Items]							
Line of credit facility, maximum borrowing capacity			$ 158,500,000			158,500,000	
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Senior Term Loan | Basis point							
Line Of Credit Facility [Line Items]							

Debt instrument, variable rate periodic increase		0.25%				
Annual Contractual Interest Rate		2.75%				
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Subordinated Term Loan						
Line Of Credit Facility [Line Items]						
Line of credit facility, maximum borrowing capacity		$ 24,000,000			24,000,000	
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Subordinated Term Loan | Minimum						
Line Of Credit Facility [Line Items]						
Debt prepayment penalty percentage		0.00%				
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Subordinated Term Loan | Minimum | Basis point						
Line Of Credit Facility [Line Items]						
Annual Contractual Interest Rate		1.00%				
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Subordinated Term Loan | Maximum						
Line Of Credit Facility [Line Items]						
Debt prepayment penalty percentage		2.00%				
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Subordinated Term Loan | Maximum | Basis point						
Line Of Credit Facility [Line Items]						
Annual Contractual Interest Rate		5.00%				
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Working Capital Revolver Commitment						
Line Of Credit Facility [Line Items]						
Line of credit facility, maximum borrowing capacity		$ 5,000,000			5,000,000	
Syndicated Term Loans | Credit Facility Agreements with Syndicate of Banks | Senior Secured Revolving Letter Of Credit Facility						
Line Of Credit Facility [Line Items]						
Line of credit facility, maximum borrowing capacity		7,900,000			7,900,000	
Bank Term Loans						
Line Of Credit Facility [Line Items]						
Line of credit facility, maximum borrowing capacity			38,000,000			$ 38,000,000
Notes Payable						
Line Of Credit Facility [Line Items]						
Proceeds from issuance of senior secured notes			$ 27,200,000			
Notes Payable | Payment in Kind ("PIK")						
Line Of Credit Facility [Line Items]						
Interest Rate			12.00%			12.00%
Loan outstanding balance		$ 2,900,000		$ 6,300,000	$ 2,900,000	
Solar Asset Backed Securities Class A						
Line Of Credit Facility [Line Items]						
Aggregate amount of debt	$ 100,000,000					
Solar Asset Backed Securities Class B						
Line Of Credit Facility [Line Items]						
Aggregate amount of debt	11,000,000					
Asset Backed Securities						
Line Of Credit Facility [Line Items]						
Secured Borrowings Assets Carrying Amount				$ 190,200,000		
Debt instrument discount rate				0.08%		
Solar energy systems, gross				$ 119,700,000		
Repayment of lease obligations	$ 88,900,000			88,900,000		
Net of fees from proceeds from debt instrument				$ 7,300,000		

Indebtedness - Schedule of Maturities of Debt, Excluding Debt Discount (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Debt Disclosure [Abstract]		
2016	$ 6,330	
2017	7,392	
2018	238,250	
2019	9,253	
2020	11,414	
Thereafter	273,693	
Subtotal	546,332	
Less: Debt Discount	(8,014)	

Long term debt	$ 538,318	$ 239,251

Derivatives - Additional Information (Details)	1 Months Ended Jul. 31, 2015 USD ($) $ / shares shares	12 Months Ended Dec. 31, 2015 USD ($)	Aug. 10, 2015 shares	Jan. 31, 2015 USD ($) Counterparty
Derivatives Fair Value [Line Items]				
Unrealized fair market value gain (loss)		$ (921,000)		
Common shares issuable upon conversion of warrants | shares			1,250,764	
Warrant				
Derivatives Fair Value [Line Items]				
Common shares issuable upon conversion of warrants | shares	1,250,764			
Class of warrant exercisable period	3 years			
Warrants exercise price | $ / shares	$ 22.50			
Fair value derivative, liabilities	$ 1,500,000	600,000		
Fair value derivative, gain		900,000		
Interest Rate Swaps				
Derivatives Fair Value [Line Items]				
Derivative notional amount		109,143,000		$ 109,100,000
Number of counterparties | Counterparty				4
Unrealized fair market value gain (loss)		900,000		
Additional amount to be classified as an increase to interest expense during next 12 months		1,700,000		
Undesignated derivative instruments recorded by the Company		$ 0		

Derivatives - Summary of Designated Derivative Instruments Classified as Derivative Liabilities (Details)	12 Months Ended Dec. 31, 2015 USD ($) Instrument	Dec. 31, 2014 USD ($)	Dec. 31, 2013 USD ($)	Jan. 31, 2015 USD ($)
Derivative Instruments And Hedging Activities Disclosures [Line Items]				
Deferred Tax Benefit	$ (5,299,000)	$ (10,043,000)	$ (760,000)	
Loss Recognized in Accumulated Comprehensive Loss	$ (921,000)			
Interest Rate Swaps				
Derivative Instruments And Hedging Activities Disclosures [Line Items]				
Quantity | Instrument	4			
Maturity Dates	Oct. 31, 2028			
Notional Amount	$ 109,143,000			$ 109,100,000
Fair Market Value	384,000			
Credit Risk Adjustment	537,000			
Adjusted Fair Market Value	921,000			
Loss Recognized in Accumulated Comprehensive Loss	921,000			
Interest Expense Recognized into Earnings	$ 1,521,000			
Interest Rate Swaps | Minimum				
Derivative Instruments And Hedging Activities Disclosures [Line Items]				
Hedge Interest Rates	2.17%			
Interest Rate Swaps | Maximum				
Derivative Instruments And Hedging Activities Disclosures [Line Items]				
Hedge Interest Rates	2.18%			

Lease Passthrough Financing Obligations - Additional Information (Details) - USD ($) $ in Thousands	1 Months Ended Jul. 31, 2015	12 Months Ended Dec. 31, 2015	Dec. 31, 2014	Sep. 30, 2015
Property Subject To Or Available For Operating Lease [Line Items]				
Initial lease term		20 years		
Solar energy systems, gross		$ 2,091,585	$ 1,570,695	
Depreciation on lease		$ 212,671	143,028	
Discount on expected remaining lease payments		5.00%		
Repayment of lease obligations		$ 4,854	1,181	
Maximum percentage to defer a portion of upfront payments				25.00%
Aggregate amount of term loan agreement				$ 30,000
Loan amount		21,800		
Asset Backed Securities				
Property Subject To Or Available For Operating Lease [Line Items]				
Solar energy systems, gross		119,700		
Repayment of lease obligations	$ 88,900	88,900		
Solar Energy Systems Under Lease Pass-through Fund Arrangements [Member]				
Property Subject To Or Available For Operating Lease [Line Items]				

Solar energy systems, gross	447,400	322,200
Depreciation on lease	$ 33,500	$ 19,300
Solar Energy Systems Under Lease Pass-through Fund Arrangements [Member] | Minimum		
Property Subject To Or Available For Operating Lease [Line Items]		
Initial lease term	20 years	
Solar Energy Systems Under Lease Pass-through Fund Arrangements [Member] | Maximum		
Property Subject To Or Available For Operating Lease [Line Items]		
Initial lease term	25 years	

Lease Passthrough Financing Obligations - Schedule of Future Minimum Lease Payments Expected Under Lease Pass-Fund Arrangement (Details) $ in Thousands	Dec. 31, 2015 USD ($)
Property Subject To Or Available For Operating Lease [Line Items]	
2016	$ 13,557
2017	13,697
2018	13,817
2019	13,939
2020	14,065
Thereafter	199,278
Total	268,353
Investor Under Lease Pass-Through Fund Arrangement	
Property Subject To Or Available For Operating Lease [Line Items]	
2016	524
2017	524
2018	524
2019	524
2020	524
Thereafter	3,516
Total	$ 6,136

VIE Arrangements - Carrying Amounts and Classification of the VIEs' Assets and Liabilities Included in the Consolidated Balance Sheets (Details) - USD ($) $ in Thousands		Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013	Dec. 31, 2012
Current assets:					
Cash		$ 203,864	$ 152,154	$ 99,699	$ 89,785
Restricted cash		9,203	2,534		
Accounts receivable, net		60,275	43,189		
Prepaid expenses and other current assets		6,696	9,560		
Total current assets		360,494	236,534		
Restricted cash		8,094	6,012		
Solar energy systems, net		1,992,021	1,484,251		
Total assets	[1]	2,738,146	1,932,584		
Current liabilities:					
Accounts payable		104,133	51,166		
Distributions payable to noncontrolling interests and redeemable noncontrolling interests		8,144	6,764		
Accrued expenses and other liabilities		49,146	25,445		
Deferred revenue, current portion		59,726	44,398		
Deferred grants, current portion		13,949	13,754		
Long-term debt, current portion		5,408	2,602		
Total current liabilities		253,167	150,883		
Deferred revenue, net of current portion		559,066	467,726		
Deferred grants, net of current portion		220,784	226,801		
Long term debt, Noncurrent		532,910	236,649		
Total liabilities	[1]	1,931,447	1,380,017		
Variable Interest Entities					
Current assets:					
Cash		44,407	29,099		
Restricted cash		757	228		
Accounts receivable, net		12,965	14,351		
Prepaid expenses and other current assets		66	180		

Total current assets	58,195	43,858
Restricted cash		365
Solar energy systems, net	1,305,420	942,655
Total assets	1,363,615	986,878
Current liabilities:		
Accounts payable	11,025	9,057
Distributions payable to noncontrolling interests and redeemable noncontrolling interests	8,063	6,426
Accrued expenses and other liabilities	175	340
Deferred revenue, current portion	21,344	16,991
Deferred grants, current portion	7,198	7,225
Long-term debt, current portion	1,159	1,437
Total current liabilities	48,964	41,476
Deferred revenue, net of current portion	353,392	284,801
Deferred grants, net of current portion	108,528	116,126
Long term debt, Noncurrent	29,580	31,945
Total liabilities	$ 540,464	$ 474,348

[1] The Company's consolidated assets as of December 31, 2015 and 2014 include $1,363,615 and $986,878, respectively, in assets of variable interest entities, or VIEs, that can only be used to settle obligations of the VIEs. Solar energy systems, net, as of December 31, 2015 and 2014 were $1,305,420 and $942,655, respectively; cash as of December 31, 2015 and 2014 were $44,407 and $29,099, respectively; restricted cash as of December 31, 2015 and 2014 were $757 and $593, respectively; accounts receivable, net as of December 31, 2015 and 2014 were $12,965 and $14,351; respectively; prepaid expenses and other current assets as of December 31, 2015 and 2014 were $66 and $180, respectively. The Company's consolidated liabilities as of December 31, 2015 and 2014 include $540,464 and $474,348, respectively, in liabilities of VIEs whose creditors have no recourse to the Company. These liabilities include accounts payable as of December 31, 2015 and 2014 of $11,025 and $9,057, respectively; distributions payable to noncontrolling interests and redeemable noncontrolling interests as of December 31, 2015 and 2014 of $8,063 and $6,426, respectively; accrued expenses and other liabilities as of December 31, 2015 and 2014 of $175 and $340, respectively; deferred revenue as of December 31, 2015 and 2014 of $374,736 and $301,792, respectively; deferred grants as of December 31, 2015 and 2014 of $115,726 and $123,351, respectively; and long-term debt as of December 31, 2015 and 2014 of $30,739 and $33,382, respectively.

VIE Arrangements - Additional Information (Details) - Variable Interest Entities $ in Millions	12 Months Ended Dec. 31, 2013 USD ($) Entity
Variable Interest Entity [Line Items]	
Number of entities | Entity	3
Payments to acquire solar projects and the associated leases	$ 22.0
Decrease in additional paid-in-capital, net of tax	$ 2.8

Stockholders' Equity - Additional Information (Details) - USD ($)		12 Months Ended	
	Aug. 10, 2015	Dec. 31, 2015	Dec. 31, 2014
Class Of Stock [Line Items]			
Common stock issuable upon preferred stock conversion	1,667,683		
Common shares issuable upon conversion of warrants	1,250,764		
Deemed dividend to convertible preferred shareholders		$ 24,890,000	
Common stock dividends		0	
Series D and E Preferred Shares			
Class Of Stock [Line Items]			
Deemed dividend to convertible preferred shareholders	$ 24,900,000	$ 24,900,000	
Convertible Preferred Stock			
Class Of Stock [Line Items]			
Preferred Stock Shares Issued And Outstanding		0	54,841,000
Initial Public Offering			
Class Of Stock [Line Items]			
Issuance of common stock in connection with underwritten public offering, net of issuance costs, (in shares)	17,900,000		
Sale of stock, price per share	$ 14.00		
Proceeds from issuance initial public offering	$ 221,300,000		
Offering expense	$ 7,500,000		
Shares sold by shareholders in initial public offering	417,732		
Convertible preferred stock into common stock	54,840,767		

Stockholders' Equity - Schedule of Company's Series of Convertible Preferred Stock (Details) - USD ($) $ / shares in Units, $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Class Of Stock [Line Items]		
Preferred stock, shares authorized	200,000,000	0
Series A Convertible Preferred Stock		

Class Of Stock [Line Items]		
Preferred stock, shares authorized		12,043,000
Preferred Stock Shares Issued And Outstanding		12,007,000
Aggregate liquidation preference		$ 12,007
Noncumulative Dividend Per Share Per Annum		$ 0.08
Series B Convertible Preferred Stock		
Class Of Stock [Line Items]		
Preferred stock, shares authorized		10,758,000
Preferred Stock Shares Issued And Outstanding		10,758,000
Aggregate liquidation preference		$ 18,420
Noncumulative Dividend Per Share Per Annum		$ 0.14
Series C Convertible Preferred Stock		
Class Of Stock [Line Items]		
Preferred stock, shares authorized		13,613,000
Preferred Stock Shares Issued And Outstanding		13,613,000
Aggregate liquidation preference		$ 55,000
Noncumulative Dividend Per Share Per Annum		$ 0.32
Series D Convertible Preferred Stock		
Class Of Stock [Line Items]		
Preferred stock, shares authorized		7,584,000
Preferred Stock Shares Issued And Outstanding		7,584,000
Aggregate liquidation preference		$ 70,000
Noncumulative Dividend Per Share Per Annum		$ 0.74
Series E Convertible Preferred Stock		
Class Of Stock [Line Items]		
Preferred stock, shares authorized		13,030,000
Preferred Stock Shares Issued And Outstanding		10,879,000
Aggregate liquidation preference		$ 150,456
Noncumulative Dividend Per Share Per Annum		$ 1.11
Convertible Preferred Stock		
Class Of Stock [Line Items]		
Preferred stock, shares authorized	0	57,028,000
Preferred Stock Shares Issued And Outstanding	0	54,841,000
Aggregate liquidation preference	$ 0	$ 305,883

Stockholders' Equity - Schedule of Reserve Share of Common Stock for Issuance (Details) - shares	**Dec. 31, 2015**	**Jul. 31, 2015**	**Dec. 31, 2014**
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance	27,307,000		67,890,000
Series A Convertible Preferred Stock			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance			12,007,000
Series B Convertible Preferred Stock			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance			10,758,000
Series C Convertible Preferred Stock			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance			13,613,000
Series D Convertible Preferred Stock			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance			7,584,000
Series E Convertible Preferred Stock			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance			10,879,000
Twenty Fifteen Equity Incentive Plan			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance	12,006,000	11,400,000	
Twenty Thirteen Equity Incentive Plan			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance			694,000
Twenty Fifteen Employee Stock Purchase Plan			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance	1,000,000		
Employee Stock Option			
Class Of Stock [Line Items]			
Shares of common stock reserved for issuance	12,795,000		11,408,000

Restricted Stock Units (RSUs)		
Class Of Stock [Line Items]		
Shares of common stock reserved for issuance	1,506,000	947,000

Stock-Based Compensation - Additional Information (Details) - USD ($)	1 Months Ended			12 Months Ended			
	Aug. 31, 2015	Jul. 31, 2015	Mar. 31, 2015	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013	Aug. 31, 2014
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]							
Common stock, shares outstanding				101,282,000	24,249,000		
Common stock reserved for issuance				27,307,000	67,890,000		
Unvested exercisable shares				517,285	469,000		
Unvested exercisable shares, vesting period				3 years 2 months 12 days			
Unvested options exercised				0	0		
Unvested options subject to repurchase, outstanding				0	0		
Weighted-average grant-date fair value of stock options granted				$ 4.56	$ 3.72	$ 1.77	
Total intrinsic value of options exercised				$ 8,100,000	$ 4,800,000	$ 1,400,000	
Total fair value of options vested				9,100,000	3,900,000	2,300,000	
Compensation expense recognized				$ 15,823,000	$ 9,218,000	$ 2,655,000	
Expected dividend yield rate				0.00%	0.00%	0.00%	
Total unrecognized compensation cost				$ 20,900,000	$ 12,100,000		
Weighted-average period of recognition				2 years 9 months 18 days	2 years 9 months 18 days		
Internal Use Software Development							
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]							
Capitalized stock based compensation expense				$ 200,000	$ 100,000	$ 0	
Employee Stock							
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]							
Compensation expense recognized				$ 1,600,000	$ 3,400,000		
Sale of shares				1,131,028	1,092,421		
Restricted Stock Units (RSUs)							
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]							
Common stock reserved for issuance				1,506,000	947,000		
Stock option plan, number of shares granted				808,000	947,342		
Vesting starting period				2014-08			
Vesting ending period				2017-08			
Stock option plan, number of additional shares available for grant					372,342		
Stock Options							
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]							
Common stock reserved for issuance				12,795,000	11,408,000		
Outstanding stock options				180,000			
Performance-based Plan							
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]							
Compensation expense recognized				$ 800,000			
Maximum							
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]							
Risk-free interest rate				1.95%	2.01%	2.06%	
Expected volatility				39.63%	46.68%	55.80%	
Expected term (in years)				6 years 2 months 23 days	6 years 29 days	6 years 29 days	
MEC 2009 Stock Plan							

Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Common stock, shares outstanding			527,770	
2013 Equity Incentive Plan				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Additional common stock shares reserved for issuance		3,000,000		
Common stock reserved for issuance		4,500,000		
Stock options vesting period		4 years		
Stock option plan, number of shares granted			0	
2013 Equity Incentive Plan | Maximum				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Common stock reserved for issuance		8,044,829		
Stock options granted, expiration period		10 years		
2013 Equity Incentive Plan | End of One Year				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Vesting award percentage		25.00%		
2013 Equity Incentive Plan | Monthly Over the Remaining Three Years				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Vesting award percentage		75.00%		
2014 Equity Incentive Plan				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Common stock reserved for issuance	1,197,342			947,342
2014 Equity Incentive Plan | Restricted Stock Units (RSUs)				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Stock option plan, number of shares granted	1,197,342			
2015 Equity Incentive Plan				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Common stock reserved for issuance	11,400,000		12,006,000	
Stock options vesting period	4 years			
2015 Equity Incentive Plan | Restricted Stock Units (RSUs)				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Stock options vesting period	4 years			
Stock option plan, number of shares granted			250,000	
Outstanding RSUs			783,228	
2015 Equity Incentive Plan | Maximum				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Common stock reserved for issuance	15,439,334			
Stock options granted, expiration period	10 years			
2015 Equity Incentive Plan | End of One Year				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				
Vesting award percentage	25.00%			
2015 Equity Incentive Plan | End of One Year | Restricted Stock Units (RSUs)				
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]				

Vesting award percentage		25.00%	
2015 Equity Incentive Plan | Monthly Over the Remaining Three Years			
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]			
Vesting award percentage		75.00%	
2015 Equity Incentive Plan | Quarterly Over the Remaining Three Years | Restricted Stock Units (RSUs)			
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]			
Vesting award percentage		75.00%	
Employee Stock Purchase Plan			
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]			
Common stock reserved for issuance	1,000,000		1,000,000
Minimum annual increase included in common stock reserved for future issuance as of first day of each fiscal year	5,000,000		
Minimum percentage of annual increase included in common stock reserved for future issuance as of last day of immediately preceding fiscal year	2.00%		
Terms of shares available for issuance			The number of shares of common stock available for sale under the Company's ESPP will also include an annual increase on the first day of each fiscal year beginning on January 1, 2016, equal to the least of (i) 5,000,000 shares (ii) 2% of the common stock as of the last day of the immediately preceding fiscal year or (iii) such other amount as the Company's board of directors may determine.
Maximum deductible value of shares available for employee to purchase per calendar year	$ 25,000		
Maximum percentage in payroll deductions to acquire shares of common stock	15.00%		
Maximum number of shares available for employee to purchase per offering period	2,000		
Term of offering period			Employees are offered shares bi-annually through two six month offering periods, which begin on the first trading day on or after May 15 and November 15 of each year. The first offering period began on November 16, 2015.
Risk-free interest rate			0.33%
Expected volatility			33.84%
Expected term (in years)			6 months
Expected dividend yield rate			0.00%

Stock-Based Compensation - Summary of Stock Option Activity (Details) - $ / shares	12 Months Ended	
	Dec. 31, 2015	Dec. 31, 2014
Disclosure Of Compensation Related Costs Sharebased Payments [Abstract]		
Stock options, Outstanding, balance	11,408,000	
Stock options, Granted	3,806,000	
Stock options, Exercised	(1,210,000)	
Stock options, Cancelled/Forfeited	(1,209,000)	
Stock options, Outstanding, Balance	12,795,000	11,408,000
Stock options, Options vested and exercisable	6,409,000	
Stock options, Options vested and expected to vest	10,460,000	
Weighted-average exercise price, Outstanding, Balance	$ 4.42	
Weighted-average exercise price, Granted	9.50	
Weighted-average exercise price, Exercised	2.96	
Weighted-average exercise price, Cancelled/Forfeited	6.27	
Weighted-average exercise price, Outstanding, Balance	5.89	$ 4.42
Weighted-average exercise price, Options vested and exercisable	3.88	
Weighted-average exercise price, Options vested and expected to vest	$ 5.69	
Weighted-average remaining contractual life, options outstanding	7 years 9 months 26 days	8 years 2 months 12 days
Weighted-average remaining contractual life, options vested and exercisable	6 years 9 months 18 days	
Weighted-average remaining contractual life, options vested and expected to vest	7 years 7 months 24 days	

Stock-Based Compensation - Estimated Fair Value of Stock Options (Details)	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]			
Expected dividend yield	0.00%	0.00%	0.00%
Minimum			
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]			
Risk-free interest rate	1.55%	1.68%	0.82%
Volatility	36.30%	37.41%	54.36%
Expected term (in years)	5 years 6 months	5 years 4 months 2 days	5 years 6 months 15 days
Maximum			
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]			
Risk-free interest rate	1.95%	2.01%	2.06%
Volatility	39.63%	46.68%	55.80%
Expected term (in years)	6 years 2 months 23 days	6 years 29 days	6 years 29 days

Stock-Based Compensation - Summary of Activity for All RSUs (Details) - Restricted Stock Units (RSUs) - $ / shares	12 Months Ended	
	Dec. 31, 2015	Dec. 31, 2014
Share Based Compensation Arrangement By Share Based Payment Award [Line Items]		
Shares, Unvested, Balance	947,000	
Shares, Granted	808,000	947,342
Shares, Issued	(182,000)	
Shares, Cancelled / forfeited	(67,000)	
Shares, Unvested, Balance	1,506,000	947,000
Weighted-average grant date fair value, Unvested, Balance	$ 9.40	
Weighted-average grant date fair value, Granted	11.13	
Weighted-average grant date fair value, Issued	9.58	
Weighted-average grant date fair value, Cancelled / forfeited	11.37	
Weighted-average grant date fair value, Unvested, Balance	$ 10.44	$ 9.40

Stock-Based Compensation - Summary of Stock-Based Compensation Expense (Details) - USD ($) $ in Thousands	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Employee Service Share Based Compensation Allocation Of Recognized Period Costs [Line Items]			
Compensation expense recognized	$ 15,823	$ 9,218	$ 2,655
Cost of Operating Leases and Incentives			
Employee Service Share Based Compensation Allocation Of Recognized Period Costs [Line Items]			
Compensation expense recognized	1,649	155	116
Cost of Solar Energy Systems and Product Sales			
Employee Service Share Based Compensation Allocation Of Recognized Period Costs [Line Items]			
Compensation expense recognized	236	682	
Sales and Marketing			
Employee Service Share Based Compensation Allocation Of Recognized Period Costs [Line Items]			
Compensation expense recognized	5,242	897	474
Research and Development			
Employee Service Share Based Compensation Allocation Of Recognized Period Costs [Line Items]			
Compensation expense recognized	205	270	379
General and Administration			
Employee Service Share Based Compensation Allocation Of Recognized Period Costs [Line Items]			
Compensation expense recognized	$ 8,491	$ 7,214	$ 1,686

Retirement Plan - Additional Information (Details) $ in Millions	12 Months Ended Dec. 31, 2014 USD ($)
Mainstream Energy Corporation	
Defined Benefit Plan Disclosure [Line Items]	
Post acquisition contributions	$ 0.5

Operating Revenues under Customer Agreements - Additional Information (Details) - USD ($) $ in Millions	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Leases Operating [Abstract]			

Operating Revenues under Customer Agreements - Schedule of Future Minimum Lease Payments (Details) $ in Thousands	Dec. 31, 2015 USD ($)
Operating Leases Future Minimum Payments Receivable [Abstract]	
2016	$ 13,557
2017	13,697
2018	13,817
2019	13,939
2020	14,065
Thereafter	199,278
Total	$ 268,353

Income Taxes - Loss Before Income Taxes (Details) - USD ($) $ in Thousands	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Income Tax Disclosure [Abstract]			
Loss attributable to common stockholders	$ 33,545	$ 80,895	$ 1,792
Loss attributable to noncontrolling interest and redeemable noncontrolling interests	220,660	86,638	64,294
Total	$ 254,205	$ 167,533	$ 66,086

Income Taxes - Income Tax Provision Benefit (Details) - USD ($) $ in Thousands	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Current:			
State			$ 169
Total current expense			169
Deferred:			
Federal	$ (7,516)	$ (8,196)	(1,114)
State	2,217	(1,847)	354
Total deferred provision	(5,299)	(10,043)	(760)
Total	$ (5,299)	$ (10,043)	$ (591)

Income Taxes - Reconciliation of The Statutory Federal Rate and The Company's Effective Tax Rate (Details)	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Income Tax Disclosure [Abstract]			
Tax provision (benefit) at federal statutory rate	(34.00%)	(34.00%)	(34.00%)
State income taxes, net of federal benefit	0.87%	(1.10%)	0.79%
Effect of noncontrolling and redeemable noncontrolling interests	29.53%	17.59%	34.10%
Stock-based compensation	1.06%	1.37%	0.94%
Effect of prepaid tax asset	0.04%	9.39%	
Tax credits	(0.43%)	(0.22%)	(2.16%)
Other	0.85%	0.98%	(0.56%)
Total	(2.08%)	(5.99%)	(0.89%)

Income Taxes - Significant Components of The Deferred Tax Assets and Liabilities (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Deferred tax assets:		
Accruals and prepaids	$ 12,904	$ 4,302
Deferred revenue	34,710	44,359
Net operating loss carryforwards	229,464	176,555
Stock-based Compensation	3,748	1,612
Investment tax and other credits	11,261	7,369
Gross deferred tax assets	292,087	234,197
Deferred tax liabilities:		
Capitalized initial direct costs	27,539	16,640
Fixed asset depreciation	178,511	142,866
Deferred tax on investment in partnerships	276,183	184,240

Gross deferred tax liabilities	482,233	343,746
Net deferred tax liabilities	$ (190,146)	$ (109,549)

Income Taxes - Summary of Deferred Tax Liabilities (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Income Tax Disclosure [Abstract]		
Deferred tax assets	$ 292,087	$ 234,197
Deferred tax liabilities	(482,233)	(343,746)
Net deferred tax liabilities	$ (190,146)	$ (109,549)

Income Taxes - Additional Information (Details) - USD ($)	12 Months Ended	
	Dec. 31, 2015	Dec. 31, 2014
Income Tax Contingency [Line Items]		
Investment Tax Credit	$ 4,200,000	$ 2,400,000
Tax Credit Carryforward, Expiration Date	2028	
Tax benefit realized upon settlement	50.00%	
Unrecognized Tax Benefits	$ 1,525,000	0
Unrecognized Tax Benefits Income Tax Penalties And Interest Accrued	300,000	0
Federal		
Income Tax Contingency [Line Items]		
Net operating loss carryforwards	$ 595,000,000	454,500,000
Net operating loss carryforwards, Year of expiration	2028	
California		
Income Tax Contingency [Line Items]		
Net operating loss carryforwards	$ 368,000,000	283,100,000
Net operating loss carryforwards, Year of expiration	2020	
Other State		
Income Tax Contingency [Line Items]		
Net operating loss carryforwards	$ 178,600,000	126,500,000
Net operating loss carryforwards, Year of expiration	2020	
California Enterprise Zone Credits.		
Income Tax Contingency [Line Items]		
Investment Tax Credit	$ 1,000,000	900,000
Tax Credit Carryforward, Expiration Date	2023	
Windfall Stock Option | Federal		
Income Tax Contingency [Line Items]		
Net operating loss carryforwards	$ 5,300,000	1,800,000
Windfall Stock Option | California		
Income Tax Contingency [Line Items]		
Net operating loss carryforwards	1,300,000	1,100,000
Windfall Stock Option | Other State		
Income Tax Contingency [Line Items]		
Net operating loss carryforwards	$ 2,500,000	$ 500,000

Income Taxes - Reconciliation of Unrecognized Tax Benefits (Details)	12 Months Ended
	Dec. 31, 2015 USD ($)
Income Tax Disclosure [Abstract]	
Balance at January 1, 2014 and December 31, 2014	$ 0
Acquired from CEE	1,525,000
Balance at December 31, 2015	$ 1,525,000

Income Taxes - Summary of Tax Years that Remain Open and Subject to Examination by The Tax Authorities (Details)	12 Months Ended
	Dec. 31, 2015
U.S. Federal | Earliest Tax Year	
Income Tax Contingency [Line Items]	
Open Tax Year	2011
U.S. Federal | Latest Tax Year	
Income Tax Contingency [Line Items]	
Open Tax Year	2015
State | Earliest Tax Year	
Income Tax Contingency [Line Items]	
Open Tax Year	2010

State | Latest Tax Year	
Income Tax Contingency [Line Items]	
Open Tax Year	2015

Commitments and Contingencies - Additional Information (Details) - USD ($) $ in Millions	1 Months Ended			12 Months Ended		
	Oct. 31, 2015	Jun. 30, 2015	Jan. 31, 2015	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Other Commitments [Line Items]						
Letters of credit outstanding, amount				$ 3.5	$ 5.8	
Capital Lease Obligations				$ 24.0	7.4	
Photovoltaic Modules						
Other Commitments [Line Items]						
Purchase commitment with suppliers	$ 146.0	$ 32.0	$ 70.0			
Long-term purchase commitment, period				12 months		
Long term purchase commitment ending period	2016-12			2016-12		
Commitment of $146.0 million | Photovoltaic Modules						
Other Commitments [Line Items]						
Delivered purchase commitments				$ 78.0		
Commitment of $32.0 million | Photovoltaic Modules						
Other Commitments [Line Items]						
Delivered purchase commitments				$ 8.0		
Capital Lease Obligations						
Other Commitments [Line Items]						
Lease obligation interest rates				10.00%		
Non Cancellable Operating Leases Arrangements						
Other Commitments [Line Items]						
Operating lease expenses				$ 19.7	13.8	$ 2.0
Deferred rent liabilities				$ 1.9	$ 2.0	
Letter of Credit | Minimum						
Other Commitments [Line Items]						
Letter of credit, fee percentage				2.00%		
Letter of Credit | Maximum						
Other Commitments [Line Items]						
Letter of credit, fee percentage					3.25%	

Commitment and Contingencies - Schedule of Future Minimum Lease Payments Under Non-Cancelable Operating Lease Agreements (Details) - Non Cancellable Operating Leases Arrangements $ in Thousands	Dec. 31, 2015 USD ($)
Operating Leased Assets [Line Items]	
2016	$ 7,019
2017	6,669
2018	5,906
2019	2,521
2020	879
Thereafter	53
Total	$ 23,047

Commitment and Contingencies - Schedule of Future Lease Payments Under Capital Lease Obligations (Details) - USD ($) $ in Thousands	Dec. 31, 2015	Dec. 31, 2014
Commitments And Contingencies Disclosure [Abstract]		
2016	$ 9,727	
2017	7,444	
2018	5,321	
2019	2,799	
2020	219	
Thereafter	200	
Total future lease payments	25,710	

Less: amount representing estimated executory costs included in future lease payments	537	
Net minimum future lease payments	25,173	
Amount representing interest	1,180	
Present value of future payments	23,993	
Capital lease obligation, current portion	8,951	$ 1,593
Capital lease obligation, net of current portion	$ 15,042	$ 5,761

Net Loss Per Share - Additional Information (Details) - USD ($) $ in Thousands	12 Months Ended	
	Aug. 10, 2015	Dec. 31, 2015
Schedule Of Earnings Per Share Basic And Diluted [Line Items]		
Deemed dividend to convertible preferred shareholders		$ 24,890
Series D and E Preferred Shares		
Schedule Of Earnings Per Share Basic And Diluted [Line Items]		
Deemed dividend to convertible preferred shareholders	$ 24,900	$ 24,900

Net Loss Per Share - Computation of Basic and Diluted Net Loss per Share (Details) - USD ($) $ / shares in Units, shares in Thousands, $ in Thousands	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Numerator:			
Net loss attributable to common stockholders	$ (28,246)	$ (70,852)	$ (1,201)
Deemed dividend to convertible preferred stockholders	(24,890)		
Net loss available to common stockholders	$ (53,136)	$ (70,852)	$ (1,201)
Denominator:			
Weighted average shares used to compute net loss per share available to common stockholders, basic and diluted	55,091	22,795	9,780
Basic and diluted	$ (0.96)	$ (3.11)	$ (0.12)

Net Loss Per Share - Schedule of Shares Excluded From Computation of Diluted Net Los Per Share (Details) - shares	12 Months Ended		
	Dec. 31, 2015	Dec. 31, 2014	Dec. 31, 2013
Antidilutive Securities Excluded From Computation Of Earnings Per Share [Line Items]			
Antidilutive securities excluded from computation of net loss per share	14,668	66,249	52,125
Preferred Stock			
Antidilutive Securities Excluded From Computation Of Earnings Per Share [Line Items]			
Antidilutive securities excluded from computation of net loss per share		54,841	43,998
Warrant			
Antidilutive Securities Excluded From Computation Of Earnings Per Share [Line Items]			
Antidilutive securities excluded from computation of net loss per share	1,251		
Employee Stock Option			
Antidilutive Securities Excluded From Computation Of Earnings Per Share [Line Items]			
Antidilutive securities excluded from computation of net loss per share	12,615	11,408	8,127
Unvested Restricted Stock Units			
Antidilutive Securities Excluded From Computation Of Earnings Per Share [Line Items]			
Antidilutive securities excluded from computation of net loss per share	723		
ESPP			
Antidilutive Securities Excluded From Computation Of Earnings Per Share [Line Items]			
Antidilutive securities excluded from computation of net loss per share	79		

Related Party Transactions - Additional Information (Details) - USD ($) $ in Millions	12 Months Ended	
	Dec. 31, 2015	Dec. 31, 2014
Enphase Energy I N C		
Related Party Transaction [Line Items]		
Purchase from related party	$ 11.9	$ 8.9
Outstanding payables to related party	0.7	1.1
RECC		
Related Party Transaction [Line Items]		
Solar energy systems and products sales revenue	0.3	7.6
Accounts receivable	$ 0.0	$ 0.1

Subsequent Events - Additional Information	1 Months Ended

(Details) - USD ($)	Mar. 31, 2016	Jan. 31, 2016	12 Months Ended Dec. 31, 2015	Jan. 01, 2016
Basis point				
Subsequent Event [Line Items]				
Annual Contractual Interest Rate			3.25%	
Subsequent Event | Syndicated Term Loans				
Subsequent Event [Line Items]				
Line of credit facility, maximum borrowing capacity				$ 250,000,000
Maturity Date		Dec. 31, 2020		
Subsequent Event | Syndicated Term Loans | Aggregate Banking Facilities				
Subsequent Event [Line Items]				
Line of credit facility, maximum borrowing capacity				220,000,000
Subsequent Event | Syndicated Term Loans | Term Loan				
Subsequent Event [Line Items]				
Line of credit facility, maximum borrowing capacity				23,000,000
Subsequent Event | Syndicated Term Loans | Letter of Credit Sub-Facility				
Subsequent Event [Line Items]				
Line of credit facility, maximum borrowing capacity				$ 7,000,000
Subsequent Event | Syndicated Term Loans | Basis point | Aggregate Banking Facilities				
Subsequent Event [Line Items]				
Annual Contractual Interest Rate		2.50%		
Revolving line of credit facility available period		3 years		
Debt instrument, variable rate periodic increase		2.75%		
Revolving line of credit facility available period increase		2 years		
Subsequent Event | Syndicated Term Loans | Basis point | Term Loan				
Subsequent Event [Line Items]				
Annual Contractual Interest Rate		5.00%		
Revolving line of credit facility available period		3 years		
Debt instrument, variable rate periodic increase		6.50%		
Revolving line of credit facility available period increase		2 years		
Subsequent Event | Syndicated Term Loans | Basis point | Letter of Credit Sub-Facility				
Subsequent Event [Line Items]				
Annual Contractual Interest Rate		2.50%		
Revolving line of credit facility available period		3 years		
Debt instrument, variable rate periodic increase		2.75%		
Revolving line of credit facility available period increase		2 years		
Subsequent Event | Syndicated Term Loans | LIBOR Floor Rate | Term Loan				
Subsequent Event [Line Items]				
Annual Contractual Interest Rate		1.00%		
Subsequent Event | Secured, Non-recourse Loan Agreement				
Subsequent Event [Line Items]				
Aggregate amount of debt	$ 24,500,000			
Debt instrument maturity year	2022-09			
Debt instrument, Description	In March 2016, a subsidiary of the Company entered into a $24.5 million secured, non-recourse loan agreement. The loan will be repaid through cashflows from a lease pass-through arrangement previously entered into by the Company. The loan matures in September 2022 and has an interest rate of LIBOR + 2.25%.			

Subsequent Event | Secured, Non-recourse Loan Agreement | Basis point	
Subsequent Event [Line Items]	
Annual Contractual Interest Rate	2.25%


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MHM#NA+-[%(5/8OGZG7!^CZ)R1*'?">/W. K]3M#OA/';2XFC,J1H>OK"XQFA
MH)%#VD04FIZR 7L;ZI]&]A6BT/:4L7VT52E6(BG:GC*V\]E H)8+Y;4*;4\9
MV[<4$D\3@"BT/7U]3?+8J!Y1WI;#"S7)T 64O&FLAD\0A;:GNY4G)ZK#FB)%
MVU/.]JVH8;@0A;:GC.UCE0YU&#=5T/:,+4 &4$>(0MLSQO;1HBG#\B1#VS/&
M]G$4VIZA[1EC^S@*8WN&MF>,[>,HC.T9VIXQMH]6A1G&]@QMSQC;1ZO"S-MA
M\[;8V =&J K]E7-"'R *;<]>V,9XALHPMF=H>\;6+AYJ)+;G:'O.V#[2JB^R
MPR"3H^TY8SL6P,\;A< I.=J>,[;[* CM)\I27D04VIXSMH^6U3G:GJ/M^:X5
M>HZVYVA[ IH*?4\<2V,>'.IHV2(*;<\9VQD4CCVBT/9\6Z6^6?+ QB'*VU+F
M8CN/>O(+46A[SFTTCZ$*?/0LT/:"L7WKH\BZDXA"VPMN%V4[ROF**+2]X/94
MMJ-.K5,[>,HK-L+M+U@8SL\3.ZMG^4^*(IZ2KB/$.6=JKST7+HG?K\45)C<
M^LVM\/ .XT)&.LW8"/Y, R\4YF \7YLS,(@\6#>V4S F+^]FVY& -@WNE,
MP)X</K]FFP9/)@W@K@CAZW;^8/W?5@W@I@#ROW] 3]
M9>#!O!6P/IC]1 +3;S#> P]02P,$% @ HZ5J2'$4X>:8 @
MY D !@ !X;"]W;W)K51K-HUR0AB36VR0!)IG]?'HX'1\#&-OB<>X![#U "/U@%XQY
M\-5W UN%%\ZORRABAPON$5N0*Q[$GQ.A/>*B2<\1NU*,CHK4=Q&,XSSJ43N$
M3:WZWFA3DQOOV@& T8#=^A[1?QO)Q#)@,>
M2,?4,SC<&"?]DQ(&/?K2[W90[X?^D^4CS4Z (P%.! B]A&0D)!,!I%Y".A+2
M%T*DIZ(68H0OR@UY:!4Q$91?(/0*Y0O?V+,\@CC07'HG"Y+ D>= 2&I+K
M2HB!(Q.E1Z0T1:RELIE!'+52>20JDY]9)6:0W"XA=QRWYV(S0F%WW0Q3.E2\
MS@9FA,J:DA&3C\N55TGNJ% @\?@:0$,*.K:1&<918AS3"NOO-9'YC>A]9"
MVXV80F R!5@X=C'@LS\PS9W$-J'MB!DK.@9IE27E:X8BXXSL,3VKRP8+#N0V
M<'T83KW3A6:M3O'H&][45W3&OQ$]MP,+]H2+DUJ=M2=".!9CB1&PO=V]R:W-H965T&ULC9G;;MM&$(9?1=!]HMW9
MV9,A"ZA)%.U%@2 7[35CT[80E(RE.D[?R-N%RNOPSML$21WVRA?RO5C=6S0[SD84F#9VNS0S4T]EF^.2@M"EZV.AH2,]:&UF*!:9O+27=Z2B5\RC8ZT$
MV9,A"ZA)%.U%@2 7[35CT[80270E.D[?OCQ(RHPSL^V-#NO W']/'V=WUV =
M\>OIN6W[Q??][G"Z73[W EC]](>ACN/W7'?],/?X]/J]')L
MFXM;6[6[W?BDH>2 SP ]4>882']?GO[K5-W!
M I?FU%;=[J M0 \\N#7+Q4/[V+SN^L =VV MN0Z3P MN=YH^% >OI[[;7T*6
MBWWS??[>'J;OM E.,N[(A>J B\4YSX@A-/G031B2>%! -1]%M3%3J;LNPE
M%+P$ZB6*7@)M%9N3:(6*O$W*:(D%)Y$Z$0NI(BDD6O"R%:H"EZW20ZG@)5$O
M6?22: ^%+'9C3479!R,[R04GF3A!(SK)I! 7#&9Y#F76+$$=N2.5=2Z9 YY%
M9\U<4C**':8*QBI\LD5*6MHZ5G9C23DV#],:1&'-A9@0O%4\E:!I@7H"V1/0
MB8LIR*.'R0!L]HJ?$H0MI3"*2*O.FDM!T)
MZ*Z9+#L-A;;$94O!C. *F35W7"/#VS(NQZ%MM%:,K+7=P'G-=XGA-I'T!957
MHRVQUU+X>AF^-K,N1^N4L9K96+5!&:M0HB]0^GJ9=\#H:^495C-5B$%I8"C1
M%RA]O4PZH%#%K'4YDX%'5$@'Q725DM?+I .*5)\C*'XXH!U)>KB?$GF!DM?+
MI ..U(QBLE& DT4M X42>8&2U\ND T;>+(^QFJFLSTJV!R7N N6NERD'E*=@
MDOQ:XJHA6U;SH.!,=>!5NL23(&"4LY?*Z#\<]&*X*F9RMN@O&F@
MA$B@>:Z7\UQ(;&HZ&^17#=-9;Y*V!H 26H'RBD+6J;#- !:,53<=J#,5NK@2
M>1TE;Y#)ZQA3C?=>JWN)JHY259X7E6-9ZC"CDU)WIDL&0'GKN!)9'26KS([*
M4;)&+6=A*D#538F CO(WR/QU//]4LWVN,]EK2:8K,=A1!H=W##ZGUTRCI-=G
M3;IDS4,KRJ#F0I>,L=I(*Y':45)'( FNN$;U:FYSOF,2N:')4*C)4N/J+P'L015I%"-*+8NU\BMJVFXDQ)-D=)4QG:%
M;']6SE>81H$H%O=O*42CC#:D$ T( $HW4YU++FE;4FFL]27"
M>48X.??PE%[*GM:
MW'>OAWYNLNO5ZPGQW72>^ ZZQYO*HW!G<##&PO=V]R:W-H965T
M&ULC9G?3NLX$(=?I>H#4'O&=FQ4*BVM5KL7*QV=B!>ZV[*4S[C6TZ&X
MTS9L$N#LVV ^E3,#,P8N:)O^G'Q)[&]&&]7-L]Q=99R[&=&U*A[6[*A]^U4@AL%@4>R>U!^F+?)3KC?H>1P?/1S/R@-^@U']H;6YJ6MJYT]NTHRQ!0K%!-H1;M3JJY9O!&:9C,Z5TDR]5R"BNL2MPA
MS69=/W>' :GZUBS:Y^.Q;/Z[K@[UZ]72+L\;ON\?'KMAPVJS7KVUN]L?JU.[
MKT^+IKJ 6OYF+W<.A\B8^'M?O;;D 6* OZGK'\.'/^^NEF9@J [5;3?LHNQ?
M7JIM=3@,>^J/ .^\TU ''!K2]^>] SZ>;H] 4[;5MC[\L[ K'GM:LUS<5??E
M\Z'[7K ^43&\#<
M +[: .<&^-; NFP#-S=P[QJLIE,9+\2N[,K-NJE?%\UT]Y[*H9/82]=?ZMM%
M? ;M(#HA\:6C4VN1=09,,*F6@$H5"$2K1(QD+
M$30FF@0'+JE(@^1US1D*Y42H.?,5*A;]!"MK7TNP7"')]9IG9 W,F&0HVYVY+Y8W*+48V
M&C &,;=C.>O!>NTJY?QMJ<"3EXFHEX.!0HSM6,RA)0KF/#F'6RIQE"5NJ:-#
M2$HWHJGD@];W^,6"G>N EA: KQ<
MAN;,627.HNC!'VT'I]C05BJ!U^IS]+=6 EVN2
MI59W2945D[]WSLL\D#, ,/,KDTNJ\V!C(=?2'I)GF7-F
M/A+&?L3+1#0'F%1U0G;^376>HK*'G'R!RE<>?UM@4L6 P
M42Y00*U9>(6&AGQ2?GE!3JO 9M8*"],JI*#T'Q9SJ(Z)G%6!6E4IEL!\*4N,
M96Q4*B7DE I4J>\KY1F%NM([XY29#S&D9V:18[LS(M&Q] OH1RP&J(QUS5D9J
M9:4>SYDXGWLA"V''8XA1NT(Y*R.UI2;1WKB\L4N1PGRMD4J4V5
MM2RDII3+,(OXPD!4?W=CSJA(C:HL9V'Z'(=+-SJKXKB<3AV;H\HZ=>93'!;Y
M!">G4T=U:N4ED*VC*PD*CV6#QD>M,SM1IZ>99EA7 M@D9SW'9J/O>MO\TY)E
M/BR"K,@J^K%J'L;'$>WBMGX^=<,2,MGZ]LCC>GQ \7Z[@\MM?PH?O^D)^F &
MIR2K7X?8K) *A^JOLGG8G]K%3=UU]7%URT^1]02P,$% @ HZ5J2#XM@;Y=! \!,
M !@ !X;"]W;W)KR^M;T [H
MCM;VT<^Z.G=OJV/?7U[CN-L>;5UV+\W%GMT ^Z:MR]Y=MH>XN[2VVW(V(V#ZBH&
MQI*X+D GU68]WOO6;M;-M:].9 NMC;IK79?M?YFMFMO;BJ N-[Z?#L=^N!%O
MUO%CW.Y4VW-W:LY1: =OJW?^6D Z("/Q]\G>NL7O:!# T30 AHL =V\K-FBP
ME=WV0XC2?7W:W%;5$,G- .\]&O.8>#R]SWZ[^-RG?R/LK-Y4 USVO5'IY:M
MHIW=E]>J ][< K#S&M0O<-M4W?@9;:]=W]3W(:NH+G].WZ?S^'V; M%L'D8/
M@'D / ;P)#A S /$UP 9'"#G ?)I0#PM94Q$4?;E9MTVMZB=GMZE'(J$OTJ7
MZFWD5M^MAK & [$9OVYX8ROX\\A$&*RB8&)>1"QB Z8 OQ39+ 8#M0$^9(0
M)%(L$HL6"Z0;O*Q9C,TSY08LBOFB )(
MC$=.R#$XL@Q.6\8,S2T*A/8T/,0)X7J$Y E+]+[IE/FDAXR#(^?@M'/PI2?\
M!MRX/26M'8%<0,+)EE@4GCS7O(9C8CR&4[#)-@YBVZLQI1CU<%-7@)1?_OSJ*YC
MRE>^(:?A*=)-]H%LAN[=G>ZY3Y#RV!X/V19'OL5IW^+N(0@J1Q1SM0] 191
MB: ;AFR+(]^BBRSC!I6MDD#OC'(,\B15PJ,<@6X+M>C-)L<\CA '@>TQP%#
M;P@8G+^%,[XMO/HBP%PBP7AL&D)V!\CNZ%U,!@)IUR ]
M>4=QG" %)ZPU8@S*3ZN5;BQ;E(;=O#>,#41=OF>NZG@X7'W<;! E>WA=.ZBCZ;OFWH\=]DW36^=//;B*N)HR]WCHK+[
M?OB9NM M=" U7?3-Y7Z^]CCDV P/4$L#!!0 ( *.E:DAPO40K)P( (8&
M 8 >&PO=V]R:W-H965T&ULC57+CILP%/T5BBL=8W4'*8B8I
M$4&:)*K:1:I\1'1"&%&PJ]FLAV#@8&:FO#)%4;S0.0BX:B)BCR?D#G('^DR+#*)\,JF2@Z^9:EH<*/+$IB)T$D;*6#@N"3R/_8!/1%R@-+ZEWB1,W:?_V5GOGM-(;UFM<:E;!$W[=ZQO\-]!$V=>F5!CKPZ]+71W&BNI/(
M3NA\T=B=EG,+9R:\ZY3:?(VCUZG0PD:WB/3Q!SG2DN6:5BEFR*&8FWTM=Z9!N=JL'&K+Y.]Z!J9!KGJ-X$+9(*2M
```

MI$/42?*@.MF"F6QFQIN.;38U$ZW0@W3D"V;RF1E #?-9#9^C-//6,/^ &N;
MJ"&0%.2[+>O!GN5AM3H?/=?WR933:W#^7RV+S
MN7HI5\U 'JOULJB;7]=/H\W+NBP>MD;+Q4@FB1TMB EJ>':R =O=^NRD>JT7
M\U5YMQYL7I?+8OW?N%Q4;Z=#,>S^,)L /=?M'T9G)Z.]W<-\6:XV\VHU6)>/
MI\. Q)>9T2VR)?Z>EV^;X.=!& S/JOK5 G+]<#I,VAC*17E?MT,4S;??Y7FY
M6+0C-9[ ]8,>?+:&X< =Z%?;Z3;A RPVY7FU^&?^4#\WT2;#P4/Y6+PNZEGU
M-BG]'$P[X'VUV&R #NY?-W6U[$R&@V7Q9 =]OMI^?]O])TV\&6T@O8'<&PC!
M&BAOH/8&RK$&VAOH@P'OP7@#0.W-S"2-4B]07KPH%B#
MS!MD>P/-&[1KOENY9&\B^<2* 6(?5MM^X*5;;G%8; .!EV[!Q=$K+KHE%X\@O@^I+IX Z*"J/4Q@UWWT(B)KT-/:0W^SRG0K[MO?,J5A]
M8T;#P%E!$J!(EJRX8P YE;5".')9+I%+,T=6S!DW'(;.:IP D9.D\HP]Y'TI
MD25D-B][G#(I64END1,R(=WF#(8S9.5'@/[0^CP6&B)/7!++)JLN N3%1K8F
MJ$*261LI@((5!F$]C46H30T 8D3=' B.:Y! 83N4,!;(5"DOOD%CF1]KO)
M;OT!LSI+(X]"R!GG9&SM6 D4H(&6[E-$*%WQ1@4PD6@1*RNLQ@DO.4LNR[F'
MTNZ\H3(R\J (4RG=>B>7H9:E"GZD#L]BLKC%$;-JIK$\P[= \JPX*>)I0^5EXBE
M:?^2RT 9ZL*G1OME)'+DFJZ%;E^Y\3!V5F@D"$VD"91X
MG&KR1. >2P1-DO4O"7T7@%S3<<7V%4%D8
M%'\1"5)'-R=7"DY+3$@J&CF&Q.J8PE,5W<0HT+'LW&I2IE8AD*)BE%YG,*H61U3>!5(UH"Q@O.-
M%.0S,HE3& ^K30JTR=%E6X4GDD:;R#(R53T%BQ2;*(51LV*C0&P<628G*A0;
MD<;NUEFET7C31W=Y&I3&)@E=MH #<@;#P%G9TL=<]NFPH OM9/\=H)=2Y&2J
MZ1HYX\;#V%F%T,?<]VFXH&MV+GTPO^QQ,I.TN''C8>RLEFC0$OIR\4+#:RVE
MZ N::\#() /[NY'(!?S!.,2Y\6^:0)0Z$P0FTFII5FPTB(VCNP@-KXND
M4/2;DXGGN,;T 5#D['/.)4Z/U2Z-VA4).]2;9M-&=8 5' V"$SG":3C="*UC
M1[@>F&AER!%O$92I['\(H4LHP^'+6U;M#)ZKZ%F:!((75B61:F)8A3*@4(Y6
M* -'F(Q. (T)STPQ*H^/A5&SVF1 F^C+ODL3?CRBT4$1>V%G6"TQZF-?8Q.6
M=FLR0^OE!#BZHYSB6%I*^@7##7"Q?-\BE3H9>0\!G#$ZH0 9L]X,C,YB*\BJ
MF $5BUS\&KPB;'J>?MD8!9]>BF>RIMB 31?;08 J[JNEML/@CU655TVHR6?
M&V5Y+HN' 2^+\K%N?W3-S^O=)SQWO]352 >!U?VG9L ^!U!+ P04 " "C
MI6I(I^HP.JH! "T P & 'AL+W=O#]H 1Z"YW:'LV !!#0N*# '>$>A A"
MOO#'2?.K9""NUV?UQ]BM=W]@%NZU^,U;-WBS&48M=&P2[DW/3W!JX3H(-EK8
M.*)FLD[+,P4CR3[3S%6A"H,EX*A1M/C#'ZLKH&9ETM",+
M-YAOJ3^(!GEO%H>MV'U U-6QSDM:D6,0^H;9)PQ-F 5!O/I2@OZ Q)ZNZ>7F
MLL#F!X^;*% D@&&FY\JB@W;^E4I<'H\ Y'EH]9 5!+ P04 " "CI6I($C(*LO0& "Q)
M& 'AL+W=OVK,W41)C;2NUER;" 'F"'V$MO*(E(#M\;4EQ^](=O
MQ]>N&V8 =MO]\6'^.@QO]XO%\?&UVZV/G JW;I ^\]P?=NLA 3R\+(YOAV[]
M="JTVRZ@JMQBM][LYZOEZ=F7PVK9OP ;S;[[[]>& NMOV'P]S,[\\
M^&OS\CJ,#Q:KY>):[FFSZ ;'3;^?';KGA EG<] :,$).B+\WW<'N;5R*';=H #6,4Z?7SOFFZ['6M*+?][KO1GFV/! /NE]M].W4WT
MOZZ/7=-O]D\#:^);36?/77/Z ?M\%? \7MW[H,=*WSLM\?3W]GC^W'H=YK]<3[^ZS2^(V*U +XRP2X7W\>*&*:>
M,#!AKHA%JOW:!.A-U) 5!ZF!)D>@"&ESB*E 9H&%CN*I CQWU,D54*$".E5
M4P5@.,O]U-4)$TZ8.Z 0*R?A&H8SUE.L)%S+<,Y2M#)O6^!M6<>]7($K5.#R
MCH<@=GS"N&D&K9%[G8,(;253\04JGE&)(A6?M>(->A2YY*@TK"3.9YNCL#)1
MB;M0H!QRRO(TUR%KQL0H#G&3@RR)(]RRBKS"-A;81L96#O*8-V*B%:>A8:@*
M*A()YRA'J$3GJ-^Z@E6,,XB]J:ZJ*BB*2JO8;S%
MANHSZ#Q ,7J9=HX"#/)8,Y2Q5B-=T/+/!AAIL:'Z#+HT%$!>@@P6P8AAWS(4
M.*LHH"EIOT'&VLJLD?%"*K/H$NG4G HD<9Q5'EQ,%N.2 JJ$" YCLF-!V7?,;FGW)%'$D.RX3CT
MF8UQ0B7W,X9=T%>BPU')=62 9 #P'@M $H.9'(+LK(#&>8N593]
MI6$P8RJGA#Z#H:HT)2L"+@5R7D5&!:RE04G!PD'^@BRL ,W
M+?3:@)?\""#3Q[2E5:HHF0/DY@"5G/, $W,;*019(#F0#(3@2T'(D"E1ES)
M((8>WF=G$&7J<,*%/(<9U%V@9;CT(,V[B5? LN8R D/<+])+BHN@X;CT.4Y
M$*=4>Y(U(PX'D,,KZU'(@0NJDQKYD3^#96E 2)2A9!00V
M (J Y>I.[O;0X-)[Y@'6BV/4,A1$!$V^2E8!D;&6,QS(Y=T2H<:;>PIXV3%;
MCJ, 03N4*!D&5HRZG%(@VVV@]<'+1L>!)NFAE;<"'.B,1KUD&F@8==DTD)L&
M>65SBS>>@7*X<)BEJ.346/(,S/PLR)P"C
MJ2F6? "9#QC1!QHD%K.(ZOB5A!N9-25O.3%/[Y/2>-ER&H8S+FK'A32=F+S+V51-N1BC)5DA&0J\['(M0R79B@KIDK 3$W;Y6*8FEKVG
M\?'**J&2%!.78ME#*)?B.PJRIS4<9DQ08I]*@DU,L.5=>4U,L(.WLK0Q6%);
M>0/'*R-G--K%=Q-, ;67$[GZ^T#DY R(X2P0ROUK&0[33B=J2Z3D)L3NY5D5)U"T3=?E(IK;\#4&0MSX-AU'E
MY4F @9%3)MV6',+F#B$+46USY0]&.0)F*.?EB&[/J'!.H?*7C)QTR44L=Q'9
MUFPN &GE6/DTC<&L<\H)L"W9@V7V@+*K6;8Y"%XV L;F[Z2]BTY13UM\)\U$
M'Y5IS67:.V579$LJ;9E*H[+-M26]M/Z7UEY)N"Q+J%'VBC-H&M?3U8&;EA;9
MQ8Y==W@YW9 YSA[[] TPW8RX/KW>POD,X\60F^>UN6^GNS0 JUDMW]8OW9 K
MP\MF?YQ][8>AWYTNCCSW = E?M6G-!NOW?KI^F/;/0 C5Y^^'Z8;-=./H7^[
M7!"ZWE): 0]02P,$% @ HZ5J2,Z.44.C 0 LO, !@ !X;"]W;W)K
M]8E"B19OTRQ-FL=IY^Y^IETF\)G
M%*W+!F?"B6;WX4796%Q)'8ZVE[$&UQM>3B(B@1OCL:MU'U$E,6QY.N\8,7!?(K GD2R*^V^!5S
M^T\1=G:F&FR;GHXC%0[&3X>W9)?7^<#3G7S"RZ(7+?P6MI7&D0/Z<+/I;AI$
M#\%$=K.AI O 9PD4-#XN[\+:3D]J"CSVIP^R -+R U!+ P04 " "CI6I(
MWQ!MSJ,! "Q P &0 'AL+W=O#XBO,?C1[&@6+8""VD<%$:8C/()242@4
M?ELT/TI&XOGZI/XM=1O<'X2#1U2 9>/[8#:CI(%6C,J X/0=EA9NHV"-RJ61
MU*/SJ$\42K1XGV=ITCS-.T6^T"X3^$+@*^$^2\;G0LGFD "B*BU.Q,Y'.XAX
M@YLM#P=1D^#-T;B5NH^(JCQ6/+\KV3$*?<+L9PQ/F,V*8$%]+<' 7V+/S^C\
M,CV XC!/]'QQ>']9H+@B4"2!XFJ+GS%? RG"SLY4@^W2TW&DQM'X^?#6[/HZ
M'WBZDP]X50ZB@Y "=M(X^^'+6.N
M[D$+=X4#F+#3HM7"A]!VS T61)-(6C&>93=,"VEH5:;]C@E4E6WF-U&"<1$,LM#MZN]GNBXA(@-\2)G>V)M'[
M ?$U!H -CF;1 BBH?50083K"'2@5A4+AMT7SHV0DGJ]/ZO>IV^#^(!S)]GJ5)\S3OY/E"^YK
M%P)?"3^S9'PNE&S^$EY4I<6)V/EH!Q%O<+/EX2!J$KPY&K=2]Q%1E<>*%UG)
MCE'H$V8 8WC";%8$"^IK"?Y]B3T H .OZ?D%AWFBYXO#;^H7%P2*)%!<;/$S
MYG^7[.Q,-=@N/1U':AR-GP]OS:ZO\Y:G. F 5^4@.G@2MI/&D0/Z<+/I;EI$
M#\%$=G5-21 ^SQHH:'U< @AK.S^I.? XG#[(^DNK?U!+ P04 " "CI6I(
MD<<*[:(! "Q P &0 'AL+W=O[JAY\2S['H?$ZPJVCX@O,?C9[&D6+8""VD<%$:83/(!242@4
M?ETTWTM&XN7ZK/Z8N@WNC\+! ZH LO%],)M1TD K1N6?@\ZC.%$BW>YEF:-$ S3EXLM.L$OA#X2OB6)>-SH63SN "B*BU.Q,Y'.XAX
M@YL=#P=1D^#-T;B5NH^(JCQ5O,A+=HI"'S"'&<,39K,B6%!?2 # ESCP"SJ
M3L]O.,P3/5\<%M<%BAL"11(H;K;X$;/]5(1=G*D&VZ6GXTB-H 'SX:W9]77>
M\W0G["J'$0'OX3MI''DB#[<;+J;%M%#,)'=;2GIP]9 P6MC\NO86WG)S4'
M'H?S!UE :?4/4$L#!!0 (*.E:DA#5CT HP$ *\# 9 >&PO=V]R
M:W-H965TU#I2@/
M[3-KCVT48!S Z 3O"WC7<:KMO@ SG'/F#)=R0OOF>@!//K0R;D=[[X)5=[V."525;>(W48)Q$0RRT. JXV>Z+B$B 7Q(FMUJ3Z/V
M^!:#'\V.9M$"**A]5!!A.L(3*!6%0N'WD^9GR4A,B2\;E0LODLO*A*BQ.Q\]$.(M[@9LO#0=0D>',T;J7N(Z(JCU7^4+)C
MU/D"V<\0GB";!<&"^%*! ["GJ H #(]OV(P3 1\IA=WEP6**P)%$BBN=;B&
M\.+^GQIL=:(:;)<>CB,UCL;/1[=DE[?YF*Z0?<*KA[6=']0<>!S.WV/YH]5?4$L#!!0 (*.E
M:DABBU;=I $ +$# 9 >&PO=V]R:W-H965TVKZP \>=/*N!WMO.^WC+FJ RW<#?9@PDZ#5@L?0MLRUUL0=2)I
MQ7B6W3(MI*%ED7)/MBQP\$H:>++$#5H+^V\/"L<=7=%3XEFVG8\)5A9LX=52
M@W$2#;'0[.C]:KO/(R(!7B2,[FQ-HO<#XFL,?M4[FD4+H*#R44&$Z0@/H%04
M"H7 SIH?)2/Q?'U2 YFZ#>X/PL$#JC^R]ETPFU%20R,&Y9]Q?(2YA4T4K%"Y
M-))J%$6%D=BIZ/M
M1;S!U9:'@ZA(\.9HW$K=1T19'$N>WQ7L&(4^8?83AB?,:D&PH+Z4X/\OL>=G
M='Z9OK[B<)WHZ]GA]\L"^16!/ GD5UO\A-ED7XJPLS/58-OT=!RI<#!^.KPE
MN[S.>Y[NY ->%KUHX;>PK32.'-"'FTUWTR!Z"":RFPTE7?@ 2Z"@\7'Y+:SM
M]*2FP&- ^B#++RW? 5!+ P04 " "CI6I(3/QCFZ ! "Q P &0 'AL
M+W=O93^8%M+0LDBY)UL6.'@E#3Q9
MX@:MA7W?@\)Q1U?TE'B6;>=C@I4%6WBUU&"<1$,L-#MZO]KN\XA(@+\21G>Q
M)M'[?$E!K K')MFJ5)\SCMY-E,

M^YK 9P)?"'>)P*9"R>9/X4596!R)G8ZV% $&5UL>#J(BP9NC<2MU'Q%E<2SY
M9E6P8Q3ZA-E/&)XP9P0+ZDL) GV)/;^@\Z IZRL.UXF^GAU^(Y!?$CJ.5#@8/QW>DEU>YSU/=W*&ET4O6O@C;"N-(P?TX6;3
MW32('H*)[&9#21?^SQ(H:'QG0>]9E"B1;O\RQ-FJ=YI]@NM.L$OA#X2OB:)>-SH63S27A1E18G8N>C
M'42\P&PO
M=V]R:W-H965TSCGW7#Z*$>VKZP \>=?*N#WMO.]W
MC+FJ RW<'?9@PDZ#5@L?OMLRUUL0=2)IQ7B6?6%:2$/+(N6>;5G@X)4T\&R)
M&[O6]L\!%(Y[NJ+GQ(ML.Q\3K"S8PJNE!N,D&F*AV=.'U>Z01T0")(PNHLU
MB=Z/B*\Q^%'O:18M@(++1P41IA,\@E)1*!1^FS4 2D;BY?JL BUU&]P?A8-'
M5+]E[;M@-J.DAD8,RK @^!WF%C91L$+ETDBJP7G49PHE6KQ/LS1I'J>=;3[3
MKA/X3. +X3Y+QJ="R>:3*(L+([$3D?;BWB#JQT/!U&1X,W1N)6ZCXBR.)5\
MLRW8*0I]PAPF#$^8U8)@07TIP?]?XL OZ/PZ?7W#X3K1U[/#^^L"^0V!/ GD
M-UO\C/GZ3Q%V<:8:;)N>CB,5#L9/A[=DE]?YP-.=?,#+HA&PO=V]R:W-H965TDM\BQU+1:[3Y4JOK0/A-[;*,"XP4
M@!G..7.&2SZ@?7,M@"?O6AFWH:WWW9HQ5[:@A;O #DS8J=%JX4-H&^8Z"Z)*
M)*T8S[(KIH4TM,A3[LD6.?9>20-/EKA>:V$ MJ!FV- %/22>9=/ZF&!%SF9>
M)348)]$0" 6&WBW6VU5$),"+A,$=K4GTOD-\B\& :D.S: $4E#XJB##MX1Z4
MBD*A\/])\ZMD)!ZO#^I 4K?! 4XXN$?U*BO?!K,9)174HE?^&8> ,+5P&05+
M5"Z-I.R=1WV@4*+%^SA+D^9AW%G>3K2?"7PB\)EPDR7C8Z%D\T%X4>06!V+'
MH^U$O,'%FH>#*$GPYFC<2MU'1)'O"WZ5Y6P?A4XPVQ'#$V8Q(UA0GTOPWTML
M^1&= TQ?GG&X3/3EY/"7^JLS JLDL#K;XBGFNTMV=*8:;).>CB,E]L:/AS=G
MY]=YQ].=?,&+O!,-/ K;2./(#GVXV7OW-:*'8"*[N*2D#?]G#A34/BZOP]J.
M3VH,/':'#S+ TN(34$L#!!O (*.E:D@"SU]"H@$ +$# 9 >&PO
M=V]R:W-H965TVRC N,%''? OH =-ZW2O SG'/F#)=B1/OJ.@!/WK0R;D<[[LM
M8Z[J0 MW@SV8L-.@U<*'T+;,]19$G4A:,9YEMTP+:6A9I-RS+0L)%MYV."E05;>+748)Q$0RPT. JPVN[SB$B /Q)&=[8F
MT?L!\34&O^H=S:(%4%#YJ"#"=(1'4"H*A<+ 9LV/DI%XOCZI TC=!O<'X> 1
MU5]9^RZ8S2BIH1&#\B\X H2YA4T4K%"Y-))J',T;J7N(Z(LCB6
M71?L&(4^8?83AB?,:D&PH+Z4X-^7V/,S.K],7U]QN$[T]>PPORR07Q'(DT!^
MM<7/F,V7(NSL3#78-CT=1RHQF0TD7 L\2*&A\7-Z%M9V>U!1X[$\?9/FEY3M02P,$% @
MHZ5J2!,99CBB 0 L0, !D !X;"]W;W)K&UL
M?5/;;N,@$/T5Q <4AZ1I%#F6FE95^U"IZL/N,[''-BHP+N"X^ <+V''35380
MP SG#G#)1 0?K@6P),OK8S;T=;[;LN8*UO0PMU@!R;LU&BU\"&T#7.=!5$E
MDE:,9]F:2$-+?*4>[-%CKU7TL";):[76M@ >U X[.B"GA+OLFE]3+ B9S.O
MDAJ,DVB(A7I'[Q?; 2HB$N"7A,&=K4GT?D#\B,%+M:-9M *2A\51)B.\ !*
M1:%0^'/2 "X9B>?KD I3ZC:X/P@'#ZA^R\JWP6Q&206UZ)5 Q^$9IA9NHV")
MRJ61E+WSJ$\42K3X&F=ITCR,.^O-1+M,X!.!SX1-EHR/A9+-1^%%D5L,(L9P8+Z7(+ O\2>
MG]'Y9?KRBL-EHB\GAW>7!597!%9)8'6UQ9^8S3]%V-F9:K!->CJ.E-@;/Q[>
MG)U?YSU/= (-+).-/ J;".-(P?TX6;3W=2('H*)[.:6DC;\GSE04/NXO MK
M.SZI,?#8G3[($N+OU!+ P4 " "CI6I(9GFQTJ,! "Q P &O 'AL
M+W=O#UYDU MXP*J2S;Q&:C!.HB$6VAU]7&SWJXA(@%\2)G>Q
M)M'[?$U;GXT.UI$%"Z"@]E%!A.D(3Z!4% J! YPTWT-&XN7ZK/XM91O<'X2#
M)U2 9>/[8+:@I(%6C,J X/0=3BG<1\$:E4LCJ4?G49\IE&CQEF=ITCSEF 7#
MB7:=P$\$/A,>BFO\!THVOPHOJM+B1&PN[2!B!Q=;'@I1D^#-T7B5LH^(JCQ6
M?/VE9,,(L9P8+Z'(+ /\2>7]#Y=?KRAL-EHB\S?5-<$UC=$%@E
M@=7-%#]@-I^39!-(P?T
MH;.I-RVBAV"BN+NGI 9]XH:'U<;L+:YB>5-QZ'\P>9?VGU#U!+ P04
M" "CI6I(RM/% J(! "Q P &AL+W=O97=,"VEH6:3=C@I4%
M6WBUU&"<1$,L-#MZO]KN\XA(@%\21G>V)M'[?$]!B UCF;1 BBH?%0083K"
M R@5A4+ACUGSJV0DGJ]/ZD^IV^*^(!P\H/HM:]\%LQDE-31B4/X-QV>86[B-
M@A4JET92@)SFJ5)\SCMY)N9=IG 9P)?"#"R9'PJE&P^*"B *PN)(
M['2TO8@WN-KR1+(K[;X'9/ 4X2=G:D&VZ:GXTB%@@ '3
MX2W9Y77>\W0G7 "RZ$4+/X5MI7'D@#*#[<;L+;!M%#;!"'=W$ H:'Y>;
ML+;3DYH"C WI@RR M/P+4$L#!!O (*.E:DCH[$]; I $ +$# 9
M>&PO=V]R:W-H965T7600-L>-3'0'.C3:G]N\V8R2&AHQ2O>*TS>XM+)@A5*&T=2C=:ANE(H4>()S;V.\Y1V
M\NV%=IO +P0$QZS:#P5BC: ""?*PN!$3#K:O80;7.VY/XB*&AJW8?4"4
MQ;EA3YACPO"$F1'J\\E^/]+'/F"SF 3\SL.\TC/$WVWN2VPOB.P
MC@+KNRTN,7RW :<(6YRI M/&IV-)A:-VZ?#F#[/PZGWB\DP]RBBA1 "M+VV
M MY(3.WVR\FP,1@3>1/6PHZ?S FO,)COO+G5^;]*12X'X#I@YEY9 5!+ P04
M M " "CI6I(""B%Z(! "Q P &O 'AL+W=O=OYK3<^)%MIV/
M"586;.'54H-VQT.SIO[X[K"B,B,B7TY+&-W%D?3O1\37&-RL)\37&/RL]S2+%D!!IY:.
M"-,-)'D&I*!0%V\'4>JKZ1KHR&TR*%UQ)/W!T+!V"%Y#/:Y(%H5CR>PQ
M)R3$AD:R-QU
MF9%(D$\QW-H3M#]E9HU @&AHQ/W.U%N^E"-/ H3&O.IS5CEM!!?(G4(P4>DVDA+#S;DVA:.*GI"".B11Y$S.(0&*AO5*5'M>#=2('
M !H5]O(+KNEH:@EF&NK3+1!FFREAS57J9DVG+3BLR3X-9BDS'KS[:/@#3B.>
MSHJ@:R3BM3[!7YVEVWAT7EFTHEEJ@NBCV@A*5!4K^)5)GX-"9%1&^:)\>_^LOUFJ (K-
M3SA4BZ4,(GMM$WMHR9@LT"]ZE[@UDS\Q;+@G5PGG+6)]L(GEK^D&5MLDHH-UHA^NG>CYDMY<4,BQ>XS@\CJ\8?
M) ,7V&1NEQNL&X@$Q!+ P04 " "CI6I(HP9
M$ZI&X3O*BDOTZ+IOT9!?X2;*9[]%:W
GUE
M>^EYFR]4Q7B "JCFU)RF*@,&K;)@(T"!IZL\QM=.UB@#QXFIVNNK2;2GSFM7=*
MC1(JCPVL[VK6E3TO+C3#Q>B(J"?0IJ%:+M)48O*>;?DNEK@IT9M&N

M
M$\V$$\U\@+W=O=KGVI>=1ZK^V]:I+,)5L/CZ
M

M4$L#!!0   (*.E:DA) ,B*H@$ +$#   9   >&PO=V]R:W-H965TV+ZP \>=7*N!WMO.^WC+FJ RW<#?9@PDZ#
M5@L?0MLRUUL0=2)IQ7B6W3(MI*%ED7)/MBQP\$H:>++$#5H+^[8'A>..KN@I
M\2S;SL<$*PNV\&JIP3B)AEAH=O1NM=WG$9$?R2,[FQ-HO<#XDL,'NL=S:(%
M4%#YJ"#"=(1[4"H*A<+ 9LV/DI%XOCZI TK=!O<'X> >U5]9^RZ8S2BIH1&#
M\L\X/L#XVO)P$!4)WAR-6ZG[B"B+8\E Y 4[1J%/F/V$X0FS
M6A LJ"\E^/]+[/D9G5^FKZ\X7"?Z>G:XN2R07Q'(DT!^M<7/F-LO1=C9F6JP
M;7HZCE0X&#\=WI)=7N<=3W?R 2^+7K3P6]A6&D<.Z,/-IKMI$#T$$]G-AI(N
M)\E4-#XN/P6UG9Z4E/@L3]]D.67EN]02P,$%   @ HZ5J2&%H)T.C 0
ML0, !D   !X;"]W;W)K&UL?5/;;N,@$/T5Q <4
MAZ3;-'(L-5U5VX=*51]VGXD]ME&!<0''W;]?P(Z;5-F\ #.<<^8,EWQ ^^Y:
M $\^M3)N2UOONPUCKFQ!"W>#'9BP4Z/5PH?0-LQU%D252%HQGF4 F!;2T")/
MN5=;Y-A[)0V\6N)ZK87]NP.%PY8NZ#'Q)IO6QP0KYGFB7"7PB\)FPSI+QL5"R^5-X4>06!V+'H^U$O,'%AH>#*$GP
MYFC<2MU'1)$?"GY E[-#%#K#[$8,3YC%C&!!?2[! U]BQT H #)]><7A,M&7
MD\/U98'5%8%5$EA=;?$<< ^M"#LY4PVV24 'D1)[X\?#F[/SZWS@Z4Z^X$7>
MB09>A&VD<62//MQLNIL:T4,PD=W<4M*& S,'"FH?EW=A;<N^,'F7]I
M\0]02P,$%   @ HZ5J2 YKOW6@ 0 LO, !D   !X;"]W;W)K&UL?5-=4^L@$/TK##] 4EJOVDDS8[US1Q^<<7S09YIL$D9@
MKB(B 5XD#.YH3:+W'>);#!ZJ#+P^J/]+W0;W.^'@#M6KK'P;S&:45%"+
M7OEG'.YA:N$R"I:H7!I)V3N/^D"A1(OW<98FS<.XPV\FVL\$/A'X3+C.DO&Q
M4++Y5WA1Y!8'8L>C[42\P<6:AX,H2?#F:-Q*W4=$D>^+99;E;!^%3C#;$<,3
M9C$C6%"?2 #?2VSY$9W 3%^><;A,].7D\)?ZJS,"JR2P.MOB*>:[2W9TIAIL
MDYZ.(R7VQH^'-V?GUWG+TYU\P8N\$PT\"MM(X\@.?;C9=#&UL?5?;;IM $/T5Q <$
M=A9\B3!2G*IJ'RI%>6B?B;VV48!U81VG?U]VL0F#=N;%W,[,6? Y!R:[ZO:]
M.REE@L^Z:KI->#+F !A%W>ZDZJ)[T&?5]%<.NJT+TQ^VQZ@[MZK8NZ*ZBB".
M%U%=E$V89^[<2YMG^F*JLE$O;=!=ZKIH VU5I:^;4(3W$Z E\63LB2C/HK%N
M7]:JZ4K=!*TZ;,(G\;B5TD(IKMUD/["+?]/ZW1[\W& "V*Y!56IG;(NB
MWWRH9U55ME// /?6](O3%D[W[]V N]OME]6=.I95W *O3GUJXW#8*\.Q:4R
MK KZ0]WN(;4-=[KJW&^PNW1&U >2,*B+SV%;-FY[':XL[F7^ K@5P%BPBMW"
M!R*WS&^%*?*LU=>@'9[MN;! H7B$ D'L@GYM76@ON;NWB#S[R&4LL^C#-D*8
M[8 !AQ$C(NJ[CQ1 4VQA4@[^&UL?53;
M;IPP$/T5BP\(=Y:N6*1LJJA]J!3EH7WVPG!1;$QLLZ1 7]NP9%TYO.#;N#SG&F$ OWN8Q=T3K8K^@@4\,?*GKV6G@@T\5$.#)R)?V?P#UA12+5@Q
M(LP759.0C-XH'J+X8QG[P8SSL7S \1NHB*J1B$YX^,MEK1%E<%$!A-N"%^I;Q;1UQ;G
MZ(X>N>GQ3H2QH<<+/<[= LF.0&($DC7%;\X4+4P6N$W2'9/4$@B=)C;FBZO(
M=DPR2R!VFMB8Q&URV#$Y6 *IT\3&9&Z3?,FG(6
MJ&+3()MO=.L9C9.KD$UX6(V[A%^9M/PAT85)5FZF7AC$)*HC@03U:IWK:
MMB#02#T]J#E?RGQ92#;>FM;6.@[9T0$ "$%
M   9   >&PO=V]R:W-H965T8Q'&".>U$5.1^[ED5
MN1P,ZP0*Z0'SJGZ>P(FQV.TB6X3+UW3&C>!BQS/O*KC('0G!5)0'Z/'S>&4
M.80' .I@U'=]Y+*?I7QU@Q 5,8I=!&!0&J= ;7.!)V#,"5GC/U?-=TM'O. ?
MU+ YW=KT9ZKA2;+?765:&S:.4 4U'9AYD>-WN&YA[P1+R;3 HG+01O(;)4*<
MODUM)WP[3BM)=J4M$\B50&9"%OO@DY&/^94:6N1*CDA-1]M3=X.; [$'42*;
M34=NR> >(8K\4FR3+SF^.*$ OIN
M2IC&BPE#S"<9=RLFNT" +)J$F.VRR7[%9!\([)8%DA6!)!#8+Z8,,1KH9;2@ T1/]@+:>U[-0\8U,9U4]M74PE/ R/[VX,TOXK%
M/U!+ P04   " "CI6I(L@^9'KO!   6!   &0   'AL+W=O62*B=MWFP/X-"[%,KN<. %5][U+BR0JB0SK^$2E.5:(0/M#C^NMOMU0$3 ;PZ3O8A1\'[0^BU,?C8[
MG 4+(*!V08'YX0A/($00\HG GC0 4@;B97Q6?X[5>O<'9N%)BS^\<;TWFV'4
M0,M&X5[U] -.)42'M18V?E$]6J?EF8*19.]IY"J.4]K9%"?:,H&>"'0F/&31
M>$H4;7YGCE6ET1,RZ6@'%CJXVE) $#7RWBP.6['Z@*C*8Y5OOI7D&(2N,/N$
MH1&SFA'$J\\IZ-:3GB5X4RP+%#8$B"A2IQ(=LL<1KS!=%
MKF\D65\)T,4DUYC\4Q)RT3@)IHOWTZ):C\JE#LVK\Q-XI+'Q' "J'%@'OYCI
MN++HH)V /O$"M%H[\":R.^^B]X]TG@AH70@W/C;IWJ:)T\/Y%&PO=V]R:W-H965TS)U!5.3@H-3X;822EN AY XKRG&WH^>!;]
MX,(!JRNV\EJA0%N!FACH]O1^LSN4 1$!OP7,]F)-@OO,H@Y . +IKO(0/QO=';N$!Y1 1NL&;S2AIH>.3=,\X
M X EA6TO;%#:.))FL@[5F4*)XF]I%CK.<[HI\H5VG9 OA'PEW&71> H4;7[G
MCM>5P9F85-J1APYN=KDO1$.\-TO#5@#YI P><1L5@3S
MZFN(/\A#OD%/;].+[YP6$1ZD>CE[76!\@N!,@J42XK;JRE^Q'P.PBYJJL#T
M\>E8TN"D72K>>KJ^SO081/8.KZN1] "+FUYH2X[H?&=C;SI$!]Y$=K.E9/#
M9]U(Z%Q8?O-KDYY4VC@;$]XW/.G/&EFK5YL0.
M0V]2*'O @W/CGA#;#""9O=$C*+ 3:2.9\Z'IB1T-L#:2I" TR[X0R;C"=15S
M3Z:N].0$5 !DD)VD9.;/$82>#WB'+XEGW@\N)$A=D977<@G*Z [W?[
M8Q0?"+PVPW:Q2\G[1^"<&/]H"S8 $$-"XH,#^=X0&$"$*^\.NB^5XR$+?K
MB JWV*UW?V(6'K3XS5LW>+,91BUT;!+N6< ?86GA-@@V6M@XHF:R3LL+!2/)
MWM+,59SGM%/D"^TZ@2X$NA+*+!I/A:+-1^9871D](Y..=F3A!G=[Z@^B0=Z;
MQ6$K=A\0=76N\ *N(N<@] %S3!@:,;L50;SZ6H+^O\21;NCT.CW Q&$>Z7FB
M%U^O"Q2?"!11H%@$RJLM;C%Y6?Y3A&S.5(+IX].QJ-&3%V-K(>?S/1<6732SM]LO)M.:P?>1'9SB]'@ \\:".A<6-[YM4E/*@5.CY&UL?5-=;]L@%/TKB!]0'.)L;>18:CI-V\.DJ@
M;53@>H#C[M^/C\1-J[OOP+V<<^X75#/:9S< >/*BE7$[.G@ ;AESS0!:N!L<
MP82;#JT6/IBV9VZT(-I$THKQHOC"M)"&UE7R/=JZPLDK:>#1$C=I+>R /2B<
M=W1%SXXGV0\^.EA=L8772@W&233$0K>C]ZOMOHR(!/@M87879Q)S/R ^1^-G
MNZ-%3 $4-#XJB+ =X0&4BD(A\-^3YFO(2+P\G]6 IVI#]@?AX '5']GZ(21;
M4-)")R;EGW#^ :<2-E&P0>722IK)>=1G"B5:O.1=FK3/^:8L3K3K!'XB\(5P
MFP@L!TII?A->U)7%F=C1!B?C< ,6[(Z[WF:R2N\KD;1PR]A>VD<.: /DTVSZ1]
MA"2*FPTE0 @ BZ&@\ 'X-9QM?E+9\#B>/\CR2^O 4$L#!!0   (*.E:DCM
MS7+4O@$ 'L$ 9   >&PO=V]R:W-H965TK#S+,#ET6U,;5-Z/S]> DT5#0O>#O;A6NR
M4:IWW0 8]"EXI >X,:;?$:*+!@33-[*'SIY44@EF[%+51/<*6.E)@A,:12D1
MK.UPGOF]5Y5G!5(3T(P=2 W Y[O$&3QMO;=T8MT'RC,R\LA70Z59V
M2$&UQ >;W2%U" XT*H+^;(93]*^>X6+^4>1RX"<"B,4V!V.,$#<.Z$K/''
M6?/+TA$OYY/ZDZ 6IC\R#0^2 VU+T]BP$48E5&S@YDV.SW N(7&"A>3:/U$Q
M:"/%1,%(L,\PMIT?QW"23+1U CT3Z$RXBWSP8.1C/C+#\DS)$:GP:GOFON!F
M1^V+*)#-IK$[\M4[1)Z=\O@7SVKD*ER,LC.RGJS[; + 4$L#!!0   (
M *.E:DCRLEL"I@$ +$#   9   >&PO=V]R:W-H965TS)UA5.7DD#3Y:X26MA ^Y!X;RC*WH^>);]X.,!JRNV
M\%JIP3B)AECH=O1AM=V7$9$ OR3,[F)-HO<#XDO< &AWM(@60$'CHX((TQ$>
M0:DH% + .6F^A8S$R 59 5O*-K@ " >/J'[+U@ !;$%)"YV8E' &^3N<4MA$
MP0:52R-I)N=1GRF4:/&:9VG2/.>;V)$NT[@)P)?"'=%,IX#)9M?A1=U97$F
M-I=V%+&#JRT/A6A(\.9HO$K91T1='>OU 7W%CE'H'6:?,3QA5@N"!?4E!/]
MB#V H//K]/4G#M>)OL[TS=UU@?(3@3()E$F@+(JK*;['?$R27=14@^W3TW&D
MP5Z/HX:>PO32.'-"'SJ;>=(@>@HGB9D/)$/[/LE'0
M^;B\#6N;GU3>>!S/'V3YI?4 4$L#!!0   (*.E:DAN[:/6I $ +$#   9
M   >&PO=V]R:W-H965T#3$3EH+\^\ "N<]S>GYX$EVO0L'K"K9RFNDAL%*'(B!=D O\MVA"(@(
M^"-AMA=K$KP?$9 #YE>SIUFP IJ%Q2$GTYP#TH%(1 X9=%\"QF(E^NS^H^8
MK7= %!;N4?V5C>N]V8R2!EHQ*?>$\T]84M@&P1J5C2.I)^M0GRF4:/&:9CG$
M>4XWVWRA72?PAA@ON.^$#7QWBP-5S'[
M@*C*4U5DO&2G(/0.?0W!/P]QX!=T?IV^^<+A)M(WB7[[2?SB
M"X$B"A1+BINK*;['%!^"L(N::C!=?#J6U#@-+A5O/5U?YQV//7F#5^4H.O@M
M3"<'2X[H?&=C;UI$!]Y$=K.EI/? 9]TH:%U8?O-KDYY4VC@H, [$!   6!   &0   'AL+W=O;LP]8]4)M$SIO
M/[8A-*EH+GC[MM\+^:#-NVT!'/J40MD=;IWKMH38L@7)[(WN0/F56AO)G!^:
MAMC. *LB20I"DV1#).,*%WF<>S5%KGLGN()7@VPO)3/]B#TL,,K?)IXXTWK
MP@0IMW\/@I=KA)$0   :4+
M"LPW1W@ (8*0- Z8-+\L &\?U) BM7Z] =FX4&+O[QRK0^;8%1!S7KAWO3P
M#%,),6&IA8U?5/;6:7FB8"39Y]AR%=MA7,DV$VV90"<"G0EW20P^&L68C\RQ
M(C=Z0&;E6'U %/FQ2),L)\<@=('9CQ@:,:L90;SZ
M;$% MMC3,SI=IJ^O)%Q'^GJD;])E@?2*0!H%TJG$S6*)EYC;99/LBDEV(7"W
M:'*)^?7-A)P=G 33Q/MI4:E[Y<83FF?G)W!/X\% P8N\8PW\9J;ARJ*#=O[Z
MQ MO:^W ATAN?(K6/])Y(*!VH7OK^V:\M^/ Z>[T"N=?0?$?4$L#!!0   (

```
M *.E:DCM<\IJH@$  +$#   9    >&PO=V]R:W-H965T,V68 Q>T5CJ#]38=&<>>WIF=V-,#;
M2%*2%5EVPQ07FM95/'LT=863DT+#HR%V4HJ;?WN0..]H3D\'3Z(?7#A@=<56
M7BL4:"M0$P/=CM[GVWT9$!'P+&"V9VL2O!\07\/F=[NC6;  $AH7%+B?CO
M4@8A' COHOD1,A#/UR?UGS%;[ [ +3R@?!&M&[S9C)(6.CY)]X3S+UA2N Z"
M#4H;1]),UJ$Z42A1 "W-0L=Y3C=WV4*[3"@60O&%P%*@:/,'=[RN#,[$I-*.
M/'0PWQ:^$ WQWBP-5S'[@*BK8UWF6<6.0>@39I\P1<3D*X)Y]35$\?\0^^*,
M7ERF;[YQN(GT3:+?W%X6*+\1**- N:287TSQ,^:K2W964P6FCT 'D@8G[5+Q
MUM/U==X7L20] N.F%MN2 SG&UL?5/;;MP@$/T5Q <$V^MMJI774C95
ME#Y4BO+0/K/VV$8!Q@6\3O^^7+S.)MKD!9CAG#,WJ&8T+W8 <.1526WW='!N
MW#%FFP$4MS1I"0KLNP;4UQH6E?1}V3J"BS^H/L5J? 9%;
MN$?Y1[1N\,EFE+30\4FZ9YP?82EA&P0;E#:NI)FL0W6F4*+X:]J%CON<;KYG
M"^TZH5@(Q0<"2X%BFC^XXW5E<"8FM7;D88+YKO"-:(C/S=)P%:L/B+HZU66^
MJ=@I"+W#'!*FB)A\13"OOH8H/@]Q*"[HQ77ZYHL,-Y&^2?3;[+I ^85 &07*
MI<3R:HGO,=L/0=A%3Q68/CX=2QJX'4U\AY^<=,+;/X@ZR^M P-02P,$%
M  @ HZ5J2#\*Y%JC 0  L0,  !D   !X;"]W;W)K&UL?5/;;MP@$/T5Q <$V^MDHY774C95U3Y4BO+0/K/VV$8!Q@6\3O^^7+S.
M)MKD!9CAG#,WJ&8T+W8 <.1526WW='!NW#%FFP$4MS1I"0KLNR.*2XTK:OH>S)UA9.30L.3(792BIM !Y X[VE.SXYGT0\N.%A=
ML977"@7:"M3$0+>G# GN4 9$!/P6,-N+,PFY'Q%?@O&SW=,LI  2&A<4N-].
M\ A2!B$?^.^B^18R$" /9 7OL5J? 9%;>$3Y1[1N\,EFE+30\4FZ9YQ P%+"
M;1!L4-JXDF:R#M690HGBKVD7.NYSNKG/%MIU0K$0B@\$E@+%-+]QQ^O*X$Q,
M:NW(PP3S7>$;T1"?FZ7A*E8?$'5UJLO\KF*G(/0./3L:3!
M2;O4O-6[OLZ'(L[D#5Y7(^ A%S>]T)85#(&UL?51=;]L@%/TKR#^@V"1IM\BQ
MU'2:MH=)51^V9V)?VZC ]0#'XF;5&Y>S 7..?=<+KB#;$KD$@?#Z1$W%=/ DV:5F3GA1?1]2XLT*JD,Z\1"K05J(F!=I<]%MO])B B
MX+> R5[$)'@ (+Z&R<]FE^7! DBH75#@?CC"$T@9A'SBOR?-]Y2!>!F?U; '
M:KW[ [?PA/*/:%SOS>89::#EHW0O./V 4PG188W2QB^I1^M0G2D94?PMC4+'
M<4H[] F)MDQ@)P*;"5\B@:9$T>8W[GA5&IR(24<[\-#!8LO\0=3$>[-9V(K5
M!T15'JMU\;6DQR!TA=DG#(N88D90KSZG8)^GV+,+.ENFKVXX7$7Z*M$?-LL"
MZQL"ZRBP3B6R?+'$:\PG16YN)-E<";#%)->8U8&2Q\> PJAQX![^XZ82VY(#.7Y]X 5I$!]Y$?N==]/Z1SA,)KOOA@X]-
MNK=IXG XO\+Y5U#]!U!+ P04    " "CI6I(9.OTLLT!  #@!   &0   'AL
M+W=O5)K(SO&[@12'=
M"<'4OQ-PV1]QB*\3KW59&3=!TH1,O+P:-DA!<<3WX>$4.X0'O-70'O-70ZYL^
MG/3,.#
MY' KW%0V;(!1#@7KN'F5 1.,)6R=8":Y]E^4==I(<:5@)-CGT-:-; MA):8C
M;9E 1P*="/O !Q^,?,S?S+ T4;)':MC:EKD &!ZHW8@,V6P:NR5?O4.DR26-
M:)20BQ.:84X#AGI,."&(59\LZ,\6)WI#I\OTS4K"C:=O!OH^6!:(5@0B+Q"-
M)6X72YQC=LLFVQ63[4P@7C298 ;+)KL5D]U,X->BR0RS^6&[XA63>"80+IK,
M,? 5')S! 6HTM\TC3+9-68X:]/L=)GO 9DGW  T:5D)?Y@JZT:CLS3V(OBC
M7$AIP(8([NQ^5O:YF08<"N.ZL>VKX08. R/;ZWLR/6KI%U!+ P04    " "C
MI6I(E,:WVZ4!  "Q P  &0   'AL+W=OL9COO=@!PY$U);?=T<&[<,6:; 12W-SB"]C<=&L6=WYJ>V=$ ;R-)
M299GV2U37&A:5 'LR=053DX*#4^&V$DI;OX>0.*\IQMZ/G@6 >#" :LKMO):
MH4!;@9H8Z/;T?K,[E $1 ;\%S/9B38+W(^)+V/QL]S0+%D!"XX("]],)'D#*
M(.0#ORZ:[R$#\7)]5G^,V7KW1V[A >4?T;K!F\TH::'CDW3/./^ )85M$&Q0
MVCB29K(.U9E"B>)O:18ZSG.ZV98+[3HA7PCY2KC+HO$4*-K\SAVO*X,,S:FT
M(P\=W.QR7XB&>&^4U:DNBZ?4BU(E+7/(*'"B&4:BPK,L#X3P!M(DASEL[N5UK<[  $9X(!DB\;?#L3DE#H2KWNJEJI%#S@(K!A"*\1[?#1VL44X4RQL6J%'V!WBG4%A!MUS"%3@M:V(4>4!@7Q4S\?%R,DBF\Q;K!%D<5$"QC8
M\VN3G8/>3(\F\!5R$%8=0MPYUEW!Z5W%ZV2,EYJ<#
M@ZBLJ!+F"VVPI"C\%/OUYDFW8S4%L0X9_-V?MFZO?OZ(H!I>T'%21&5U%*Y;=@KU%Z0$Y6UHR71@A1*<2%O]=6G@-A87W1)H@/5&+3OBUH5/GO1S!>3EB9G#EN%@ATS8$S#8+=;0BQ2:BE%%Y"%G%S[BP=-AW^#CDX5N[Y]=>ADRO@HM*AP#G;(@IPF_KFF^)D9R%E.CXB:(2Z7H0
M#C!W1B@#>(*:B(F5/HW(VX6JQZTW-%TOI8O_;
MS5=U'>;UWI)/6%>-4+U,[6G]W>X$%Q
MW,-,@#+#?I,(DFJ@C$#)('5@DO#(EY'+"\8FGA;@D?(2]@:(6R$@JT9K=MNT;!SO9X*;[3/2-6BNCS
M%<7#KK9_FQMA4%>7Q1EP!C4RU4:=*60@8#9I5X=<@)QO>NR8*DH<='XX7!L=[,$DK!:]Y6IZ4I=4*1G*2X3C>2KK+?7D<<0I!1K9\(5>%D4A60-4%FNT%=EJ@:4>YH/'[-8)U=4E8.B"16*W,1%TX1OD4;(-6EB&-YQ7+T&?V2=$\W
MF2-#WSJTC2L*4:S.T/(@>TV?#S:MGZ8W52D5#B46+>$WSE#7?\#!X4D5!9S$29:3=XJAM35CDJ9?X@3B/GDK6WX^5E<8@1B@?76S9T27OX8O%I8X/%)3,:Z!4Q9RTO6P18D34YIL9%0FHBWXS-%?%.C:AXX;6F=T<7=?3B+T0N6J%WV34O6DQLXDGCJ@%=Q
M%0XUY[VA,97>8CT+3F?%M+8P.;#C:P>8
MN3A+[.A;>"BUJ6HV(F!1G[Q[O6=F%8Z2,,Y^5K1P09!)HKR!;K
```

MCDTOHS>N]/%J#\@#YXII?^";+F(G?4^:.BT[*-,L=%L,-X>AH CY=A&:;F/U
M?U!+ P04   " "CI6I((D @]AD" !N!@ &0   'AL+W=O^ +UP2$:2&T:A=5!K-HET[B1/0&$QM
M)TS?OKZ0C!E9;/#M \ Y#D:':N+B7;:4JNBC9X/Q5UQ:^*=0-]%9&\]CT1 :4
M\6D7@ B^\=9=6F4VDKI*'KY3U]-!=GR(!#WOXN]@VY1&806 .SI);QX9]@/G
M[V;Q\[2+4X- &3TJ$X'HX48;RI@)I!/ G6-^IC1&?WZ/ F*KU?0'(FG#V9 N
MI%H-F\;1B9[)E:DW/OV@Z>!5A-4-+X"?4H2#?"@@"L4T/J1RX#*< "T$@#9 '@N
M RTA!U>&TY16@W.0;T*JQE=!C(LB#(-78/ "!@=AG":W&I""+ W"+%0 H"P,
MDZW 9 N8+ B3>6DP*O(@BR *-B@/H^0K*/D")9AEG L50PB"*+X((HS#*,4*
M2N&AE&&2PDOR#>OXC+)0%=Z7MT I5U!*#\6 89^E]#[*/(5%4-7X*HQ N?D"
MDWBM8207^HN(2S?(Z,"5[C*V3YPY5U3'2I T=;>Z^3\6C)Z5F19Z+EP = O%
MQWMW? QBZO]02P,$%   @ HZ5J2/ K,'*" @ %PL !D   !X;"]W;W)K
M&ULC5;!CMHP$/V5*!^PB0="DE6(!%M5[:'2:@ M
MV8"!:).8V@:V?U_;@2Q>Q2-?B.W,O'G/\3-37;EXET?&5/31M;UE3L])
M(K='UE'YQ$^LUV V'14Z:DX)/(D&-W9I*Y-($T724>;/JXKN 8JZHJ?5=OT
M[%5$\MOU5/Q;LY9?ES&)[PMOS>&HS$)25\F8MVLZULN&]Y%@^V6\[L]K*$R(
MC?C=L*M\&$>& (;S=S/YN5O&J>' 6K95!H+JQX6]L+8U2+KRWQOH9TV3^#B^
MHW^WTF$Z?88PG-GT
MV8UA,0TP1P#F%F!^ R@G)3HQ))TNDB%%,@? LTL+!& 1(C-' /('!O,2)F7F
M#DO/QRBO(H4#,)L&*!& ,D2F<9/ Q*8!OIV@C,P]=51G$ ",P") M2BYF +$+4+ARJOCJ85XAKA-(#@3F!
M%$%J,2^0,D1M&?)M 7,,.&8 S^T&F!F A*@%S P 6J=H Q\ S:88\ Q W@N
M.<#, /,@M9@9(M1Z QK@.B! :+BT/0RVG"EVR?; .TY5TRS
M2) TGA]UESI.6K979ICKL1CZMF&B^.G>AHZ]&PO=V]R:W-H965TJRAR?E.T;LBK /+&&!; CH3R;A X+'Q5E\K93;"(@]'
MNW/-2"-KW@!!+OO@)^/*#(OB A=DTY.YL $?^+\W2Q^GO=!9&(@E)3*4&]
MW,D+H=0P:<] !])/G\9P.G^P?[=R=?@G+,D+IW JLZITM%$ SN2";U2]\>X'
M&32DAK#D5-HO*&]2 =$?[#9&#.?889#%P1(2:
M?72!EET)YGC9#=/L/$0;-;(W'H(MBMD3C')+IYWLO,XV4V=Q-$\@:FFY8R-U@B%
MWJ2'*Z2ZH'@A\:$G\P\0.10+R0]]VO C56I]^0^3-6H=$%PH,^@K$^C40+R0
M'-!7!#!;I=97!G"S1JT#BA?*%?JJ!3KE$J<+%+Y:@+LU:I&O&%"T0JT+^O)O
MPTG'8$1<;6.4H.2W1O6M8=P=F^\!V8[S"2 R%E)+RRN=2/!B2O=MVSGN7"N
MB(XB>M+I4>GGP;B@Y*+,=*/GHF^8 4+Q]M' QT=(\1]02P,$%   @ HZ5J
M2-([#V]# @   @@ !D   !X;"]W;W)K&ULC571
MCJ,@%/T5XP>, J+86)IM,YF,YF'WF;:TFE@%Q@@Q=;9OU] V%&&&:5\4\4\5Y&(Q0^@UA[AH+J/EM+@=GT=+E[T)MSY,JD!MFWWKOHFGK5IL#AXU)C"D%]OPHSXEB5G^E
ML-*I^T<'A0^1!9DUFNM\92PO=V]R:W-H965TF
MK?)^>&W?XN[4FGP &55E3)-$Q9E>O/KN1[M9-^^3F1QMU[.[J6(\^CF@B$]ES
MF+(YWZ (ZO+%SU)Q[@Y1/?!AFF%YNZ*=%Y?F%%7?"F]&%7B'5&(EDNI\M'7%"D
MB@QO5!+*0V*HFOCDFK:@B!4*4"!ZBDOG.2EE3LO$KCGF2QB"(T%S;@%Z
MI:H9?G?@Y!O5D3TFS;!L6,E]BP+H6Z(S[3=@LSWTHM'^E@^!SAMTVA3.
MA?[&4BLR>
MI=,3#+#-8CG5S*_*-&K&G;5.SIXFI+--4!PSPLSNS?PDXXTRIZ^L@ :+14*TPO!%
MI?/3^L*&A2^3SQ4^C&%*'MT[;QI]*R[;&GRJG&<(-O?%*[ ]+B9%&PMP8]L9M3&X^NH86KOQ7+7&9-H='TBKRU%XIX%!2GWK'5GXT_QP0T1TV
MCFC9TTRYH&=XJ*U9DJVC#WW;3@IB!PW2ABGA6V/EOP.3?JK1KHRAW&5'TJK]N4PG=*X!.:2BOGBO%"@R
M%QQ=A^C/1/4)Q&\X&D?-A*(BYW#D&>;X%2$**'C+A@I&(!8\3-X>3R<P<)
M!@)+8?#=FYY1?#(%D6%5(/BPX>*HR@3J(#OX2'K@=OT9#(PO'_"&$(U'2)&R)Z5&S$F"P[C9%IE('\'K%J(
MH0X_D3HX\1N\>/Q8TOXS!^HX-XEH05ORDHY2UCEC.4+G/$9XM&O/\1,R"0GJ(;X
M^)J)8<X[Z*]/J[*($A5&JA*K)/B'7D@.#^YZ6T*,E&#]BQBPI]X^2+6W=LH4\<&?OH[!U=2ZX"LRD=O
M%2S-DI&=5\JI/Y[4[G;'@:ACDSQO1)7>G0C9+5*B9'X;*A7Z)/R16(OZ;*;#X%KCJT7+L*\,!%-9'V8;3
MR'VT=:6*DJR%19&?W7&6YTT2V*4(%RV,:&:(.#HT:A>+4)/'.B2
M,U<K2+G,"-2ZJD3N5VP6+$_B"[.M&2ZUX'9:CZ"7X6J[\PQ\JY30F5S>7[=MK1CP9N@@TQ&J-:>FMP5SNV]-7O;M?.H'@<U@M"/3:7K=$1&BJ'[D5&LO6JSAP1"=5[&&W@F.J,H2,?D4D/00+V1M'6Z9I
M&>S$X@[F+,T>CM=Z[;\3(U-;U[%*S^Y2U.J8HI+[)RWD(%F-0L[(>X,2+0:#F&X5QU9E.@0I.U%%X4G^
M7;$T.)@$>J%P\TK%2+9RF>GNZ!/4[?H;+#_.)LIGG.@2C]P@$PQ'6AK8@L*36DH5U0Z8F<O-/HY6)(JOZ2(9G@T;K7^
M%>Z*PA.C#52?[>1;/(!9DZ[W+C9^PH=1!GQ.#GEM>J55A^3BEQRS15L)<G+9!@=W1#/PUA7P1MAH>\DXS%2I>5Z]6/X%2&$-W$ZA(/Y%HE-4%RR+B#\T$(V8%KNIF5GSIQ@4KXS/@6J!)[4^&(GZ2A@T^&0&%XSH2*6&&LQDR"3W^J;\X^4[QT;93JS:GX.(2>/F^[I;ZV!)2*OFPD0;1(YZ5Z#^IE!@"(`I=0\QZ]C("'6S6@+@MGBK8]W1>NLK!?-1C+KT?&1MQH]UCB"RR?"W#G"&;FO=3\?PSPQ89^6%SP2%2Z&ORPL:VDO*LTCYQEP0Z7W+2V9\D7[1-?6BY@!&P9!S0P9>T(<6FEBBGL@S!H;BDM8&M/1M6&

MBP^(P2&01@1ILU75/E1:[4/[[, 0T-J8VD[8 GU](6Q8N;S@VYESSMC,%*.0
M;ZH%T.B=LUX=HU;KX8"QJEK@5&W$ +TY:83D5)NEO& U2*"U"^(,DSC.,*==
M'Y6%VWN192&NFG4]O$BDKIQ3^?<$3(S'*(GN&Z =I=5V Y<%GN/JCD.O.M$C
M"DH.I[U%.,"O#D;U,$?6^UF(-[OX41^CV%H !I6V#-0,-W@&QBR1$?XS
M<7Y(VL#'^9W]F\O6N#]3!<^" >YJW1JS<81J:.B5Z5C:, R9,I+!Q I@ R!Q"G@[VOL F5:EH64HQ(^JL=J'W!
MY$#,153(>%.1/7+96T19W,HL(06^6:(%YN0QQ&&2&8$-^RQ! B]Q[@ A6;(-
M$VQ7/&X=P=81D#0-$Z0K!*DC2"<'Z3+)WKOTF"3V62:;/ K[%9T=@N=7? R
MEY@L+)*MB&0+@CPHLL3LPR+YBDB^(/@2%%E@2!P6V:^([!<$25!DB2&?1/##
MS\Y!7EQ-*U2):Z]7SWOSFWCB;AB^8"7Q4 O\)/*2]?>8WQB
M%SWC'Z(B1 9?#6W%/JRD['8 B%-%&BR>6$=:M7)AO,%2#?D5B(X3?#9!#04H
MBE+0X+H-R\+,O?&R8#=)ZY:\\4#4?L2 OC/ZNS[)2U49A<"87?*/RG?7?R: A
MT80G1H7Y#4XW(5DSAH1!@[]L6[>F[>U*'@UARP%H"$!3@-T)8!.9,K]AB)E@XR#8&()X($CF5;:V2HO)#0;&6;Z<)5[*8AF>8[L7=C/0
M4DF4-E]JARLQR?.XK,?51N'01;#Y7;!Y5)
MDBTGT:9;/]C1+,W*J85.;T ?J=!U\B'R$#N O--HRE
MUF4 F/BH3;S4NGP"YT99L3I<=,%(D7FI=1D!YCYJ&UL?93+;IPP&(5?Q>(!
M8K"!N8A!2JBJ=E$IRJ)=>\ ,*#:FMF=(W[Z^,,03(3;X=L[Q]X-Q,0GYKCI*
M-?C@;%"GJ--Z/$*HZHYRHI[$2 >ST@K)B39#>8%JE)0TSL091'&<0T[Z(2H+
M- L'^BJ!NG).Y+\7RL1TBI+H/O'67SIM)V!9P,77])P.JA<#D+0]
M1<)LZK*(L;F6.XP+>;-"#YL5KD-.@-445*O"G!!J A0)M
M4"#GQWZ'-%\/P!L!V 6D@0[Y;4U6A"B59D/4 DV[I \P
M:!7&:W*GV:/#*G$5BA#>XW64; ,E"U 2G*VB9$'%NP1E^U664(7P(4F P,#@
MW(WD0G\1>>D'!&ULC9;-CILP%(5?!;'OX'\@(DB=5%6[J#2:1;MV$B=!
M SC%3C)]^]J&9,S(L;(!&\X]?/=BKJDNN&UV1^TO9#557:+VS:=Z%4C^V0ONV7Z%2Y6D%J)4 QN
MQ$5YX\3"KZ5\LY.?VV4*+(-HQ49;"VY.9[$2;6N=S)/ 3J8?S[2! OCJ MVE
M: #77(F5;/\T6WTPM"!-MF+'3ZU^E9
MF]Z=+^,=QJ:P< ": M M))H)X"*> ;"1S>7WCFM?5("),+Z,([?O'"ZP
MJ=PF,9YU""G02'%RE?@#TEF &X4*$*!7#R>
M*$C8 $<,L#,@DP&=0 9C&J.F&-,):1%4+?R=9#F@)4T#$0B0&0&Q() HX8Y
MS1<$$F8X4!%$8!LHC0/D,J P;%!&#XI$E7$8,R@>6<.FG6A & OZ6
M9*8C@)'\SHJQC>Y^;P >$BGO5!5&VPM\I"PPUAL@>J PDVC*., -8@D69JY#
MN(3@#E*LV\!9NR'W+&+] 9*'"A/[HB%]I##4ZV:L0 4(U\67$8"]+W\$RKQM
MY\Q.2BV,&7@R9@?SYW";M&*G[3 WXV'<2\>)EL?K
MK\'M Z3^#U!+ P04 " "CI6I(C@$!N?D! !K!0 &0 'AL+W=O99^*B6=/"FT3JPCF5
M ; 1+\+HN 6>&^J6ML SC,\\LX-AU8UHD42REWP&FV/J44XP.\&>C69(^O]
M),2'7?P\[X+06@ &A;8*U Q7. !C5L@D CMHWE-:XG1^4 NJC7N3U3!0;
MS5G7QFP8H#.4],+TN^A P%""E!;]1 L3IIQ^;UHV]WWD)!]H\
M(1X(\4B(UHN$9" D=P)9))"!0)X(V)?B#N)(-7K2 58S8.LPE7FSG080I*R3SH
MZ$$O#D3">;?I@MOTP2V9=9M.C$1D%<^Z?0 EJV^S;I] Y,DOGMQ)#K)RCUNA
M0EQ:[7 J&!W[QVML[13?& ZBF\#=YD\ZV@%OZBLFE:AD]#FQ;@[7PJAP;@+
M5\9>;3K?N&!0:CO=F+GTS< OM.ANK6WLK E 4$L#!!0 (*.E:DA!&]B8
M;P(!X) 9 >&PO=V]R:W-H965TU#)6RVT21.%Y90\43[UBKWIQYWU"IIOTE$EW/Z,F0FCJ"
M<4RBAE9M6!;FV7-?%OPFZZIESWT@;DU#^S\[5O-A&X+P N"ENERE?A"51?3@
MG:J&M:+B;="S\S;\##9[D&J(0?RLV""L<:#-'SA U9/OIVT8:P^L9D>I):BZ
MO;$]JVNMI%;^/8E^K*F)]OBN M6$J^P?J&![7O^J3O*JW,9A<&)G>JOE"Q^^
ML2F&1 L>>2W,-3C>A.3-G1(T?[U5K[L/X)HLGFIL)P)\$ #V$M!$0/\0
MHM&9B>L+E;0L>CX$?@Q.JJ .=@@E;ECH((1H7YETJ419?%6$IP4T9L6FF%V
M(P8:#'0A]C8"?4 B9>#A GI<0,-'AI $F5L >020$N\U@CQELFT%N,R.&&,PG"!(,G6YF,! G>>*VDWCL)#,[SJAW
MB;4.QAEQFM[;* C!DAGB,4-F'RIU"Z0>@73-5LD\ MF*K9+9@68+.\4&@1@!
MMY7<8R6?65F(1?>BY?*-UZ0#>#L 6)&0"70/EI#D9F>IAZD:]^/Q/4XD[^Y (X]?HO(O4$L#!!0 (*.E:D@?
MDH39' ($\& 9 >&PO=V]R:W-H965T(!1-BRD2(1MPKT[.C$,DU9)?H!@X1B=#H@0F
M451 BKH^J"NS]\+KBETEZ7K\PH&X4HKXGQTF;-P&<7#?>.TNK=0;L*[@S#MU
M%/>B8SW@^+P-GN.G0ZD1!O"SPZ-PYD![/S+VIA??3]L@TA8PP8W4"D@--[S'
MA&@A%?CWI/D(J8GN *[^U62KW!^1P'M&?G4GV2JS40!.^(RN1+ZR\1N>4LBU
M8,.(,+^@N0K)Z)T2 (K>[=CU9ASM21E--#\AF0C)3(B+54(Z$=('5LE9!,A
M^T" -A53B .2J*XX&P&WES<@ 8W$3YDJ=0-4]B+01Z:^&E%7M[K(XPK>M- "
ML[.8Q& >"*C4YQ#)YR%VB4-/? 'V+B+U0@XN)(X2OXMT)='4"*13HI\(9"L"
MF1'()H%TZ;*WJ5K,QKJ,P\0'VKN@(LQ\F(/%E+8B?J YBM?<]9I]\0L4*P+%
M U1KLR*P653+F^3.8F)[J7E8>JNU +DE75@I5ZR4"RNYUTKIW$D>>B]W[V+^
M-0*==TKN\X+@L]33C9ISV #L0K+AWK[G Y#Z+U!+ P04
M " "CI6I(.PRP1S0" !7!P &0 'AL+W=O&$=;M7)B7&*I%KR
MGC;\%ZSV &F(0OQK$:"7E #F(WCTU<3J J7\SZ:KP#TC@/2. FZ.L5;2A[QWQ
M"5V(?&?]=SSDD&C!BA%AOEYU$9+1&\7W*/JR8].:L;3C0Y@G10(A& DB=
M!#@0X)T0FTQM9":O5R1167#6>]S^C [I?P[64%6N\E0RPM='IEP:41;7,DW2
M(KAJH0?,SF(B@P$C(E#JHT7TW&(73>C1G,%^BH#1O -T) $-'PY)9/,"L4,@
M-@+Q() !MG:-"PF-Y@$9'DZ;Y,X;)('F]6LC<6D!I-G20SG4/MD63"I(YAT
M$@S,XGF!S"&0+:EZ[A#(I^5(P]E$\V6)KAPVJP557TVJ[K#1?>'Y50H?*OJD
M(,!Y&\&2F@+';=N"Z/]5W0T@FR],LJ=.KEL'X(+"#J#\J5,PZ5<4\[/IX*K
MV*65MB>,N^-;L8UTO MG?Z??$-,'[S)ET:$S HGXN6F%=V!2=5/3#T^,2:SB
M"U 43:K5*S2=;=G;'Q+R[]02P,$% @ HZ5J2"/)
MHY=Q P #A !D !X;"]W;W)K&ULC5A=;YLP
M%/TKB/<5^QH;J$BD)M.T/4RJ]K]T\1)4 %GX#3=OQ]?26UDNWXI8,Z]/KK<
M'^Q!GWO1O#J*M"]D ML>H.[>\
MV(]!=14!0BRJB[()U DX]MRN=.5H@E:?EB%3 AQ2] &1& 2W[ME/M@(/\BQ.OP\&. "M'
M@5=\)X<417]YXUM>54.F?N: <]*/.8=]?Z6 =NXW)[^2]'QK:C^E'MYZMFB
M,-CSOW&IY"]Q <[G-= AX4Y4W?@WV%TZ*>I;2!C4Q?MT+9OQ>IW>I&@.,P?
M' #W *#. #('D$5 -#$;U 6UD,4Z;\4U:*>/<2Z&;XX?25*Y7= OI@N'5V.Y
M!L0Z?ULSAO/H;4BD8383!D;,!R+JL]^G /L4&U#"P33!5D40,,] '(L@8SP9
MXRDDY@2Q(T$\)HCG*BQ(-M,R)DPZ+2-E"3*AMBH*4Y(B,QGJ($,U,L1(9L*P
M$?.%9HP:R6@H)9R3 '&::1B8UDF#(-0(+,9%04)AA;E)0XR"0*&4HLI4T=
M"5(?H62.!)F'4#*U',@L$S*XD'WC(@^9S*"; BQD=!1.B86.TT?PYT+9
MSJ!Y=UC*CQU>\H1!FX8:[60!8I9Y7(Z"B2JUS.))V.4I./81&W8Y :8>
M(@;5&5@*9@UKJ Q;% PN P'P4/ ,NDD3B/E$6\"8K3HNHP'B(> 9-*V;TM1"
M1T4EL<7%P>59$'O(=P'*C/*U@G0R+0<#U?UH%EM2N/P*F)=\70X#B8]\5>M@
M66:1KXJ*D>W8!Y?!0.JCWU039H;-AJ?#4F:KL,MC(//1;Z;J%R7F T%#$4PL
MYS9Q^15!'@+600 B 98-EWP(F3?!(YMW$$(R7MVZ*'?&Z>^.;\ 5/P@
MA]NDOV^G=G5ZD.)\Z[[O P)8 P=02P,$% @ HZ5J2(RE+SK, 0 0PO
M !D !X;"]W;W)K&UL?53;;J,P$/T5BP^HP:
M1@2I855U'U:J^K#[[L[[,!P46W@N=/D;X,RP&#PIM!!@/G+-(RGX)Q<4_R!D(,#4'?#;%"F;9-(#.!+(0HO4F(9T\)`;BCP]Z9J^L'U33/I)BO]+T8J&UY
MM(-R97*%+"N^6.RR+R]RG]K(@ALU)<4Y/L41/*BDXCDI>N(^NEC(^;>:;W
MQ1H1D^T,\8TB8L>/?88DV1;8W1#8.8&=KS"*/YOL?1D>\^!-IH)%JA8@PA)
M'[]8P:OF<)"-N[0*E6+LM3^);J&BR=BF LE?C3OQ5 OJTR>#;2!7U0V7: 0
M26AS=5SS:R$T&'?A71*@UKSH9<&@UG9Z;^;27W* T&*X/-GEOY' !U!+ P04
M " "CI6I(]O^Q* ," (/'T[1L;H)%Y]SOA^,235R\28;2E7TT;%>;N)&J6$-@#PTM"/RB0^TUT].7'1$
MZ:$X SD(2H[6U#& DB0''6G[N*[LW(NH*WY1K.WIBXCDI>N(^+NEC(^;&;W
MB=?VW"@S >H*W'W'MJ.];'D?"7K:Q- @>KOW(U+[G ,T,?AXW
M<6)*H(P>E$D@NKG2'67,!&GP^Y3YB31&OW]+ VY7JZO?$TEWG/UICZK1Q29Q
M=*0G.)/V-SII*\#$2[ET,Q+QRN,9ZYPZ17HR,S2.[74915]>8(HCQ18\QV0(FFV/*(";[+TR^@,GGF%40XXLP
MQ@\PQ0*FF&%0$L3,1##%84RY<(9*FY!.)QD'*:6 9SE\<%)7"Y253\G3(&7E
MG3.$"N 5>*J=KX(8OOBE&.!]R ,YTU]$G-M>1GNN])U@O^H3YXKJK.1)'X9&
M7]7W :,G9;J%[@MW>[F!XL/M+K[(=3 %!+ P04 " "CI6I(75EM^0$"

M #:!0 &0 'AL+W=OXKNS,S[L8QK>)U [<*3,!Z@KMK%W^"VP49A!;][.DNO'QGV ^=O9O#SN(L3@T 9;96)0'1SIOUES 32
MB=^7F)\IC='OWZ) M[O5] !S)-Q93,0<.=QFNG)MI#8'R
M,$J^@I)[* @7012G0:Y>&0Z2^)JT3/Y3E&*%I'@@04&2PLN2IV$27P,AQ&$2
MM$*"'DB"6?;(RX(WP2-L? U,, R3X!42[)' +'PZV/L'$-H$"]?XHDV!DB\H
MP+N&$SG37T2<^U%&!Z[TC;9W\L2YHCI4\J0+W.F']CY@]*1,%^N^<&^/&R@^
MW5[2^W-> P-02P,$% @ HZ5J2"O!#BO\ 0 O04 !D !X;"]W;W)K
M&UL?93+CILP%(9?!?$ 8["Y)2)('':JJ750:S:)=
M.V "&H.I[83IV]<7DC$CEPV^ ?\YW[&QRX7Q-]$3(H/WD4[B%/92SD< 1-.3
M$8LG-I-)K72,CUBJ(;\ ,7."6V,:*8!1E($1#U-8E6;NA5].!'>PHCC4 H::2.@%5S(S6A5 =2B?^L,3]2:J/;OT? 9JI5]&[
M4D2KS6^ JP$^#'&R:T"K 7TR $MFZOJ*):Y*SI: V[.8L3[R^(C4SC6!*D:$
M>LELEU94Y:W*\J($-QUHHWFV&F@TT*>H707ZD %*" .Q30^)'-D,7^ &@G
M #(!DK6,PQ9RLF5836&3Q"A%/E7MJF*8%H4?)MF!25R8(O+"6$UFTQQ0[(=Q
M58<49GZ6=(3/DNUDR399H#=+YF1!B7];ZHT(H? \"?D.
M2NZ@J$/VHN3.&2>'.,F\+*X*IDF2?H(!SDV;\87\Q/PR3"(X,ZDNK;EV'6.2
MJ%C1D]KC7KVECP$EG=3=7/6Y?5[L0++Y E@^7NSJ'U!+ P04 " "CI6I(
MKI(V$"D& R)P &0 'AL+W=OGY68]?O>UV:SKC^ZP/U5?FT7[<3R6S7 ;
MZE!?'I=R^?G%M W;>S=\L=JL5]=R+ MC=6KW]6G15*^/RR?Y4,01,B+^WE>7
M-GF &,@ U 7WX<.?+X]+,7"H#M6N&ZHH^Y>RK8KZ\, ^I7OOV8KEXJ5Z+3\.W;?Z\D[J0SO^7^P^
MVJX^?A99+H[ES^EU?QI?+],OSL %\@747$!="TA'%M!S 7U38#4Q& OU6]F5
MFW537Q;--!GGSYTP^0H,48$9*S!S!1:2/$W=
MF#!A&@4EO0<74$%0>H^"P5
MEU+1*DJ1)9/"E';.Q#P=3]#Q@$ZVTUL/Z OM\V/C 9VH+!+7@: 34CHZRR:D
M,1--]-G0*D+"Q@0;?9Y,),A$,#;(X ZVACN!X*A(DF8B4Q91Y-T$@I"!EX2C
M/$D%JD B6U*6(5F>(2G3D(;36PC22#N4(4C@"!&C2@E9.E9O*?%)S^DM!%FD
M'4I5$L@J.J0*2@LR05- G?78(H92H8)Y&9D RYP RYP 2MO*IN=\
M/E2.R<@EP4PQHCQ"O?DC64A1\E>!%1*4 %7DA$1,^HN'A*9,0JS4E/AU ;Q%+UY3X-"OW&DI61C#T
M:]+D:]UM!'SNQ@ *W8X92GT&9%YD0V;2C(KNR *WY(92G\&I%TD#\V@J2&M
M?=1YUP8T)'%FE&^BHLJ "@BSB
M6H9R+1,YHHII9/9K179^E7- *AJ@LV(+T*<[E=0YQRJ#K'4LY
MH06K!XE50;F751Q163(8")*A
M7,9&4 5B5(YR!<;:@^^R''[RE,RV@0NA82?IUS+LTY3/.4TGG.: D$*,1!/&8BWC."$((5D?4 Y@H>^
M@)BO)Y\ULGS!4[[@.;X 0OI9$WA*\IXC>0C"1C50:@[@)%,AZ3YO^@N2,ZJ!
M4DR YQ Y)#V#/B6,F5>@=!7@:B!O7@&<5@AK+1)L@=)?@)D^;TL!7$ 0(01D
M C1,H"0:@+HU50:DKL/8(@5)78.P1"@C2V!-Z\A%]N"^- H*P^R>!DF"(]X.R
M".DC!X6=)4=*@I&14(N8/F]4$1NX2 DU,A)E$4&BE/K60%;)5:1CU;R-5[3:
MQ:[^.'73=9 KM]=K8$]JN,IT\ U6/A339:Y?U6S6Y *M^JMLWO:G=O%<=UU]
M'*\ZO=9U5 7TQ)<^U-^K\N7ZX5"]=L/;(<,TTY6NZ4-7GS]OJ%VOR6W^!U!+
M P04 " "CI6I(L#)SNP@" "T!@ &0 'AL+W=OZ52S<[W95X"(*)-U#KDS,7
MC"B]%!=?-@)(84F,^F$OK'U&JMK+4KOW)K*47Q6M:G@32%X9(^+?$2AO]Q[V
M'AOOU:549L//4K G%16#6E:\1@+.>^^ =T<<&XA% *Z@E8,Y,N9/G'^8Q<]B
M[P7& U#(E9$@>KC!,U!JE'3DOW?1KYB&.)P U%]LNMK^B4AXYO1/5:A2NPT\
M5,"97*EZY^TKW'-8&<&<4VE 47Z5BK,'Q4.,?'9C5=NQ[4Y6FSMMFA#>"6%/
MP&MKO MD;?X@BF2IX"T2W=TVQ/R%>!?JB\B1]B8]@?JNP 4$L#!!O (*2E
M:DA2B@)Q#@8 /,D 9 >&PO=V]R:W-H965T/=6[JOW2/-?[XR\/
MS6%7=<>OA\=9^WRHJ O!:+>=R:*PLUVUV4\7\^'9M\-BWKQTV\V^ G:8M"^[
M777X;UEOF]?+J9B^/?B^>7SJ^@>SQ7QVLKO?[.I]NVGVDT/]<#G]*B[6WO62
MO?'/IGYMH \G?? F^97 ^6O^\MIT<=0;^N[KG=1'3]^UU?U=MM[.I;\;W#Z
M7F9O&/ YGTU5/<8 L^JK:^:[8 -??=TC+:83N[KA^IEVWUO7M=UJ(/I'=XU
MVW;X.[E[:;MF]V8RG>RJ/^/G9C]\OHZ ^"*8I0UD,) G@U,Y:0,5#-2[@88&
M.ACH7 ,3#$RN@OT&]MW 0@,7#%QN"3X8^#.#V=@=0V=>5UVUF!^:U\EA'('/
M53 OQ84 #I>[R;$'VVG TS!&>L5B GOAE)W/?O>.B&8Y:F30N)1F%6O23[
M1G *0)A+"4IPJ>*N**:,J6YCC5*IB0WL40424Z5MI>
MRL1NO.PFBET(EXQ]U-A!HY7@ J4I72<"&M;!22
M45X)MM5CY4>?)'P'PG=1^%:99/@N*DH85]C2ON)5U(##VK@
M2O>H9%@^Z@#MV0%ZZ^.8A.>;M O!E7&3E@S? ?3))]\BAW !\[<@413IY$Q%
MBBD').BOOI+FUXP+E,Y$5CX3**&)C(QV'41C[Y:Z'P1<]PJ4@80AA1G&!4H:
MPF95&8$K'(G"IJL<OS8D.&[D8R4-"]$H*(Z.<8'X$65.XT@$D"PR&B>(NV@
M;:"O!H6OE(($Y1D7B#8ILYH&T2;5YTUS%41AQBH,K#,"4U(PRV1VEO&Z0.+"
M$)B2@&DX%PA,F06F1&!* J81RB8ID^AT1*Z+!(&X=Y3;]9L*1HQ>>VQ416L4##CW2Z!'@C@+.+' < MQE
M >[@VQ&ZS4N>;BQ=C&TX'F3KC+AUE%MFF>,0MRZ+6X^X]1DG.DM/CVE0E3WB
MUE-NF>621]SZ+&X]XM83VESZI:*/ST1%6:!EHSJ%:(=H\W18FW\,M?;PM]![D&Q]O"S\H:5B(8$\(]DQA,<%.
MI&PO=V]R:W-H965T\9Y[MV$![M7)FO"-2#?DE$@.GY&1(71O!.,ZBCC1]6)5F[I57
M);O*MNGI*P $M>L(_[>C+1NW(OCO$V -I99Z(JK*Z,$[-1WM1 #QMPUC'O%MZE%J"J.9&][1MM9)R CN)?GIJ
MHMN J[^8=%7X!R+HGK5 FI.L5;1Q&)SHF5Q;^<;&'W3*(=6"1]8*\PV.5R%9
M=Z>$04<^;-OTIAWM"HXGFI\ )P)\$$"R2D 3 7TA1#8RD]6'&7%0C[%BD A^.08>GT*QR=-5+DMU(&^:I9/
M9SQS\F NW?87W(3R)Z@%&'D+\W]# ?5$4C!EY BYY8:
MR(7^(OS2]"(X,*DN/'-EG1F35*G%3ZK2: 40/08M/4O=S56?VZO9#BO;[B -
MX[FK @-02P,$% @ I*5J2+5A H7# @ OPH !D !X;"]W;W)K&ULC59-<]L@$/TK&MT; ?K.R)J)DW3:0V=O9(HA5X0;VG/]&VU.7-#A8A)' XT
MSV[4S[/Y4H')S&^)@,T&Z1ET""=#-+9 ,&@03899%>#L$OY9)!?74IU+DWL
M.G-/6."V8?0<,7/<1ZQN%;S/Y=EL(IDN'JM/^D 4HFT^VK+*FN1#$3F8M<$@
M@TE+'^;1QL 9D4@/9C?0LAMK9$M4N5?"QN19X<,\N3Q>S+.+*?W.IH&
M(')\ROQ2R)*J0U*A8H:ISU'\6A#3Z,P?]OS[CRK/2]#5SA;7/$> (#
MLWTW\NB-"CE3Z*E@1ZD@T@=P)Z +04Z3\Z(G.Z%>2 G.S'QE%H(>+^/B/+.V
M?P%02P,$% @ I*5J2-]]OH/1 @ 8@L !D !X;"]W;W)K&ULC59+^&[6X==Z[IH
M VY(16]K%]S[Q$MY.G,QX>69- .94T:5M+&:]B\/.P=I&(@51DSX5$T3T^R)94E5#JG/ THE^>@CA^OZM E^EVX;\5
MC&QI]5H>^+F+%KG.@1R+:\5?Z.T'Z7,(A>">5DS^.OLKX[2^4URG+C[5LVSD
M\Z:^)*BGF0FX)^"!X(.5X/<$?R!@.R'H"<%20M@3P@G!4[G+E=L5O,BSEMZ<
M5FWWI1"G"E9AMS=[IULNYHI/
MM]C@$3U!R&2Q'6,@\4V8W1@31(D)\Z1[SO3K6];#EP)^+X#- H%%() "O2\P
MR:11*Z(PB<1\"W&:HNFR*.!6 P)"@3^#W&G(.$)CG!9[:(D]U&(/C+&'8Z,4
MPZQ19#&*1D81CLP"L44@7K)-B44@T5(-C:DJ3*0.G-DBM5BDFD5D+"T=$YM-
MQ'TW7\!(DTB,F?0@M6N 4I@]2$ 0='\60+KS0):8*DY,!BML9\$\U:6&^81
M\-@*C(EM>I"R"OUXWLIV/X"O68'9RA]9V6H$;#<)! O*LOMMJ'2//R9R1LU0^+RA]L]0 :!O"!L3HGH'#&QW8)@%;A,'/585N%
M8[OD6VRK10P+LIV II>1-VHL:M*>9$O'G#V]-ES]Y0ZS0]OXB$5C,IG?P&JG
M&I8OF3R[%"?RJVA/9<.<-\J[MDFBOP =Z3MW#>\PJ,B1B]>X>V]5
M"Z@&G%[N'>WO5N? %!+ P04 " "DI6I(371I""<#]#0 &0 'AL
M+W=O6A9Q[
M[8C!")^%73RZ"-@Y'\.V,?X\V/W3*,1PZTH5L^NJC$Y9.N:=.,GD3D
M/Y/36\S14!]?O7^3Z0KZ[]5 UZSY7> X4;"-PV!']]6YX6 L\IU..4B&6]8,
M\C 8G@?.VJM)&+35E[K6G;Q>U!,23V9V S@9P-E@CF,WO),!NAFD7@,\&>";
M ?8:))-!QQ@Z0 K!C"VIJIC<.H(DGB"))J#%"5FD$X%
M41BBUC/.04*LN(V. TD6IWEB)Y1Z"*5&UL!**-4) 9AF5MA&P5+%!Z,8$CN=
MS$,G,^A8C\I:QV0@LPBY8Q)@JT9$SUC0!SZRCU47":121K'X.2)YRQ8P(J76M9U Z72@B#.2IS(] ZCO
M8I8Z7/A*!GBH9@!?T0#X 4%/H.LYR3-GPK[2 9+ ']L5T(L"(7D@GHDS7$#V7KDRM,'LG6 *'[O8VTGK&E 4%VZT.P9>>.JV9IGIV ")[A
MV'/>S: !8J/Z^IN;LCA5! JSZ@]U-P3OC(N.5O:D>\8X%>SB)\'N*+YEYIN&
M[ODXS,2X5]V]NN'L=/U8F;^8RG]02P,$% @ I*5J2$:*JIUF @ $@D
M !D !X;"]W;W)K&ULC9;-CILP%(5?!?$ [;!
MF!%!:J:JVD6ET2S:M9,X"1K *7;"].WK'Y++D;'8!!O.(/=]UX&"JD0 OXLR8
MC#ZZMA>;^"SEY3E)Q/[,BJLJ#QV5:CJ%G%G9$%#V8HJY-8)KBI*--
M']>5.?L0B6O7T>'OEK5\W,0@OI]X:TYGJ4\D=94\Z@Y-QWK1

M\#X:V'$3?P'/6T"TQ"A^-6P4LW&DF]]Q JXG/PZ;.-4]L);MI;:@ZG!C+ZQM
MM9,B YE, S-UX7Q\=]FEJO:WU'!7GC[NSG(L^HVC:,#.])K*] X^)U-:\BU
MX9ZWPOQ&^ZN0O+N7Q%%'/^RQZ5[X.5F D[FU# I%&> U&7-4RR!OEN /4[$B9& >9I2#A4T!A,(,R(J432+[5L?J
M=?L)E,RVNPL]L9]T.#6]B'9&ULC9G;#BUM\OGKGNY6:W:^^?J6+8?ZI?JU)]YK)MCV?5 FZ=5^])4Y<,8=#RL
MK#%^=2SWI^5F/1[[W&S6]6MWV)^JS\VB?3T>R^;?C]6A?KM=PO)\X,O^Z;D;
M#JPVZ]4E[F% K$[MOCXMFNKQ=OD;W-R1'R2CXJ]]]=:RWXO! ->Z C;\^>/A
M=FD&#]6ANN^&2Y3]U =J6QT.PY7Z. \S7 3G/8= OM\];NQN;W]KV5;;>O#
MW N'[KEW:Y:+A^JQ?#UT7^JWWZNY#6ZXX'U]:,?/Q?UKV]7'<\AR<2Q 3- [
MT C]-IT)9@Z3 ^P<8-\;@', 7@* L@$T!]![ ]P#>; H^[==#J?&$1P4F 7W34!, $XQM,43ZG'
MT]O9DR1,G6$P>%&VXS)P%IPH^\1E,?H8)=4=5X58!">WC#(M(]XR)[9LDOC)
M2]\TL5U<9!WKH\2)RSAQS$F4G3AV$V]L(:IV7$4((?,:+Y[TB]OW6M$*%T7GC>RDR#@IF!,RHI."W02]H2AG'I=9].H8A8R;\.ML">PVP2A>0C*0
M8&4G,>,D\GX!T4ED-X'89ZX5=;M$1X&L]G/L"#IP#3<42%Q[&.J":+K63./
M4X$!2,ZM1 @1KOO*B$(6],#82,I<@1Q4I9(3[D. L<
MM$X +VO 7@3,A**40Y,@+'+U>
MF>Z;D#QBCTXYVU(A
M!F.@4'SG8&XYS#7 V!R +;VC^KC>'2\MQJ=3MEH,0;/1RX9[*"+4ZS.: :9,:50:F3>I/
M&4V)!H)2NML<*6U2I,JDM DI \@]N$MDA,$I0X4Y3J+Y9=KLD/,/O5)@8 Y^
MR.&GU.8("1R,(RO#+Q%&LMYTEG+PPP1L,HXQY95'#TH7<6$,/=ZUP<@^4L!W
MU-V8XQHFA:6<7L@K1@!CE28E>WSC%%!C#I*8U)7*L'/Z!>/E34"B\J35!)A#
M)"95I5QU8U(N*D\3$A&2P@',(1*3BE*NN#&I%0&5#4DB Q^C@DC,(1*3FE)Y
MG,7Q5T"4*]Q49:TV-W.41$Y)I=[&9(\.X'9^7\
M277@09OKE$,I\1)1J[:);^5M=$%>;Q(90M2VV)1]J,K)?%UKG U,FG#>0I*6
M15Q'!2$IJPV)<#[-CMQ2"LD1E#A!KS<#\X8AT?SO\=.*O7(X5LW3^':H7=S7
MKZ=N6ODN1R]OH#Z.[XNNCY.[^41..-,[Z,^,+ZU6/V^Q6;^43]6?9?.T/[6+
MKW77U&PO=V]R:W-H965T
M:A?7;@LFAL
MS-@F3/^^7@B35#0O>#O;A6N*6[^%$?
M@]!& :5M@K4#!=X!L:LD#'^6#2 +"WQ=GY5 ^:J->G/5,&S8+ [6G??NP'-\[^) \7VC:!+ 2R$DCF
M@GLC% .%:EH64LQ(^E<[4OL%HP,Q+Z)")IL*[)&KWB+*XE+F\;[%RMTASEY
M#'&8:$5@H[Y:D/];G,@-/8^3;8'X0<;8"<2+0+HML'\@L'<"^T4@NR]R\"D]
M)G68>-LB>6"1W%@D6;1IX3&YPQ"R[9$^\$CORL@W/3PF\QZ[!\3?-,<'&3K
M[H!"E9@&[;M@W5VOV1-QS?4%+XN1MO"3RK8?%#H+;5K4-5DCA 83(MR92COS
M(U@7#!IMIYF92W\W $*+\7K3U]]-^1=02P,$% @ I*5J2*T$;6B? @
M4OH !D !X;"]W;W)K&ULC5;1CJ,@%/T5XP>,
M@B@ZL2;;-IO=ATTF\[#[3%O:FE'I"IW. OV"T XTR+0/%?#<>^Z]W"/4%S:^
M\2.E(OKHNX$OXJ,0I^%U 9P%&HA:>KD9K=K
M>SKPE@W12/>+^!MX7L-402;$[Y9>N#6.5/ ;QM[4Y.=N$:L^]/NQ%%&F\;1CN[)N1.O[/*#
MFAQRY7#+.C[]1]LS%ZR FL113S[TLQVFYT6 *5-CYC> Q@#># *&F3&('O4
M !D#=&>0Z%2F0JR)($T]LDLTZMT[$=4DX!G)4F\CF3V/U:NIO@K1U.]-F55U
M\JX<.9BEQD"-0:D/L[(QT(=8VXCL$Y+((&^1PD"D<++/3!3 [R +.,@F!\@X
MN MRT*EJ3#%A0%'@HLS\1"A A!RBSN;"*8I[A ?J(\0)0[1,A'M-*84F\,
M*JM4 OQ,18"I<)AR+U-AI31#@0,4V** 64J0L(20] IS*%-V$#NM] "[)V(#F2PT7 S)"Q\$^" DON J<(2NLI@,S'Q00
M$B' #DWEI\$V;T.0A9(**1:4-EON;9JE 6DVG(>X0N(&CKISX.>JK-U" ./9
M@RJD6>AH-O>?- ;TJO5Y!-PW&@''FV8D->"Z6#?,R:H])<^
MR48[ROO=;=+1O5!#+,>COO'HB6"GZP7N=HML @-02P,$% @ I*5J2'Z-
M9\59 P TQ !D !X;"]W;W)K&ULC5C;CILP
M$/T5Q <$VX.!K$BD)E75/E1:]:%]9A,GOOLX!;+9 GTQ=K*FQ1/OPW([,V?L
M.0>;Y%?9OG8G(?K@O:Z:;A6>^O[\%$7=[B3JHEO(LVB&)P?9UD4 7+;'J#NW
MHMB/0745,4*2J"[*)ESGX[WG=IW+2U^5C7AN@^Y2UT7[9R,J>5V%-+S="%$>
M3[VZ$:WSZ!ZW+VO1=*5L@E8<5N$G^K2%3$%&Q,]27#OK/%#%OTCYJBZ^[5(FV)VI:F7
M9# ?TLQ#,IG=14BH^^5",3/2I8]DEMYD#',D(QZ2,2 M&<[=3)AQ&?6OC '=
M)>-<5=%E=>)O[GA1,R>6LR-C'LHQH!\N#
MLL1',(DEF)2XF3#;LM1',.E4,*GC'<,P=[/),@N.98EAIF5+K[T<9D4@CP5C
M,#?;$W#/+6!F!.JA& .Z+4M9NG2387XYB9 S++$B>Q:W< Z(88/#1C0$8S
M=$%=W<+L#1-[@R,#YEKPVO "9D9XO.7=@+WG=$I8>[]!V".!8^-\0;2
MQ 78$!X/<^.N! ,U>&R?-V#OGQWUV!_@//NOWY'U^7DNCN)[T1[+I@M>9#]\
MR8[?H@S%D(XNA[R=1[.\7E3CTZC0=SEO]S:TO>GF^ 81P QUC 1=02P,$
M% @ I*5J2"2(^!+O @]@T !D !X;"]W;W)K&ULC5==;YLP%/TKB!]]0 $8*H*T)IJVATE5'[9G)W$25, 9.$WW[V<#
M27&%; T"-IQ[N,?XV-?%57-O 4D(%;PW==NOPI-2Y\K/G>#[[(:BI(X)O&C6\:L.R&)X]=V4A+ZJN6O'?G?A4BDX.HQ4X9"JYO;V(MZMHPZ2 G4@ OFD"Y^T;^ =!KDY RWNQ
MEO6?:J]..EL4!GMQX)=:O;4RH O,4MKNDR0 029
MC]8<(,@]M.9SK8@EF5.K653"B>0)-DFF+JE@S9
M"UO^2C('!60''M)A@R!$Q)R4RR L>Q6S'D'3PWCQXY!P5D"LR\%$.VP)F/
MXLR:UQG+W9(A"V';0XY\"60-@GPD$\@:!'LLY1/H8]E*'6OYVD9B,QM<@T/
M'BB?0;?ZS/''6,NC3 '=O>A2R);5M
MF3@H(M1ORH/+/.\ZKQY 883Y]JPL8!YO%#Z1+."^\R/XA?OCE7;!UNI=.T^
M5-\'*970;.A!&^:D#V'W3BT.RC29;G?CL63L*'F^G;+N1[WR/U!+ P4
M" "DI6I(6>9I/H ' #>+@ &0 'AL+W=ORK*> #H>3I>[Z4M=O][.9I>'E)87&ZJU +4
M .>I.A^+NOEX?IY=7L]E\=@U.AYF2@@W.Q;[TW0Q[[[[>E[,J[?ZL#^57\^3
MR]OQ6)S 79:'ZOUN*JSQ7QV;?>X/Y:GR[XZ3<[ET]WTB[R]
ME*UF [RU[Y\OR1 3UKVWZOJ1 OAC\>[J6A)E(?RH6[[*)I?/\M5>3BT735#
M S/T^CEHVS#]^Z/W;3??AO WXE*NJL/?^\?ZI:$KII/'\JEX.]3?JO?[U25\>/)M/)L?C5]Z?NM O 7^"&)KA#=300%T;7,?!&^BA
M@?YL8-@&9FA@8*7:?NO;H^TB,7\YR(X-Y];#L"F&6/
M41W&:X]A-BE&7A&SAL&5AJ)I+%72/#ATB)4"- *&6<-^4,PFQ2@,L4T1&H7L
M4H@4*.8>DHGXJFCFX>BN]UWX 7>@6$Z,%T'INL@&DCRU*]&#W'#1*0*C;L)
M#+E-D8:.!WOTNHK'5+P#O@
MO'M0Z$%2"$I* &@""=P!H#2"UIQD'/^+5(!]Q-FKY-E&CGT*U)%AGP*5YMAS
MSBQURCZ@8VT&T+!2-G3#X?139%0RD/13H'+6TO2YN" -H"]1CP$@I !0F0/:
MD2#(F L;$L2-@)OT !I61]#;8 NO4DEN'W"A0X+8$7"S'H$,OI 4")+A H<$
M42&)4+ ++BS(D)-R2,[4)7#U@+OZ /IX4O1S2G&T G< 1[!67!!0(@$PH\5
MY\=*YJR=XDQ1J0Q;&4##FCAZ\O!0?ER<"RCH
M GA@'4#]4$%0\68+< TE;0CS5IRK*)!M1H&ZY A$;0K.>A2PGH@&H\T(I/%Q
M-<&6&I@%?K#:#J A)?&*7#K-F8H&25XD]KGF3$6KG'VNV8.HSMCG&BA;^6BI
M706130X9R*VN.1/0P 0B'FHT..$&V@0U9Q8:Y!^1B ^;POMLIX#IVT-M8W'
MAP$TI/R,ZVM.LQK*,1!=<'+4,:M^P2G-0*5%5-$ %,=[;LBO1B TY=V-0(1@
M#2=8(T$7>$8X N$9X0AD<<80Y C&G#\8!;K ZWLC$%I9VXY Z-/:D2#(F+,C
MD]I1@1;F[0DU!^OJ;$XZS"P-(0&G+5)*S &,F-9SF,L$+U$%;L&(*N(K,%R
MSF!!*"<2LP'$5K,LIV8+Y"6)BIL6^7\E*?!TG')=QJ%TYSZP,'(M3F ,*HZH3CA./R\I\
M/2<>+S+V@A=@QH:L!6T@LKW!0+^;X@3IH2#18+D"(#)8>DZ0'@B2*AE[3I ^
M2Y">$Z0W.;,U6;/E1.;M[[?WQH/7HI;.=CPG1@^BF-+X4&DER@>M%.' GGV1
MZ<%01!3RG!9]5CW:II+1&1ZVIMZJ<:@/,)=%<9 5 9"X2.!D&
M($-%E(4"I["0518*G,("/(?AUS8 B,Q% B?# &2HB,PK< H+6<7>P"DGN)S9
MNJS9S9!,XV828,]L41&9>D5-,!(JA?"9R8HA9+UXB)X:H
M,F8+0/1L.<5$H!CJN!,Y,<2LRD7DQ! S+N$L8QINI*!3"Q8(27'RBD!>&AUK
M&<$]''8L3F(12$RCQ< E 'E'N$[D=!A!*HE?)=N,0$0XB.Q%&B!6C=:BEA&\
M D1.HAH]0AGBQ",%>T%#@(,B44B>H:CS
M67L#FAL*WI4@KJ\ U/]OGO/[A?SU^*Y +,X/^]/E\GWJJZK8W=!]ZFJZK*A+6Z:
M!7HIB\?KAT/Y5+= MNG N;]]W7^HJ]>[X3;Y]4K[XC]02P,$% @ I*5J
M2!\#=BKA @ ,@L !D !X;"]W;W)K&ULC99-
MCYLP$(; "N)>L WF8T60-E15>ZBTVD-[9A,GOOLX!6>S ?>ULWN)8!Y
M9YX9'%ZFNM+I=3X1PH+WH1 G37AB[/P0Q /N1(9VCNB9C/S.@4Y#R CE=(SG

M\T3: 1(T]#$"((N'MAO#NEK6GJ:ZHA?6=R-YFH+Y,@SM]'=+>GK=A#"\+3QW
MQQ,3"W%=Q6O+4@
M#/;DT%YZ]DROWXGJ 8N$.]K/RV^PN\R,#K>0,!C:=WGLQN5XE7<*H,+L 4@%
MH#4 86] H@*2NX!85K;T];5E;5U-]!I,#-S*&XMCTLH
MZNJM+M.DBM]$(D.SE1JT:."JB'GV%8')9(E/)*$
M]@2I)T&Z)$C54TC-(D?9AM1D\BG %!0 .$C80\(&"5M)6",E!WH7MN-]4H*.PM:FM$JFN0)JYMQ1Z;0$:,&B'*?, BRJ-
M4L>K"SWN\ B104)VDA1!^8J7$7: ?"8!$P.4V$&)#D)1F3E(/C>!AIU@NYTH
MD2)E$%]5 :W&3 W4V?ZT##=K#=WY1(%91$1>$@^5P'
M&K:#[0:G1*HG'&6E@^1S'6C8#KXSN-LWTA05-E%S)W(5X ,;:!A.!NS%F"+7
M-]OG-LAPF\SZW=[>B9([3JR-(@.9CLN(-@<[>AF9 -ROJ^L8^(C$*'.WON7C
MH1SF/M+4U;D]DI M=.S&.7BAC]*RZASH)017AV(^! ZQ ?8]:(G!R9.M=2(@ X D !D !X
M;"]W;W)K&ULC9;?CJ,@%,9?Q?@ HZ#5VEB3MF:S
M>[')9"YVKZFEK1D5!V@[^ 8+:*T8)-[X!W GX^-P!-('H9 LBC%WONNJ85OW
MRGF[\3Q67'&-V!MI<2.^G FM$1>O].*QEF)T4D%UY4'?C[P:E8V;I:KMG68I
MN?&J;/ [==BMKA']M\<5>6Q=X#X;/LK+EY4UKAA)6D<(4++B60N-WQ 5>55!(]? 6BKSYE
MX/CYJ?Y##5?8/R*&#Z3Z6Y[X5;CU7>>$S^A6\0 R^(G[,:RD8$$JIJY.<6.<
MU,\0UZG1=W57$EEZSY(H3+V[%-*8?<= Q8"!
M\(3ZT 6<[V(/1^'0U,%A3 1&)!\CP(=F%X%EH($2")3 .O;- J%%(%0"89^I
ME3%38R:"YL$N8/(Y1C.[LIA=:68CLT!D$8B6I"NV",0C!^LD,:8KUES&QG3I
MS-J8+IU)S&;7%K/KL4HP8EOK$,#A/(6 ?Y
M!)KY@8%MO0+!@IK4(=\\SQ/(/-$3:&ZF;0LD"!<4Y@0R L^'"62R8< ($@(9 >&PO=V]R:W-H965TXD?>8%")*"JVD.EU1[:LPD&HDUB:IME^^WK
M1PC.UHFX$-OYS QF/,H,Q8WQ-W&F5 8?;=.)=7B6\K**(E&=:4O$@EUHI]X<
M&6^)5%M^BL2%4W(P1FT3(0#2J"5U%Y:%.7OA9<&NLJD[^L(#<6U;PO]N:<-N
MZQ"&]X/7^G26^B JBVBP.]0M[43-NH#3XSKC@]XR]
MZJ20(;
M>VSL\PSX'<0S#F+C(.YO(1\'V=DTK":UFC@#8(*3S'"2$6?IY20.)P>YRW%D
MNV0<#HXG[BV="2=UP\F]G&WJ<+['$WFGD&9"TJG[S>?X>1/U#%W
M.# !Z=0%YT 6>SD3SW*4- +&8S406-$B]E-T1YK^B,&(@[V<7@3M9P+A N()
MU&R @"-4[$=!%[5<)/D$::9M;" :D1("7U*"F<3J+G^ ?$3=>I%?:$@6,3>
MY'=CW?\%C9P&W5)^,H-+!!6[=M(VP>%T&(X;I!O\I .M'IJF\3 FV.>?XWA-?&,[UK9:2>W\=Q3]W%,3W?&'^G>3K@K
MA0JVX^V?YB@O*MHTCH[L1&^M?.;W'VS,(=>"!]X*\QL=;D+R[H,21QU]M\^F
M-\^[?4/2D>8GP)%)P+ 04(V$K)/ @H2T$A 7PB)3<48L:>2UM7 []%@ [TK
MU8<$/"!E]2%2V8M8OS+^:D1=O=4EP57RIH5FF*W%0(,!$R)1ZM,6<'F++73H
MT+?!SD5D7LC>A8 4^J/(HEF1B ;$RW\ B@@@(P ,@*$I/,H>YNJQ1 ;94Y@
MYD/M7%0) ?&!]BX(XCSW!YP' LZ=@$M" (X((#76%8$!(H5EED,MI9A5'H=
MFX$<+US#9AB =&20+1DYE?I%R@# N4:O 1=M%R-Z0K'1I#-%&;8Z]@,A,E"
MP8#@U0!<0\IT02)0^H\ KK(D5+<@6V-)YF2;0P3]GK@H4A;>8S0#H0(MA!RZ
M*0":&;=P98)0[8)\E7&AZ@5XC7'8/4NIM[)VL>&LVF-
M1'3@MU[:3^*T.K5?CU!W!% 6M[HM,YW"ITQ=7>F9 :+#N>E%],*EZC=,QW#B
M7#(57OI-'<6+:ARG2]%UWD:K"\D "BD1F$8/K? ;@:]WB%IXW7KFFMWR!%3F9>
MU0F0IE,2::CW^'ZU.V0>$0! .AC-(D;>^U&I-[]XKO8X\1: 0VF] G/3"1Z
MN(RGM0?0[7. 9$9>%#\;U?9UIE-,*J@9@.WKVI\@G,)P6&I
MN DC*@=CE9@H& GV$>=.AGF,)[<3[3*!G@ET)M!H/"8*-G\QRXI
M^1M<[:AK1(F<-X/]4:C>(XK\5&RW:4Y.7N@;YA Q-&!6,X(X]3D% 3G%@2[I
M=^EE@?2*QS0(K(- NEE?%EA?$5@'@?1LP9^,]UTTJ"CLNYQA.NM
ME;+@3+B\&+7N"\X+#K7UX<;%.K[*N+"JG [8 -&+3U!+ P04 " "DI6I(
M:G01"-\! "]! &0 'AL+W=O?OQPLA=,3D@EWE]UXM
MN)SV0GZJ&D"C+\Y:M0]JK;L=QBJO@5.U$!VTYJ04DE-M3%EAU4F@A2-QADD8
MKC"G31MDJ?.]RRP5%\V:%MXE4A?.J?Q[";Z?1 %-\='4]7:.G"6XI%7-!Q:
MU8@622CWP4NT.R46X0" &NC59(]L[F%KDVR88 **.F%Z0 1O\%0PM(*YH(I
M]T7Y16G!;Y0 0@4!&0K1Z2H@'0GPG)$\)R4!('@C8
ME^(:<:*:9JD4/9+^YW74WI%HEYA6Y\A4KP)[Y/IK$5EZS;;;58JO5N@;YN Q
MQ&&B$8&-^AB" # $@4SH9"[<8J(9R&G*20*R7P6\9-"8R<0^RPVJWF!Y(E
MX@22H5/K[UFVOE2/63O,\S G@AET]&/ /O 6W=II1X(RB)8\NJN)X/H
MV.!QTAS];]'AA+3""'YW9!*KOJ=K/S/VKH.?]=$/=0F$DDIJ!ZR:&WDFE&HC
M!?Z8/?\C=>*Z?W= ,:M5U9^Q(,^, NEJV:IB0]^K28.O5+ZQZ0>9EY!JPXI1
M8;Y>=162]?<4W^OQIVV[P;23G
M<-(=3KKEY$Y.NN'DT0,.W.' +0&UL?57+CJ,P$/P5Q >,C0&'1 1IDFBU>UAI-(?=LP-.0 .8L9TP
M^ ?K!R%.Y.&"7U75U0UN\I'Q#U%3*H.OKNW%-JRE'#8 B+*F'1$O;*"].CDQ
MWA&IEOP,Q, IJ0RI:P&"$(..-'U8Y&;OC1D;#\2EZPC MZ,M&[=A
M%-XVWIMS+?4&*'(P\ZJFH[UH6!]P>MJ&K]'F@#7" /XT=!3./-#>CXQ]Z,6O
M:AM";8&VM)1:@:CA2O>T;;60"OPY:=Y#:J([OZG ,-DJ]T]L $FG%%(M6+)6F&=07H1DW8T2!AWYLF/3FW&T)QF<:'X"F@AH
M)D1XD1!/A/A.2!8)R41(G@C IF(*<2"2%#EG8\#MRQN(D:B3:)*708J>Q'J
M(U-?C2CR:Q%!"'-PU4H/H)T%(0N:$4#)SS'0]S%VR*$C7X"]BXB]D(,+B2#R
MNX@7,HV-0&Q=9&N 0+(@D!B!Y%:JZ-%F;W.UH,QF$J=)ZD/M750&L[47=7!1
MT6K]3<[I@N7TT3+R6K8@; N#(,;0Z]F%91C'F=>SB\()6B=^TWC!-'9-Q][2
M[+!3&I0F"/KK[,(BO$KCV&O:A:GT, QD&CAWJJ/\;)J3"$IVZ:7])N?=N?^]
M(GTGG 9WJB :-G:7*?*!G.EOPL]-+X(CD^K&FSM[8DQ290^^J*+6JG//BY:>
MI)ZNU)S;9F87D@VWUCS 'XK 4$L#!!0 (*2E:D@2B9M 70(.\' :
M >&PO=V]R:W-H965T?:X=Y\)/2=U1ASY[-K
M>[9U:\Z'C>>QJL8=8L]DP+TX.1':(2Z6].RQ@6)T5*2N]:#OQUZ'FMXM<>FPSUK2.]0?-JZ
M+V"S![Z$*,2O!H ,F#O2 (&0=[GX<=RZOO2 6UQQ*8'$\(%WN&VEDHC\9Q*]
MQ91$,HADH(5:9GZ=:H+
MXZ2[4ERG0Y]Z;'HUCOHDR2::G0 G IP)(%XE!!,AN!'"54(X$<([@J=341>Q
M1QP5.26C0 7K#4C^2< F%%==.2)[YLHC=;\24>0?!?#](/<^I-("5&H0U* 9
MX0GY.09\'*.$!AW: NQ,1&"%[$T(*'=1;"2:: $@FNFH5TA7%$(E4)X58B6
M/GOM4X-2#8HS>Y1H)4JTC!);HVA0O!XE7HD2+V\CL2LD*PK)TF=J\UDFQFT\
M)1&P9K-;H%*0V7-.C)R? /7C!=\9S^QPN6J1$'0I!8+:<+,VEH1>U-5!]
M,)RM&,Z6AC.KX945]7%-\TW5@O^4)E'[A
M>@E[;/M.+KLO4YY1%CM,SZJ ,*K=?RMZFRNU-IL@'
M=,8 $3TW/7,.A(NBKB^\Z+%)RZGB9A3W8 T@I/AVE[G
M'E \ U!+ P04 " "DI6I(J2@O)?G6/N:L13?RJ2,]G
M=4N9/U/ZH1H +B<;*0^D)H50$@6#Y*1NE9*>P4X(%K;G^M8H[%[1YAMA6@S^'LFIU
MV0]?]F@,@P.\,<";MQP,\ ? RO@& S(!@# B/ &:;B%R+' B(B#W;A;\S4UP+^X&) @ 6"#8% "P3/I7+!I3(@>+K ^6K
MT,+P;L/P;JG@@X8-* -&] .-&Q (6PXW# <+A4BT+ ![4'#!G0 #2\A#\&&
MHPW#T5QA%X)^H^4HX+;)# C>$0;DPW[W&W[W2P4PV:D!@E
M IQL X*3;4!PLI?0OY)L=5.LGY5HJ0&? "8%'P$F!?XYRN&$W[JG9X3KYZZX8S^5#TS
M],WW)9/$';Z1GYC=JI9;9RKD :EOP"NE@DA[Z$6>4Z5\"$V-FER%JD:RSH:G
MP= 0M'N^=*;G5O(/4$L#!!0 (*2E:DAYKT!+JP(*$) : >&PO
M=V]R:W-H965T WF*(:.*3T=3HF\#)P=1J.N31 -.E8T\=5.3Y['JI2
M7%7;]/QYB.2UZ]CP;\=;<=O&,)X?O#2GLS(/DJI,[G:'IN.];$0?#?RXC; "
M30V)D8R*WPV 26<&?A7(=[,Y.=A&P/#P%N^5\8%T[=W7O.V-9[TRG\GIY]K
M&D-W/'O /H:K\5^9Y+5H S'==:T((X. ,BNK7H1MQ]\BB$U#O>BE>,UVE^E
MMULD<=^[#WIA O- LF!Y-9V !-!NAN8#.Q:(G Q@D%BR,:YO3+&J',0M
M&FPQ+LS4'&ZPSMP^TL'(V+P:TV445?E>08#S,GDWGCS1SHKO*$(A1>TJ*/9#) P$^9F\#L:+NBA"<+B0F76%) <3 ($WJK(-006@X,ZX,9C1-TS /
M7>&A/@*\E W.QG)@S2N"%*X4*=LA27S67"0)7.7@8@&,UB[J@S3A4+E*S"Y
M#Q.LP"YW"U4@D&=!&D^&"2RR,$^QPE-X9Y(LE-JTRN7N OR8PD=A4DVT6>H<
M?SIIOZ4(X07F%P=)OI$+^5IK:M"XC&E
MX1X J6S[@(+ ,/;KGX0@B(ECZCS8/P@[4>(R Q#= \JJ U!+ P04 " "DI6I(
M?,EVS]P! #9! &@ 'AL+W=O&UL?93+

M;IPP%(9?!;%/;##,P(A!2JBJ=E$IRJ)=>\ ,*#:FMF=(W[Z^ ($18H-O W .
M=VSC;.#B0S:$*.^3T4Z> 4:I @2 +!O"L'SF/>GT2LT%PTH/Q17(7A!<61.C
M((3P !AN.S /[-R;R#-^4[3MR)OPY(TQ+/Z]$LJ'LQ XT\1[>VV4F0!Y!F9?
MU3+2R99WGB#UV7\)3D5L%%;PNR6#7/0]PW[A ,,,?E9G'QH$0DFI3 2LFSLI
M"*4FD$[\=XSYE=(8E TI^G=;K:: 8$D*30^TE6HT+/2]BM3X1M4['WZ0L01+
M6'(J[=WDL#1MFT(1T,X&X)HUX!& WHP $=FZ J&
M%+D;Z9LENEU'DV3T/8!QDX&XBK42O3A1:4;BE
M*)8*]"4!FF#&"'>(=GGB)/W"3*%X4
M A2D,%AD6A*M=3"-H\<3 XM;V.,K^87%M>VD=^%*7VA[)6O.%='1X+,.U^AW
M9AY04BO3/>J^<+^>&RC>3P))KE P%02P,$%   @ I*5J2&!WE')/ P
MM \   !H   !X;"]W;W)KK#[C--G 051UTUW6% O!J*X"
M"$,6U$79^.M\6'MNU[FXR*IL^'/K=9>Z+MI &UZ)Z\HG FWAI3R>9+\0K/-@
MLMN7-6^Z4C1>RP\K XD\;BGM(0/B=\FOG7'O]DXK\=W3Z&;,W-.]OWK\/VU7IOQ8=WXKJ3[F7)Y5MZ'M[?B@N
ME7P1UQ]\W$/<.]R)JAO^>[M+)T5], &]NOCOU[(9KE?]AJ6CV;P!C 8P&1"&
M&M#1@'X:1,-.=6;#OKX5LECGK;AZK2;C7/2
J*K?SU&8ZOW\UE*M'K//W
M-OECF@?OO2<+M-$@T*)$2CW4PQPQ]B 80YS ;8F@L)\!(KL@@[V]+:+:-Y#
MA'B(!@ 1S4-LI]GHC6A0.H BI0?U-X?;FCB(;)R548QD%-L9L=F,-(CI2"&D
M\V$8$H;989+9#^ .Y B3(&$2VT,VNYO$J!N)(7;5-S%V[:ALBN226KFPV1B;
MU(A!W52G7Z>2(:ED5BJAH[!].W(K.%ST\1.T"Q KCXC,EF1$:7[B+ [=91FA
MNBY1',6(" C2.YX(V&0Y,H-%.B!8#R'4CN1H0P3K(B1:Q@6F>Q(OXB(VN* L
MQ;BPFD1*"<8%UBH(6\0%L[EP1<*Z!;';!:,.'YC*2;J,"TR>)%O$16;VK21E
M"!>941P"#-,%8*J'< D7(^HK+@#K#6#W!N:H(V J!EC$!6#Z!%N?CB-Z1*6W
MCNID8@3JTF08#9C@X>YWP PI/:(F&AR?,V!M >RVP&*'#TS P);1@$D3DB62
M /,HCY'S$\RSG*08#YC8X>Y,9PX?F-@A6U0=BLF2ADNJ0TU9$J0Z-A!KW!23
M,+V3<.+P@4F8+I,P17^FTT75,24,,5(=$SC;20-C&*IY>QR&Q,[;B4LC];PQ
MK4Z#Z!/TP]3=^D8-J'J< '2SSL %D?\JVF/9=-ZKD&I4&X:M@Q"2JP3#!Z79
MDQJAIX>*'V1 FZC[5@^5^D&*\VU&G@;U]7]02P,$%   @ I*5J2*=583 ,
M 0 AP0 !H   !X;"]W;W)KJQKI7P$I/$AQ30E(L6-M%
M>>;WWE2>R<'PMH,WA?0@!%/ 3L#E>(SB:-IX;^O&N V<9WCFE:V 3K>R0PJJ
M8 04'TZI0WC [Q9&O9@CE TLY8=; "R/$7$1@$-AG *SP6>@7,G9(W 7C6
M+!UQ.9 47WRU-OV9:7B6 $];FL:&)1$JH6(#-^]R?(5K"8D3+"37 HF*01LI
M)DJ$!/L,8]OY<0PGZ?Y*6R?0*X'.!!J"!R,?\P"2K'@&4!E!"
M$T*^<4KO.*6W3O&J4[JH9MT)+SI%@*K]A="HD$-GODO,N .=>Z*^T[[@>=:S
M&GXQ5;>=1F!=1;+ ZCJND-&"#D =;W;(24"U
M,;.=T/W[^4)HD,#B!= .^2XV/LX[(3]4!:#1)V>-VD65UNU+'*NR D[5DVBA
M,2MG(3G59B@OL6HET)-+XBPF29+%G-9-5.1N[DT6N;AJ5C?P]I&ZTB'-TGWNM+I>U$7.3QD'>J.32J%@V2<-Y%> QRP*D-<1&ZW3G1&Z33JJZ:^C40Q]9\4UA;P%(PY;ZHO"HM^#TE0IQ^^K9N7-O
MD#Z!# DX<\(]D9/YC6I:Y%)T2/J];:D]0OQ"S$:4R&A3D5UR[FU$D=*G&Q(
M'M\LTBCHX(.(#QHB8@, <)!YC@-Y2"?3Z:N Q)5+3^\25],(:0 A=0BK'F&=
MM3B.L PKL89TO$V-]L"F#,N\SP3,[EO5HLC'-<.AIA$T#8+2%.JX-4R
M"'T.#R/:;)I!'NOYO =9)%9'/S \1*[?=3@-YEA"MR"/29CILT,1N@JX-4R
MQZ'+@--%%T$]-"$*X)?-YR:.N%:)CZ/%'>';IMM
M+OY)?$G3)$PC*($Y'.G'F!R; ZCJND-&"#D =;W;(24"U
MQZ'+@--%%T$]-"$*X)?-YR:.N%:)CZ/%'>';IMM
MBS0P:-A2#J)Y]=KR">)9]<:C>DWEVD(,D*DCJ1JV& (-D7KFV> $U.FFH7] 3
ME*%K05O X"04L4'#%@H(9E4,;:& 4/6!M!,L4>*5]*%%K67*/D^ ,$BT<%>
M)2R9O-!5S[80PDD(MZP@7N! -^2LV:>*"DNMCSSEL?/- 4$L#!!0
M   (*2E:DAX582]\0$ *,%   :   >&PO=V]R:W-H965T(7W[^C)0
MB#QL\.T W=\L%U,C+^+EA#I??9T E7(\ ""JEO18/+&1#&JE8;S'4@WY
M!8B1$UR;H)X"!&$"'>MP-?EF8N5=>%NPJ:3>O5^Z);]]C O=$*)N.?N#/$V =
MI95Z I0%6.+JKB>#Z-C@<=(< 6 !X91KA1'\[L@D5GU/YWYF[%T/?M9''^H4
M""65U Y8-3?R3"C51@K\&?W3U;)5R4+?JTF#
MKU2^L>D'N6\AUH85H\)O>HJ).OG%- K\:=MN\&TDUW)X#W,'8#N 6@)0#9Q
M"S)I?L<2EP5GD\=M:4>L V!P0*HOE:=R$%KO7BK*XE%$&$ 40%NVFDC.ED1
M,J(X2A8-4("%@G8HR!$$S,R5T.XONA\$ZA,8A!$ZCKX^&Z>6TD<=H1H!!&Z1<,
M6%W $5 (+\POW2"\Y/J+IO;V# FB? *"3^H^H?2?(EC#+I^J4 4&$?\|@4C<
M^4E$B*\CZ$?^@X ?
M6S)@ D0G,LHW9\H&+.2070(^,8)/.FCH@R@,LV# W>C7E7[VJ/7>25%JWX
M>>PZ#)C]VY.^1<@\'I<@']&?BK!?!4?!(^(4[4?63D'1T]LX[P4*EF%:RA5$$JWX
MW9\M[MN^!9?Z Z; #SM !Y! (#*T!%^I4^,(N*9#MKAD?9;4<_K/ ?NW]#]%<%B#+QEZA; ?
M;C0DP&1/1#8'1^ /M:S>] Z)=%X0(FXRO#1,U>)Z%]HHK4>V-1%L&:B)M%U@^O$
M*Y@RQ,\.#*W*2:3O#%VY^*1;9*=S+@*@-VT0Y1K,O- 3)JL)&7I%IDJ=-
M+;9BSN3AD!E)WTH?,A@!\O.(]/%1*']O-9I^D*YTSW:V>QHCGQ]$J_U0)-P*'!0
MOO\0L60+S$R)?Z]G%+PZGY'!\8'"0A/\]%@"JFFTM+^I+Z9C;L'V^?7/^X@@
MCVN4<#%3BE9!#U+%R^4+5%!WX'KZF@@(*00.F
MZE2?Y$E4<Y*3@(J.=.HIJSM#(!)Y+C2I3*F1W0Z\/&%G]NT0%@%J6VE%3\[UE
MF$ZQ-@4Z>R*#/2\/%81-@1Z2 C!4IQ)EP.O\6:DC,/M10,,'VEF7>/+"E;T1#$%'O.U7Q+<+3M?Y@E;V.T*=;\F5B
M@7 F-O'&47?)[1-F:DJ53@:&(7(&)^%]#7$9T! %,E:MT:V#GBT$G5W\2^SLK9B9JFF3%J%(

M^R8-.]HX 78$V!, =A*BCA]" GL7HC<)
M6"!5ZKVGW M?OS+UU8@BOQ4 @"0/;EII %JW(-B">D2@Y/L8<#K&&EIT.!9@
M8R.B4N)QGV-5[()IE.!H8QB >W2I#&$#A:(MM![4P&0B;U?'@V'+PW!"P]6!
M()Y7/U<3 CRK?MARG,!H(I"K5\&P6>'4GG-U&$CG&78U&D
M.J?-27MD3%*57/BF O>SNG#UDXH>I1XF:LS;*T@[D>SRN%'UU[KB/U!+ P04
M " "DI6I(/>E3CRH" "O!@ &@ 'AL+W=O&ULC57+CILF%/T5BP @'2 101I25>VBTF@6[=H!)Z"Q,;6=,/W[^@$$
M1@Z:3?PZY]QSK\-U/E#VSAN$!/@@N.-'IQ&B/W@>KQI$('=ICSIY69'3F\!MAUX9X#="(/M7(DR'HQ,XT\9;
M>VV$VO"*W)MY=4M0QUO: 88N1^+!KZ8 V7^3.F[6ORLCXZO
M/"",*J$DH!SNZ(OP5DHR\M]1]!%3$9?S2?V[3E?:/T..3A3 :6O12+>^ VIT
M@3:G1".A' F!,DF
M(1H)T8,0ZTR-,YW7-RA@D3,Z &8NHX?JSH-#)"M7 9D,=]21+I="%/F]"((P
MS+V[4EJ!2@,*#6A&>%)^CA$^CU&&"[HUP&F)B$)[A&@CBTCSXRF+R*X0;RC$
M6B&:%&*[PFY#8;?VL%LGVIE2&% Z@MR]#71:@K(%9F4EV;"2K*TD5BL&%)BB
M^VYJM;("!>Z3RT\WO*1K+ZE=(=M0R+YT-?L-A?W;0V:MQWY=C\A:CQ4H=1=1.[
M%]4^GG]Q M+-WEKW<@1EQHS5R@A)1[^?K(\9;] &"V%7W1PXJ>NN$^=3FW;D'
MOX2JCWS:+U5OUOWE(5/D/;RB7Y!=VXZ#,Q6R2@%^0X ?NRV4&,=*L\Q"SGGKOH'DDHN8KVO3MQ
M+IW/NFJZK7N2\KSQO&YWXG71/8@S; HW!]'6A>QOVZ/7G5M>[$>CNO*P[P=>
M792-FR;CLY"6N6Q>YMP>OY?$DAP=>FGAWNWU9
M\Z8K1>.T +!U']'FF88#9$3*OFU6UP[0 !O0KP/-S V6]J;OSO["Z=%/7-Q'7JXG/Z+9OQ]SJ]B?S93&^ 9P-L:T!F W(W
M0 %H0&<#:FO 9@/V94#'6DZYCY5[*F21)JVX.NTTW.=BZ"JT8?W8[)R^7)T[
MO!H'9$"DR4>*$(X3[V-@4D#9!,(C*"2A#O.TQ* [PNM#N,>!S7%D>&F.B* S
MD:] 2!O($H1UB.<5#=9'2X"JD9&!C@Q!;""@ $="<@M!*)G8 #4T+0UNM)
MQ1B9L#,D,4S4A 4RHH!@RK((8TB)FJB/3,$,2PX%=JT 2PZ%-
MJX1*8OWS%X9DB".K3HFL.@72((YM.D45*C6T"H&$2GR;5E%0QE8AD)K)2JB&
MA9= 0B78JE4(N/4C%JVB@,RS"H%$2*A-KQ!JTRL$$B%A%KVB@DRS"H&$2@*K
M5@FL6@52,PE51X;]%8&42B*[5H%$2&*;5E%!AK:FD ;I2H.&F8E"\J)V^TD*
MR8LJ^TE&U7RG348V@^:].F7 +H-".J0KB46ZZF9KE&$O0L%O-56(3#N.V1IE
M^ :FD!*INAPRTXJ*,W 8W # !0 !X;"]S:&%R9613=')I;F=S+GAM;.R]VY(;1Y8E^CSQ
M%6&EI UI)Q+" :*+K-DBE2S6Q(Y3$IE;6WS$ E$9D8)0* B ":SG 0/4R '
MK/L[SOOY%'W)V3=WW^[A 2 E5[++[YHEO?%)F]ZU:[8PB^W5;W)] !G??=%LZN+?-7<%\5^L YBV.]/
MO]CDY?9WZ6%; N507%6'[?X??C<83$: ^^,?FO*/?]C \:MJ>=@4VWV:;U?I
MZ^V^W#^F;[?<:%EMTXOT^^NOTA?/7J;/TG*;?ENNU !U\X1P-7,.0:AOL6*.=S^L %8 C.V
M>MBFUT7>5-MBE;YMFD-1AR]\5W6-5@;SH=A5]9X6;) OVPO\+T7K*VGAAVH-
MYS"O'V%"ZZ+N>HQ^3*]@CG=5W5J3[ZKM1;Y<%O ,/+'BISM:>G^X69=+(-PJ
MWW?-JMILX,!<[ZOECUEZ?9 719.^.^R;/? %F&1K2X '5.MR17V RM?Y=EG
M:\!XFI!E?+RO#@VTTB97Q13&77N>-PVT^67KY[RY;Y%H 618+G%$R\C/E\LE
M\K\FK8ME47[*;]9%^F);[-/J-LW7Z^H!Y]"DP#W2576XV=\>UFENWH%GG@VR
MZ7A ?/+9K#^"D>&W,(EBJR36#OZV*7EZNT^ QW0P.3P;%4^WL8R-);S];9
MK 9PL(X TR;QV9?;)HLA05LCP*NIAJ("GLO G(H=\B4HH^^
MA7.PO2MQ*[C3Z%-?5]7J 2Z>KNGBNM'KX0/O:.K'IAS [5\'KOO#T..ZS& *
M=;F'U6\1I:6P7?X8V[FOD$^6-P>\F^Q#Z;Y*M]5V";=G7<'E"@REW.X+()<]
M[Q\01 $7/C[:]5QD(/6AB-*!&G [/-X6,GL2CL4&26((C35=O.%^Z0^S(WU?;N N:Z25?%S?[DXTRIM+47- GR1QCA
MMMH7IP?X#0UL!V]>[. KZG!WG]Z66^ +N-I/&*] G)ZTY,*0GKKRY[W6OO'G
MO?]-N2WH,6)2IW;IO#:[-^O,,9V[9^[]8XO) =.5!6CPA=BL0)!H6)!XUN U^ T!;$^=?LK7
MA^+GG Z:' ;W<'O]6[&"JS&#G ' M *#P2*;C&=IP^+'L0NV?:?^/BU1D%LQ
MKW.22Y8.^H-L.! R>^-L.%[\LAY:7'8%AP!("+89KZ$+D'66?, B /BP.:Q)
M6)+KN-K [MT#=X:FTW75Q'BX?6=5W);+]H%C$FNB^Q:1%\^B FXSWD:+I+-S
M+B=:S?V19D&6 3R DD!CKJN8]3U\;Y 4767;Q]AJ@V>&2>&\EU^:CK*I /9L,9]F\]GE.DAP;Y195"* NU9KS4)A $O=A+.T6L[/2L'F X-"50
MEL?#ODQI/,RFDTEX4E \/K?%\3@;]V?+L+7:E[O/;7@VD58GBU'8
M9-Z6U9F!G[L,PVPQE6V%8SR:#'X?]+ [5U0^M\OI5+J;] W9]-*C5*N.TQ-(
M=S+N9^/IF+L7ESJZE W))#N
MW8AI^/"M;LH,(P\$WM,3(#UJD/6'YLQE BR,@AME(B'$$5]]L,>QLF<7'<[=MDLV&
MALJ'(SQ5K:6!W]:>&'CFH/LPYH6,&5J>!T-NF8Z.V1]>O, Q -X7^W*9KU^>
M;8^X-$: N W@A""4.2'GY)-& +"2T+EOL(AS[M/5,?N-%M,Z1^X =G+8TF3 $>M-U%80:E3'E93PUQ ,]?[67.^OY7H H&UAGMW5Q=W:-19ER#T
MK-@>O:.- @D LM"*GLD:Q(H!'(YW.S3Q$2MTE&S65I%S]@1SVZBM+]!JM:1]
MZ1R8*.F,S.N :/4\ZF]*C$!AE[9U=7JL-RG3;[N4I4Z-LR-P/#;MC&P:DBU
MJYXV6/-:\XL&?8U?TF.;O/ZQV$=H]@/G5C"]=46FL)9]" M&8Q0\
MEJ\VY9;LZ3CFMA<"M=9 8VJ"H9>A 2R^M%5K#=O'HFG2V[K:F&;E^0N V1: .9C[Q]O 7JXO^-;W)FW+)Y%^N# OV-?"G
MHKR[)^4-9I+?%8:Q&8T)]61XCV3 < KW=.$S^C "=Z\\$9VH\%Q)PC:4OKM-
MA2[11>DW*3]T.RG?14P%?):+/#[;5WD:[R3>9E@+6 -X)XDSF>-7^IPD)"#
M)I;9VO$! 3/HZ?8(Q0][YBKW7IYX^8\+=
M#G7S(%[38\]MO3IJH,:^ 1L/9VFUYU&-8ZG PELSG9VKGC5Z8[/L-M
M7G+LG:^.F?MB!'W^D[]D64ZV=N:R=)!M^-BKXJ[<(L.P>EV^3[7P.CSY1I:^
M*.4R:EZ>?/WUYZ)>E@UY-N@" 1DH*@!U/NCU%[6K7\!-A/8QH ,@@CSF>;A<
MPIHVI1'MSI4IE-A3W-Z"PDS^[% 6UA4^9 TO) [^UB*0[P/]&\I861>;:.TJ
MZ9M=Q-;2E/S'CU) :ZUT^=(WLRDGQ>>N3AHQ2'$2TT%WC/'O@CPN+9C.MKM\5UIA8L\85=:[^K!*ELVG ##MMS[\M-#N;]'/A@3:7Y%4\^:A
M+O?[8ION.'ZI O96DT=/EK T#2ZK&&/\VW9W=$F5./YU#H^1]O!N"W1HQ>2G
M$7Q+$G\"P;?> 5N)U:'A]0GA7R*/=^XA+3D.<'?* =RMSZ%OZLVZ>CA?CW.V
MIQP-T1U1/ZL 'QKQX^ 9C;)=EFNEL^(M5^S9.;:K*SQFJ 0&UHNTW'+[4AEH
MCG2$&X)-8)LQ@R0LS;)DTQ!9DI2MR-)P'AB05L?-F* R%5OQ1=7K- E!:^LC
M@1A=4SEFK)%'0FWS7/&JZWF@\ .? %*/^>>?' GHL?*0M*MWGVSO6'-7FB<=P
MNSHO3JP[R,^$MCG74MR^]W3Z:J]A\"-3M'>^ R1*=Q8#>R!C%E/,U[8E;C^
MT07.7[2:/=3+>S+5TM&.Q0T>$9/IK9M#4VX+/!$NQ(>\T/A[2KI@L$ORO
MQ/? PI3>6)(ZM45TMBV(E@K-QK6V14P71G7:D0 #Y;G^H(NOVRK5518SH'X
M8GD\9F%][^1@Y [,5R"\<;!T*!8.W&40#)@!<:8P6R/,KOB#^(1O[.
M1ZX/N]V:9!N8 JILEB 4'&K>"9K +0@Z,!";"Q/K@\D$.7K9H1L?ZV9K+VC+
M/V'$YRS6U;&[PWC>(E>!B3LAMMV./4&9)PC-"'O^H;@OE^2WD)N!)7^?D-J;
M*$S/=R6U% 3Q ';6(4=OOWF+NI)8\Z1&VC4$JT3-? B,5202^L\%5 $R?<" D[J$0Y:OUX](
MW1LFF&$?P]A@ZT$36)?P ;;,04S;E#H*ZY%D2&@KH]7"QN1*,MZ,''2K=?Z
M'JAE5>\J(0+N8.X%>\%-!<1]E] Q '"PJZ(I[T <5]Y@#-0""6&]YH;0V9RE
MU0,(PXKH859XR'!.7)W/PD[&!"TAWP]5U>
M[W$6/!KY T?#BV3&E)2PAK4!V+,14D"+W!>&5^E J .M,8GWEX'9>+>+47
MN*;><#,KD-69K=Q5#'/=?Y75VP]82& /Z2U@X-5W+%O"CR);#FG(A.FDPO
MS5M,?\!A0+%YW*$.# MX3R1'$2>P<\,^'7*W]IMJ2V%X&>\Q -^$+3"CW:N5
MZJ67V!9\?5CO3>1HP'J^Q1;V<]MTM=,$U>.2H'44(0 K& +]9KF:3A5>OGZ
MM82?4N^HG(A[S*G*7??X;?IBR4("B[0$!;CV]=7-'L\/>N"#TOZIKBI
MH#YCGQK'4:F 2?-U@..QZW9P,OR#]V>Z??\!P<>6$6TH\W,#A*'/B>;B-;X#%
M\R& =OAZ*N0LVC/(%E:SRASP2.]E*9/EH:8 XTY^P0' -[A Z@KD@(K#'D^K
MW).54*VE.: NIBU['N@M(0^^GC9Y]=T6MFO^%5+M\'R2"0K4"'(A6B.0GJ"
M1^&U.XH/I,SGC%[;>#):;Y,7YOO(Y(QV<7@%W/X@55<
MW*Z17^"LX2?X[<\54'J*66S0-^W1/ T@7$HX+= #(8-:I5?PP]80]NO/*"-
MA]]\P!)=P#:)
M9)91N#9(/U6])V*YJZL'X'=RZ,R9R$0DP48XD>Z"O#*[#W!L-B
MBIKNI]:1]NSC'2AH9P&OEV^N[S^ZO* I5^OJQN\\@MD$<"0,#I*"!F?:BB &)G&A^^ @ UJ
MQ79>'S8;Y!KHO8#+LKP%3HHYWBSPX>C>@]BQC B6D4=.B1M#)+)S^TM?Y4W9
MB#O&23HYB3Y ">5N74CLB!:-/MX7?LSWK96+&B<741SV35%L62ZLF8?">\C@
MD-/0A?M][HG^XRW"Z8 [RA^QHUVYX:"I^+KR\OW=+I8Y[NE7>&;0R1H,C*Y
M*$.A<4MX) %4[/9$(M <5A\ X1@P:+D# T9-I]+JF&X-C/+!="HW)S[+WGCV
M')UXUPE,2);B4X&W-OF?01C&S^4[7^
M5)P8%)STMZP8U2NZY8AB<-JDSC9F=YU8KFC\&@-O\QJXR*L* N&K\ +Z%9%.

```
M]+FK:D5GA6F\@FU+YX,^O7AY?86?Z5WO+/@\31T*I,)'3$#  3+]E'O<2QY^
M22>43<4P\EJR*B( 4*H,)DQM^0#)4#+;5HYZ)2TN$N6+P4O^FB1!8)LL^37P=OP2'WZ0P6
M=*?>-%5]0S^PA5 E!AE=I\9H.?$RH#')&,]%:#!/;\$*K890,TRI1+9H+8
MV T[US1K+E  W.9[RYP=:??2#\5R#6.QAP*." @HN57OV92#/IB#S !K^Z*)
M>B2FS[>XI*ORNSMU[ 32[YDIOV[VL(ZX87PF\/:P'I[]FAJH5-C
M [,M2 / >F@*3"994X0D6;6DSQ5K\P=8#TK!..)4:;73Z30)1X0 AF^V8L?Y
MI=N\E&O0FJT<+2. AV>,5IHWVNJ)L(LW>$9X^6E]:4$Y?%5N0A13;92O>"6+
MLRWMD15O.OR D4?5%23Y>#H7A55#YF#V%;64#BH$AEFAQQ5Z)+YHG:D6D (&
MZJ\G>5](0S\PX8M1U?C*D,<7H+,0\;K7SC#5^V?EAIQJR*@=;4.#]R5JH"1?
MH8D4R-/<2=0;:]#6WVC/^0VPO>)387QY-4'GX&B BX("2]@U/4
MG\IE<:XU@6GAOBQT)LFJ6)+@1#RG9C7SW5??LKK**WQ%K[S^7"P/1./O;H$I
MH1#Y<%\)/VT\^7HK"JIEB7QSHIP+*OZNDKL?*6W)HX#EK4#YQQ7\TSU>0T*/
M*.T'PD7L+9&Z8-R895,6#XTG/;JMD.N%5;K8(/&2HS0=ZP)B3589V' ::"9#
ME?FPHZ,)[!:WQ6X!:>-V/EE8M">@O#T!/52 ,\8
M S-*PD2EY%DRGV:CT1 ^3$?98HH?QI3]G[RU*4$)M#2=#:&)K#\>)R FCA>#
M5EM!'E$R&,RS?G^G9O!)!DJN' H/^3%$"[K)MS\"M0/U(4W?%VN6<.X+M@+2EN6?,%+-7H&A
M88&=(@V2('":NWNXJ3G[3=F5&FO%$J:) J28Z^&P[ ].6T-#U89!Y-?!*6@;O9"% ',C1Q4==O*Y@^C< &A$7J3:K7CZK)!7?$87I95AEA4H
M@N( +%:4GR6KP[99?"G@N)R?E# #1R4C2WNW6,"P*DW"V0-KV-RLS4O[TF>9Y\,/T8M;@ $[5%LRA 1T0MDLR)<*C 7SOIJV ([U8QJ9?7T/?RY AIY1W>IWKT230KD6&4.=-B:(9#
M$S]:W=Z2(8;MR)3C+LGN(] \8>G!FF=H?V^"H#O*D! V^NF&P3<)5F=B N*D
M^7YOZ'[V82#(CUF#.G4!  -'[A$,Y?CW!EXO@["7?KR7*,US/(>^8TB H'L>
M^4=XTW=<[];/I@:+= DT&TP7\&$XSL:SF7O,W&%XFP\F?;@EL\%HDG BCFYC
MG(UF<'MGB]$T^2!'V?V>#++A$&[N; 2"POEH@.0%80,F+Y,7L X( J';&"6/
M?C:<37"THVPP7R2,\ <1U(,KP?E3W/(8"*#E'Y)81Z>N.=QLRJ916@WS2IF!S]R2TJ-K26]F@?"VK)O]10F[SY\J4*A%
M+M2M*AY?YP]XK8.JD:.O3RRCN MJ7WVJUL#?T$^\+=:DJ)/W1QQD&V-PO, K
MU8,(B>9.@&DOX2.\B H+.1JL1IO8&6< 93F5ZW1)' !1U0\Q!I@1$OFHB9+
M6*!SRO,O#U7](\S]8H?!3 V*XOX78LXJUX]RX]+-$+UB:6P(:4@V.1R?UDJT
MUPW-E6R]DP&)IDC&H\>"K#2H+^//.\/J'T61;':X$73K$B>N[8VX0AL1"62]
M] U\'QTE7"%UX7$L43;8DJI7*+3K;C8%W5MER]WVDBJ9AULQV!]&2TRK*@:;XUC (%13;JD>JF5/!PH,Y2
MQS* 6"W<#;-CWRVP09="R&Y .(N'FGTYQD^RSF\J=K.CV'*/ DA/.I#1BG$Q
MMA+^Q1ROR<(;X@KQ>%F(*BV $8F(
M52+Q^%XK2*S -(AKUQ%+(+'(^H0I?W#L9.)P6>KU0G/R> <2M[@5#ZFG,G,R
M!R%R'X'WONF!TKQ+6LM;^5%%OC$QL1[*'EOQ4  /2L+OBLRZU@V
MR1.X#;L4!X^50XT74$SGV(:5Y4T<#LJ2Z"VE!ZV[S*PQ,PP3NQ.:#=L!0!%-
MU/I"5D8MQ'%N$,QB7?X(HA- K74.OAC8>X[7XS%">H4IH[Q
M=#)<'J/GI8@,!-,KZA5[YBC HK"W/2MVE(FE)  ,;A&NLOH6/T6*A-RQ5P1+<
M0[<@P:"/S^D*ZV)I,GK<8DF\S8D5QRW/S!VL"-U>^?;T%7P)D+;QB4Z /B0;
M"1^Q9^$VBLYVXC+PC<"WX9A,;$?DZ-T6$C0@:1VW:BVL3Y W@]4X;2'-*
MB6+SJ>(CHL^PK"B27AU9C)!;Z/' ^ EN0+FU$*O%D
M6&M)7:B8&N;0Y%2D#$-T-+Z-<6SKKQ7CESD($:;"77"$,@G BEVK);,TJ/F5
MN1C:S=K821M4+7)']Q47\^9Y5QR:@8($LSW%THDLU#@AAP2>>] ;
M0^/E^3EYOI=Z4.20/2AR S)>@CQ]$&NX)-"!0K,H]61,$I:96
MN@K)%[=[  -#.Y>PLD7=ZHOVX  [4]V4:S1/H5.Z( C=5]64)X?6T>3W=5SQ
M:&O[P$GFMDX&<)<\GN(I,XODC=FN9"+?7!W=M60DCWT;W[QD0(>HLW M3:>< (%Z5TM)B$6F$D-!E0+60E&5IW%9]M"$;:X.
M;FTQ6I(X]%] %G= 5N^"F5)V&6.=Z@?C8JC@V+(,X'$5VY,E@B+D^J13NIZ
M&YL4[I B;$=)J /.HK:-: O2E17 N"=0/2[6E(75/=QFXOE ;:"GQ[MP3>,M]QIR9VNB?;&-8>;/XNP?%2MR=BBTA:2"LF"
M(J$4!^S^(CXYD ]"?E3KA4R#=*CF9'YO"
M!K^)B0-DQK(A6ZYQO=V2,]K=-F7C%$MXUT1:.U;DI'7A0;?^VVH[V(? JX[8
M'"YTBL-1' 6.Z'GFC9@O;P5&%-K9/Q0BG 949XQ9?@ *"8K2,P .#O6I-!?$
MIPM/:T3N-*L1G@4C%:!.9;KPF/=WE9X^"F AFW"6.\ND-9A=TX5F%SAC>NDK
M$TIRI4*6TC##W ;MDM-(W*#,GG8F9\.:#E1,D$BS'#%:%'NYVF ICF$ZS54T
M2VTCLF4^.,E83)7)?M1!OA3EBF72XE,R%73R"JA-] (YXM)Q&9
M#JE9UEV6/40[.]M(7&0I,'#GML3J>  .V^V3N1@^P+T0$9!F"WNCB8M9A\\L/,]PPBZSOW9]P>9-H*)>EIA\7QR4A>-GY[RKZXD/-TN,G,C(A5:%X
M>U-5/ +/J*X"(>L @:5-K*>0R[TPMKK5E1CU!;D5Y;*(@! ;HTHG!V<25E4C1!
ML0HB>+0H?]C!;T2*$EU&-P7;IFL#M-'\/KUY:4-J A.0Q30B'*DQ[V]8?75Y*#?92(
M?EVDAME2C$.<];/99(R?,!!C,;*A%F%097^8S8>S!*LUC0;S!!88OAQ.L ED
ME,PGV6PZ2VCTR6">C2;S9##*YN.I"[6 KV<+C/*<#(;98#A.[ 2 9BB> +)?
M1RE05MW'FN3L1PW=PS$9W(! YLF68B2U]J);M5KJI9B # D)I$1+UERJK17,
MB4"M3D3W!0F)C#XAN"=$%3;2 -YKEK+L:/@F) .HL5;/)V+YP/==A1 ?*LS,
*? /X"L&8/JT9=!9-HS>CBL8F/HJ:[ WY7AR=@49Q B9=F20.RCL#Q@%U4<$
MIN")4XSX J*\>4HBE&6**FZ25U:G%F* 6]1@P;$GG, /T1N\ZO2RCE9!7NK2
M.DWP*?LR,(UQ>[C-*5>[9M.)9+"8P5+ &<9[KS^1TK7.2^L*"2?4^)+5O6B5
M#-W##B(0VQ^-T1#W?6D59FF,U!L025.'#8%7&D:%W1[J&P'\IYI8:NEX[G8\
MN6Q#J0UYM%C(["Y,'MI*9?[:^2*[Z&"2#E2YJ=&=R=^]KS&5I# <<(P>BQ
ML,?FL/$9A43VTV(>]KL#X +S(W#B;2[C,2??R4 $ S+2Y;GOR-ID>UM[ CQ0
MYEGL\T<7"28(65N2E8Q-HXV3E.R*N19E-+("$BIO&J7X6A/ADROH#6/T4R'8K>;ESH57!$
MG6HC.?LF\KFG(&A5'OA;E9$6GCRYV?&*O!PV&8$W=+%AE+4R&O72*] J
M&^;&N1H27D <62HDB@7O>Q.W+74ER!JQCU?51!-![HV[$0PF$P2 $7XL9=T7
*V#I*JN!#Q$0KTU?5+'V.'YZ(Z,^"$$$NMO U8GRREHM'HW:C+:7.KCZT@2)
MMRP=:L0Z4\NN>::"3?V1M/RLU^G',36E,\%KS*$:-%?.7
M=95O PP8.Z5S-YWBZ5F0\.QM-O-@2X$@ LBDYFUN:7]UB!VCB+2JED)^.9DS
M=9:ZMHKC'O%:.X(UACC:OQ4'0OI11'CT,&M'"1L5.9F,Z4GL$H\27[E";D^)
M4D2L$5+Z*GYV%#&BJ4K>U-.AK02&0=7$]$8RO 2SPG+KW!/BTW!NC,R=D/WC
MCED:EE-:YH3>HO-XLM!UY, $:62PFU?!-Q'+]8UAI4:&;/L@HJRD@Z@: PF6
M@U !C$]*Q*DX +,.)SB,1U]LM/79 6PLF8ANI8 C0H/8PQ\LA<^CV,YXLLJO
MAG /4HQP7SL^1@M)W146S$QOLL9V;#P>Q#0,UQU=N7:*=Q9.3#)YK-D&[U>=
ME6V/2:1/E]ASK'/KOA3($EY'/A^R7@Y$! '*]C:J17$5BSM' (!U3)C6WO5&
M%QQJ=3OGXS7> .@3 4D45 G4F] N&7\FQ7D>G36H? @E\P\U /^/>.(!9W M FF CT%K%UGJ4G5
M1TD1G=&"2KOZ/?[%B&.*C8>S,,??J;NV,]*UVO>'/U/0*^L*+F.RU+[=LBF@
MW!^"9=\H ; 7M3&+V?>37\4CUW7)7N0"!4F#P+JXQS6>B 5
M]BC.Z0LR(GY=B$#FY)J/GM 7]' F8VR!*033M( ]=+Z\A1-UP1\EZTIDHK+A
M@8[!AVVZX?)PAYOB=R-&CV .YO! O#*4AT30" J4$/3X[1YF[D'M+
MY&R)W];0(YYF8EQU1]$ N;A*5PO$U0H4\SX-XL'Y4@[\I07?792KH
MOI?+/0%7J42RN%I)HNK:1(6(X64,ZT
M&Y-A:NSD6R>SH6CU&4YB["4#7VZRQSRM7Y974.[0!%0S(%>^^@2K WP>O3["
M]&R^=$M4),8DV05K# S)J@ 2!J7@85=*UY60'+Y1B/7KM2(5SI$)^0+*OPCV
ME;RJ%Y)#1/+/Y09! /S37)]N
MK77HL.54 #R&?SE4R/IHO\4OSYYZ6F7V5[(5<2FR&@<@>"$E^^CJ ]X-8.@/
MP"U*I@9SUE@,:DET)$=:\=QJB'LW/3J2><\(J6Z"0'8A]1^HRLAWQ(T1E7#
MM58Q""@ZE]Q#0LVP7NP$1AC'?6ZPX5A87,>S!Z(C) ^D6 B16WB50Z?7/X(]
MIS?2>!U;JF('*4CZ@H"T\G3AMSVOQ[;2$V[C ,1O$!-^L20$?@^I(,2;SUI6
MOLS+*W; ]$?J,&1^E=8;W+T'MFDQGR&OF8+T6'OERU4:8[OHAH7JH4A*X^;O
ML.X9'["5]^&.:@XYB6<%0=P>"7!O(7KA5XO!80IZ6$GR.E&:@?
M'>2P)?M")@*Z\V/S?8!P2.5GD8HM&AO61&RQ<%4%X'"@$
MZ03$S\G?S7J5.NO;2^$T3WAA$0JI.?.?B.73<3"$ZM:]$TK+Z"WWDI-5Z,(M
MXK*JB T'-9@W,<OU#QR%G9]JH%[$ 3GD%>RPC\#.HD^'NP$DIWK%=VL(]$ SE O&=0>RZ@X6T*?(<&^+'CU L
M8:5,EJL<-]=*;2J[O;RU[Y(:^(F==:R-<%1DAT#?Z F=\)*?Z?))7[336U\:
MO0GO-O&UF!U %#+D2%/44[2$K5*ET]RQZ(K2K;5^*+ARR6AJ+8
M@6\B/[&U.M3!;+-%+3B^WZJ0#&U:G@*1"PH4>2)(^ F?1>@F"HHU!,.=6@J^
M)%N:K1 WQ+DHD#@YGFB^&R,7&&P]N'O.S:ADZ>986*0D"P">)%//8X+67I11 ?<#"2#=BPID&;-\:9
M"K>"!M-:) />8.L!F"?N:K+,V-0$.P!16"A"FJ(8'*695GDJO/,DIME39HN>
```

```
M*99@L\&,S'(%6BJC+<('YMV2I; EA:TC1T^'-S?&:+%O. @Q(7 ?ZV &0R"T03IX@6LO:8("&G!+KIR<*M"DY))WH=]I C>G,F
M"AQ?+*TJX/,X.SS#W-1EX F][MFHXT-&%UOV!75Y]3E>5<5F @ZWS':3R'C2%9@1Q% QP>0WA,
MQ27J*%4;QNI$R4TA<44N\M)2722H3?9T%48 GHZ78]$3U29@>06B&R#>3'%Q
M6]ZZRA"10:@;(5>28Z2 KD3F8Q03VW@0O"PEQ?)PW5[W2(1SVU:7%O#-"'J<
M O.IA*M7"H&9@%)/[HN-(V@]R/\^E?49LD#C
MQ%7  2DLT B M2/+M-R^# ?)L/0[8(,EAR8BG"5'+.8; G:])65S>V&T'Q,.
M<#IAI"O5O[TN:,/;50:6P*M5AKDZ6 Z1."ME 8W[6?H-   :$RA;G08]V8T5%
M0*Q.L @K:L;8^(Y\=6D;U"H [.\Y[/*>T$C3/Q^ 9E?E4F$.D>T6,U[V#/GV
M-#;B&[ 5BL1.%ZQRLK97\BCGG#:-.5.B! .]MXHJ\ECRR 0"S=16*#Y 1X-NQ-
M 8"MH0O8\I(%NW(%.^,#?ZC6ATV1FGQ1HU"V)N5[$5S LC,-H$7,U**R5G84
M1L2;104>,).D\8PH%.HATHJ9B1N-!);W''>A@D>V2[W6WM'.CA""B.HK%CR%
M:?80Q[ PP69\">C<"CFHI0X[<.[]#?,S=J@0'?)H0F!9<7;+H.EB,L.V]\.5
M!( ;V?&4\<8\;^T:* .? B'I-/3@XF 5$2 UW.@.TE/719VQ1("..I;C  24
M6%Y"105#PB=CL&#PY,C4Z'+"1&;"04TH8604QG6504)33$
MC5\J=<<41"P8CO3"02 MVY8S607Q6=E77A7Y0^#2\D1,H3*
M)^ \7=VV02&]#A& I:G<&2/:W8*:7A1VM3G>P*RA4 5L9+/\ 3TQ=@<$M\>9Q@J@+I #NE=\6@@[#
M>76/ICY1+[J1P5[9[1'G*KA':=H%.
M+AKQ5PK^Y+7@['H/:'P4Y=IE T#[+-CM"3?%A?ZVIL@A#A[42V@]?445?][G
MN#T&(Z4Y((!B&*THDH/%IT$L2K=B#.VBOQ$:Z,!G>9)Z$B8221-YJS<,I1Z-
M>W.%,3R8ZEA]O*EGO5GTICXWK;\5T$^%01BF\DH5!O&C^#FXHJN("#OU,) 6
MEI=\QP8#'+-2&1@(I,#JL2@D/L*ET,,#9A"1AE&+ES<#3 MM:^64*U+G(A:D
M!RK'Y65B*5@P$44%!LAEA-H!E[;\STIG*A\5.*C/](43  %+4P=:"; FT9==
M<.-MEQ^O'T]?IG8G*4H8N4L9XOFZ GVK+B>;
MR^)0I3S!4=51>I]LB3N;0HB7A5">*DS."X"( 9RS^>'Z>UN %.\\1R\D5V&[
M+@<*)]OTZH18BQ"&L=5#PP.>KUW*T5\Q6"1GC.S[=>$?H/KK)-YW/?=56QMR 6SOZ*I@ W@'"Q+441LQ>9M :-\XF%
M5C8TULF6Z6JQ1I0K]QT^+67A#+GX+T(*%?9K,]64!DY2F:
MLA'8"OXD7VOD'BFIY4 :8HVN?K/Y/\EL:(KD!5&W+HE?.RXX^DHO$IM-20W-
M][SR FJO?+^>7E. XF1(R\X-KG"=%$UFOGFX=7ZE/#/7/[%%C$GU5R:Z?*^T
M\$V[9(T7HVB0C)7V9M:&GNO8$;.FI@!68+<-1^L=5=^-TP9W,MRK@Q:0U9'S
M16V!HDZCP1,S9Q&%\6H+/A\&FH8/$ZSX+:$]<1:+5XM# 0P&R2(&SY &9P-?
M.(3,?9%Y"3FX%#;8V9)?X/,U,0HNC[+S1)#8KXJFW1;Y7DJGJW JQ#Q?/QKK
MOZ7':AU(W;9<-WR-\00YI=F*V'<2XYNTC-.'F.U#$K;DA(H[NGEJ&1%",P>(
M7J';+]SQJ@T9V*HF9TZR(X"5A*X3[V*;SE,=N#[60WP'K%AF/
M']DAKX3[R!X
M4C$57^^.9Q*ITKIN6<8,"\\&,5)\JCC(W$CP:P<(TN'5C><[G"1C5>":*)>Z
M]54BH@A%&2X%99P6SKBP ?6N T'OU.D'S-!]$T\%H?71Q: M;-4B<%Y,T),NVF<,
MR,[T;W(PB=IB-:]D9PQF5MTJ+-7[PQ?[/ [ABZ;\XQ P  L :KS)\+Y$J1^
MO;$2^O%E7M;*&0B;5%8#-= /Q*. 3) -YL[,:LA8!OQL-G%UW&RN7(/[QD'>
M@V$VFPZS^6+ZW)2P-JM$.07X^R\"\E'?!V!B&
MHS206)/9-)O/YF(J$VN; Q(WK8* ZB@2R>8V<,!@P7:
M-T>?NBI6?E:B)0K=A'CT\9*X2-
MI<Q,U! (C-YZZN'D#D0M YBBPLXC?<5Q=X' YH
M=65Y4J&PA64*.'%;2K>UY"2SIZ+2Z-JP]Q8V31=JBDZ .NS)EY>QO031RGFO
M;58L.NK-Y?7^ :5B:RHW,>I$U.1!1K!XR86/]SH(D&FUH1 Q&ZG]RQ">0WQ(
MA A!(,9L/.XGD)*1GYB/6QY -I\EZ$>N-O3899?SA/XH5(DFDV
M&(R25H6%9##)1O.^%/QT"5/RZ["OAF12M$2:HW0N-<'DQ7"<+6:3Y&42HF4F
M+V;3.7Q I:/Q5'@NO)K-IPMX0L:A6QUDD Y"-TKROGYBG,W'6$CT[5;*VN::
M><6W(1E.L\5TG!A6E4P&V6SN$#)G\VPVZ2=FO?PL[@"$108(ZD$[5$3HAR: K#6
M)8M%I5Y-5>0,U<^[VB5UM]FF=XYQ;5./W+PV8X\1\ZQ49PCRXAPZM\<#ZMCC%AL* E@R]0/^W!8)U@A=S >95-XX#N9-)R2
M*1Z^,5;5G<^ST7 *G\ROK0M7BZ>"@P!'%%X;X6MXCONCH6[ COR3'JC6EP@UY EKQD"K:[J?-+'6F4 6B;W=%.@8 D*Q\W7LJ94O8Q
M"WA(!  @7^!TV845$L7M$Y;F>0)\;&%X:"%U&\AO^)]5=J2X$ NFJ1-C>,\*%%P=H0'D>I
M7A40>B^] EZ^-0B0&!M4HT/JFV^N4$IPE0HZ-.3.M[F"K8@DJJ8J2PMA(-O2
M[!SN[;-AH+%9$\1 1<]T('4(=@:<^&>#A:[O+4A4OL)$6IG5EE0*\]7KU[WT
MW2T;#ME;A@I?;& /!*M7KF2$XW"$C-/!/H2@^ /K @9#YMF@WS'O2;^?]?M]
MTR*9U26IXJ%"&4'L0;#K=$2^3) ID;*FYHUS./%:#,9H*B?8T& 2<['NS4KW
M0^JU[BC2,MHU>:AVXE-$[K("* S]F=HH;]Y3?][A7INB%3SNRG3!I#W+0@NX
M(&R:D5O(4F8A&%R]]PP?#G.'8U#"%W\L'E4TD^(MS$><&&MT95.84=MVO? H
M&W;"13)AI$(   'TH4Q/PE+SCB0')C?ZNO/FZ\]36)2!!1)M6'&1H 10
ML;W/@ !MQOJ]O<64"K%YB>F% K2Z#J)U79B828I.Y" K.75\]S\87(C ;6P%
M6.SE/VT%?VM;0;#* ^NJC^/A.*H\3D>+F-8WRH:+IZAV@VPXGG4I88 )BTDV
M&*/L^/8)&M@,%+"^4\!&$]"X9E8! PEW-H  VPO5EL("(:RS'BX)L!:)IT-*
MC[Z*$CN,(GEM? R>? P&?HP7"$25?C'H)Y.N@H/C; 1[,/];Q;PNG9XI&74@ 7Y+(>)M'PD!V?(>(I*M
M%%SD%[&E\FYK/2&72"]L./)=) A?BF'E[EL6]K=!*II8J2FL7SC;+ZE-EJ]K
MN'T>;1'B0J5QM[L+ZD^AY/1LM%#R'<4,O-,R
MH%^#?6AK/X=WHH] &[(U=CE(E33?G1QUM.S/NGK$T> A6=@V;/)FRU9!MY#9
M'/*@[@U8$3?5T2$!Y]NZ.9ORL#&Q5L+SJ#$S,:JD9PL1L:O#N?GY8B]]./ <
MSSFG'5;KT.&6:CDT%;3:1Y#84SCO[;J<3X9X
M8@O $V&>M'/.0]!S)B@"903]G&V5V]S!MOJ#YD.DX0HID?EF[[F C]T*0?T>
M6J?6-V.XA*5;6NG$+?J17[[QT*J2P8*MI^9?N 'GV60Q3P:"?#?HC.PUS[4U&*8S1HN& U!+* E>
MMRM?"VHLBK^?\G*M95\9?B]Z@L^9LT]!&9>#\^2 UG8QJI%1-L(AFNI,!(:(
M9XOSXP3';X.'TX'0$>*0JX*
M%( P#5OU?57L"O*5&-.JX(JB[H.NMNW2FANOCU.DBIQ^@C^(S4H;-KK'06]IYRCS6*:NPH0X!5K^Q02'DZ
MT*GD\&!RH$8+%?#R!!E6!NB4"^T)0*5+'M81 T1G63!PH%ER!\M(FEU-MA!*
M2N:;G5@9D$J^%WS )VV2!4T6@]C3$'*Q*[1HR;P.@K AH.*]\^$ FJ5NP!$0
M)[\(D[+?H?EP,.C-9LX]D=$&76#A@V#U,%*G-QP\SYPYP*T4 CH:]OJCYYE8
MB6Q!9M@5!#@QP9##WF0J'B3RKYJV5B7A/J[2Q[+ PIC29; 7[S^74!N%*=+&
MG^4%:]=AB&!^&F!C!\[[8+&%HS/SKHVO31(BH1L(U-(+B[KTTHSA=%NV!BA:
MU!C.@\,)R"J+083"1+& Y (8BJD/ NP%*<5ON3@>J:O\[2DD!"P'XP*6SU#K
M31:SY*HI$ 67RMLT=0A9LA@.O,]2
ME<\)?I/)C/YO)"?]&G[ +!EDX]D\5 ]L-(%2)TYI$Q.,  .#72M+NW6>%';#W
M#%]G%L/\D#]8@($FF8(^/,6A#T'.&\&DJ K'BQ)9#A5^2^;9<#%(AB"2CIR
M?@#"X9S$Q&PQ&(<3\ J571L\B>^*EJ(5>  ):S0-:J+9KM!T&L-UX%]^=371
M2-,N^(,-F40*\ &4!&XBB X428,B2P@V!W2#638$87M BXC1#VV#A+ZBP=!,8,@ -!-03
M=!V/1Q3A\C*Y7*V^I#6C=#:\C9@Z0- !\A@,0!N"H4VFT/GXR AI[6DI%@L,
MGAGPLLS'I&=<=I2IS#I[SL0F+LNI3/8"W8@!3'6(\,?%G=$9VH:M)&'4AE!U
M%/KS5M#X@)35.AYAA:&M?8<>D*7/)F,%)D!!I6/M4?PMX 4^WA?QX3[XT"XQ
M# PJJ$A+U[^*H4$'ZRC$1X!OXE!&OW &X:'WHJU>FP-'A-7Y*$9V[]-+ <(I
MMC(C/*JNGM)XS-=OQ%J^14?@%J&J 8@R8+79O#^G,],?X:4'-(XA('CAU]4G
MDYQZ>ZB!C1QJ0:-&C^4!W2\FZCL9H$%BD4R!GT^3'QB6I2&[PG@.O'XQ'B97
MYB6#ZY$,%MDJH(F$AZ]#WF<3%>W.1U.'OQVWY/@#OHPM72M)2D9/2SH)
M*U)BWV>MG1V$JO$:/C3R71NM^O;'UE$L3G6!:)Z9?9=Y>YQ(NF8J@OL1G+91
MBWU9YRN.0[D)+ZG)J(!D7[F,O?($46FN?+\=W2/ (JNNKD43,4Q;PWW9'!/8
M)>L61&0 C&DL<( 32A(>Z)MI&X&?FH: =]#';=L3+V=T.6G[G
M,V Y( )]MIV<[ 1Q+G!;E+,5H^@"XG (&N0!%H8'E/G)3RU/<29P IR4'!Z.
ML\7^/Q$\5[%*Q&6%GF?#*JR)/%%^+/2J(@Q3XO%BVO $&V? ]D3\AA0;V8?
MOL!  7LIVXO\[7*   5*;3/H8=3P/^N-X[[<:38?]LD+/D+^/R&I
M=MP;>+[;*?ENX:'%8$@/]4&X!M9C=93A'$19&N8$%)P)#13NAUE TG;1'UOX
M\?\/%WXP']%\!K.D#^O2M>[];#BC->I/V(U5D0XHN)W Z8#!(HG)T&R4P/'HVP JA
MN4)A>0B7S%/OE(Z*R\I(=7I0V">!%!AB0 -#<.+ US,320G3PI
MN 5K+26MK \,,QF,QK1/$S@)'XIR3R<
```

M@2 @$U^%QEW,EO,4,U!84>R0,]?OUVFB[[@E K!>&&OW&VKQ8AL,>F
MH6V[Y*+U)YWF6I1<+M91XLUO8*22XZ^QX1Z-SXI3%BBM#IGH T 1R>A
M WR% Q$^D'Q309$+K# ZIU& []4 0*A)!P!/X'OQD,<1S\C]\ K&-GA *<
MD^$(Y!40]4!<- $*V-ZX-Z9I$6I/>DE 0[O =*!20L,QBGQS]\ K^MM[@#=O
M&VX&I@"BG6(TRQ9PGX[&, :X3'G=^1W99WX0PR2&9*?5 1/ 4P88U@$DB4$+
MSN=\"Y1,;IP;1J\1@@;5VVS8"!=9<)%2Q E:J?-AA 84N"^+@4H#@3,PC'+
M-XR&(7@N\GZ -^F+:PVTZ TW0,643-<#=I3%F<+X SRF$,;^\/=N\(M1SA#+-QHV$<98@$W" <MO2G0<1#E7*\4#JE
M8]S=<\I:HQ7ISW%W*^"B#)C9*":)7];W0N]8QEX0KXT)-RI(+MPIMYA(.TPL
M4D")J)J7W80 ''9(*,] G70+S;O9V2X",J%'G[U%?G%6*F9BUKC8+@](X6K
MR^H',:B$+5?*RD,0M8'BT$NY*EDF"\,JOH 7Z\-UZII$"SI!XTIO"BI"S[%"
M!NX8%?ME]0FK#^R;3,4.X=/4A0S5X9%)FT(M!O""\P2H$HLQ7T@VD+4SF)3K
M,V#2/OK3(*!F;RY8,@&'9>H">MO"$*027@+< PWC^W82)QDW[X#R[W+&UX9C@/K]
M+ 'V10%&8"@S%WWRET..[E\JH-HY2GG(']Y#S@2'.U,ZA#0D:)% 9.^[#+($
M'WU!5P%=ARP",H;!"%-J+0VW@GG\ ZY1?(3 V]#+-56CU071\%)U20ENDVPI
M/#GA@\&B- %/.(5T8.6H2I)E58-%K0J7KQ ME:*!IAG1*C,0*^SV;(&75*9T
MD(#-C,SB4#;W
M'"Y"I8+H2NH[[V/FXD=U83+L1=6#P18I7P(>@'VJ'X/*;+@*#IJS\BLC*'E1
M1)@WS"PYWBB49HYP9)^>S5WAWZ04U7N.G(.D;DAX,5'^V#(B09@"O4VA^S&U
M,%"BW2)$U+:'-[TD8&UR& -/'"N>")/G)?:DZ^#U5 AZ!+ G
MLA"J%@N)23H!/+C!ZH+BD6M]C\L09SK%GJ=F%I ?XBRE0(@*A*]5C6B.%";#
M0,3&K"ZR'J-IV3DQ2@/9CW=: 1G[XJ([0UG @([:XJ$7-^7^R(L.KR[HZHU40C5GA+I:J H1[N*^JW
M.=$QZT72,7\)G*NJ.5 :[]F&Y/6MT;W)LOSH4F*H0#11-HNB:KVPQUW.=6*!
M 9D$*[P/=W!#K0T.5?CB*T8BY51X?A)IK^9J&<@U^L\OAL\S"5 G B;I\!96
M@\/532LH(*8*RZR=;.U-RDLNS+?,K'^+ME^YMK'JT=JKRQL=3':<
M&EN4R,"YL6M,74QFC#2)#7'20-RU^1\VG,!'?[=ET@UX[QES>75D<)%!F(XC
MXXZI>)9W4:2V$M?;%2 (WEHBR?+#>F\Q"+=DF1M'J3;2B$!^X8;J*8Y3\^T?]#;@"^^0H
MLN+B%?ODF%$ @Q GV@GS)*UW:<-F%):2A[GMRC=8M;NJUD*&JH(O5VR\[8:
MUSO)D -*KU2;K^ -;+U%D ?'Y\\& 0 /S%EFW%Y;/(V@T(8E!.@ZN^A-.F5EB]1?KC54":14QR3.Q]4'5?-/IT&=2DB0BZ<3OG
M)54N ")8/\8C?EW=]5R*5-36Q$(RDI"4G&L;NGLD#BRR(NS': ?!/ALL- BX
MX0W6-\"R6F<.4A8%NPH+]N!2\V'4F&^D@!K J.0]SI^'Z2JXB075K'3L5&#U
MJ$*UJ5?,-ZE%TZ+NR(:QQ"JB2Q]WU,-)TYMB+;F(<2/=D7$7F'746\@
M\DG5?:Z\DL9 1".6)MG):WF7P)NQ&. ,(XA!R:8G-3R&LO-@3YCDX:HFD$Y
%/8HW!CY2M+&2$#U\':">NBV?IHQ \;(H)TF)O6B#%QND=?8NR,^=RU%BB^F
MD:(M(<,T+4MG?-,"$UD^^MAWV]7Y!&&*D;4@,"2NDG3"J@XMOYDUU[6>X,T*
M=2O:=PM=2UD;VRK]GZ83D0"YO(W3PJ.TQ\5O
MV5/?AL P,)J!3Q?"4L7H7)E*2X+6:J]! RJIZTS1G +<"A&N#DT,R:-QE4/X
M^+QU&,41KYI%?XNU9!V=WDBM8"L8NPILE@<:A1J7!YQM-[!S;;^+?GRR^3CXZY(IL\8@.(4PP+;I)) ;DB1,-QI;RQE[2
M=<,(@=\R7Q8(0?9^4 & 2UO((.&/,,/V&[I\;/H*I.S;$J.1@;U \.I@JF1
M6@MWI/%A%]]L\I^\MX&N7@MU1R%LQLF@ \5H\,40,3N&O<'L^07\= X<8]3[
M"\H3>Y:,YI0W.YI%L&X06&"B,& .M \Y]RAN$!O[R%21(DI,/YM-QPZ"2A7V!7TM49EG^?BO$6]+)O< I*3T,H)DJWB.X0V0NLB"?WF=8N.CFZA86 2
M=S!D7I]';EH?./G9*ZV^.?#BS6JZHJ)\:$E88R*,([/6U T&CLHKF@%
M=>7;[90()"153]HF[IU @Y]$RCRR"$;DG7K>'B%WBA>]$S>-)Q=[9:([1-(6
%(,SS>V/6>8Z466N!5'H8Y6^J]-+:S1!Z/!W-CZ/>\&Z/J>4X%$O/7-(+71I
MRD"NMG<5"3Q:+-(8!/#@SS]^PD;:^ GG Y#@JM//.E?" *OT57.](VVN+D:
MFQN4Y.K0A6,M2DVAWD$*/-1;@Y3"$$Y[8S5N3D$W%#5<3; ^KS4^2"45\L4Q^"/CF7@UNM643U4BY%\G)-59SKWSXBIT,=3H*'?K?,F7
MMG&SJ*&>SUJ@5R!A#8 %7'0">G7!)74:RV6R/)21#L%GO ?"N2]C
M W&4M:$@0EP$(=3E3R&;V#\;8RU:5HNJ57;N:;C GSFVCB)Q7"95'7V#VL;])- V(&G[JPAVUCW+G"&ZIU4=V4)S
MB>)!^NOL*I==K:+5$9*:A%Z2RW./+NE"Q XQP9?HQ#(SLV&M<9F"<*8&O%?+TI>OQO?38SX&72 X @SB4KH.C'*B>4*[]C=CW:LN^,LK[#-L!JI70:25#:ZPE?L#']\RI:%
MP8.5D:!42$!NPHZ,"Z1]O].)DG.A<>R#:!GE0Q%UJ8HR(/*0=0O:;:W/KMT]
MQTL@YAE5'<3@UQ6Q'?N=\7VJ. 3'0"VSNBD>*SF(GM"FK^FR!I$#Y>UEJ$7=
MYV&Y(^=E#=61IO+W=VB-%T922! F/?V6EPK8D;E
MPI1T\Z%:+FY!*7QQIJ[1)J6MVD(3Y>0RF PO:0?3!IF8Q[9YW]J8K@5N"PI'
MEM3Z1267S$T^C4S^[SUWWAD=X-[XINM9N":.F ?]O^UZE;?>J.6Q4(ESD;C/8@6%=." $)+@X,EV(!<8R
M>>X"J3K-I.9E$7 DVJV5R66TU\:5 UE9*BRWKAJ-JL#"# &U)],G6M= +&&O
M\OV>A6%W@[C@XP;#;U'F7Z -RMJD;[Y=[" GVA(I9PI!CAM;PE0NOL8B*HC!
M&+$H=JB?9TJVRZ0[?LEX672A&F<=-YN..K8R'E[Z**^VM["A.] 0X8="A>GY
M3?DSLX\W#N4" \W)O6K0&G+"4/)5?1#&3$@B''VL7V)D[:A%P,'?>[=L%HG
M]X1WI!@.V KEPNTEMW%H=!L#T/8]-+JWVG5T%OS)<1*R.GTK9-DWGP5UT5'3
ME+HYMZS$2A++"\X 'TZ>OS1$X$1!E\]'$;0EUC5A$T-43W<7@"3"%/L'$LO(
M44FE'M:/'8:W5AH6YWVW? =B6EDZ4C $-CVKM :X%FZ$9-R/^F&FG4
M1C)J0GFS/3;R(9+C^(Y,IR(K5K>WR' VME/&,0KR2(G 5TM5^=? >7?(59Y)
M*C"G:G0%B:@QW1]/$Y"5Y;4CV]5PX"#7.ROI\(UHSGIP3^C*R3=HOE^U[HWC
MMCU::3V]$*R60F'(7Q3%ISU1@4="5R?#,0>NRH>Y^;"0#\,^??CHHE5'V<3@
MI%'LZV T#=U@/[Q]G5ZJ2Z'UNPF5=&$2'!CRA$C3<2\-N $4"<]88N" X(WF
M.&)^4 O3< H*OY;XF:7GF,$FX1+OJMBL(ZI.6)&?4C1)0Z8RRNR5#SIK:EN/
MLW&?Z@$MLOYBD7P0/"0YY0D"J@^'\UC]:Z[',!@2WO9@G(TF@Q:$;B=8;S*=
M)H.Y@6(+?IO,J;##&&MNSEM#,G$L(^BV,^4F&62C B0; WDNQL-L.IE(5[(:
M& SFB)0'D)X+N;3;#Z;)PK0UJZ7KM4=%O7&9@99?TAM9'U8JZ]42=;S*K*2
%VD%/)L>[7HNF6?]Z0A.TW@X3<[#VDT&,T2Z[+N0);&397:]Y0HDU-SQ&"M^
M+!8#]SS;Z]J/SV![YO#?(4S\&^M@Y CZ\%E&'6540'^S]5#'-CR8CCJ>?C[-Y/S+RCO<00-'2*]5R)I:V#+DQ@M;U6
M+0"=NS:X;HR&75.:DHB/M@QTI^9L%"!K6C1!/&105C69&CA0W=H321US?^,0- :15I='K]CXG2GP(P9 F,W"8>D>4%C3<4D]2^X-\$%WSSV^6@]1QP
MF:\@F,H76U]-7.N@BN*9JA!T*(J('HVU"N92\R4:!QB0V$.F7H8>?,<2L
MV9/"E#7&QH]*I I,GJ OI3:FV*6 +> +@OQC$7V,YHD!HR:'GBU>7,M0Q%"Q
MOQ@:((D5%> =9T"S+2*FQ#>$?%*:6>OYPF%1%AR<,R?"E2STHC%>Y5F;BI*K
MEB-$Q3+C-8P%U 3C)M,2KQ62\\]203)#V?/94 FUH5"%9;& ,YV2NB:]](.[
MS;[SC);>TPD8KNM&;-GD8\@ O*^P/'^ -. O\[1- OZ<[E/W ,CG)7=>:]J
MX!4!/FV;S&DQ#.M$5=MQ1F0J,1B9 '3"C.]@4J%"2P.YT[+)"VA+97?U)O<
M%7;K34MW82S>=J!+?!S KP9XV)8.@-/L[QER1:RT.Q/^R5>/R\E$Q8+@F%)T
M-X]L56S8]"F\&L,T=GMK,6> C!,UJ]AINV\/')>*W2#&L2/;%?;;(N]K%5G\
M7U,F]CB%8QE*]3"*]G(V$*'V< ?]IH-^+";?&%OVW3'"0*ULMQG,L,H[P@]W
MA293+!$&0(EY,VC)!=""SM+O>W5\=9PEL@4-P^([](%E#W1,!JN.*TZ:A09(
M0WW !K,,! KIVA#&-S:--9?\FRFPCTHLE-&:J58[;+S,DY=5B8;9L-0!P/'
M53"%>E'BF/[%JZ3M(##1,2SQ;#14RTN"#]U?[=5O6(CRO%:MZ.DK%67^WL9C
M$K6D;V.1Y$^/(L HX$] W!UCK/TL&+Z72NLAD/@Q[USHZK"OL+3YDNY5"9$W
MEKCN=C451O /G6F7 L<'V70ZRZ;S41<=\P9+%M\3\PM4;!B'3]PA;$^!3("Q
M> ? F8(0IB @.,O ED(2I21'CA 0G:>!\7B;P[;C7DX%.S"R\PI2/M%VBS&4FK&7A(J(8IIN-?747!&;
M0FC4 HI^*PK+HKQ4CIAS8C#,O-QQK9>U"D,>/6V"K()&$\4CC\(&Z+PZK@)F
M0P^/=:6L=5WUYH)T.)&'U$ZPA?'EE\DUGX/+ SQ>(69;]ZZ";US$THN[77W
M#0&!LW;!%Q.J,5B&0B([<49?&9JE5E.L[[%)A'@ON8S?B/XA>Z']@'@TYK%7
M6(5NAC4HY)\Y6>#Z/2RCS8]<89TX*D ! TRXQD* -QJ:1[Y*9E1=6O[;EP=F
MMHW7^') U,=NYK-%,H![83R9)H/>P-1?FLRHGC5=E)CNAL9 +&K[Q@5'J.0Q9<%)U^PO !.RJ?Z]2%00)E
M#YQ=1/+ZK%"@5\LHXMQ-E=>D*['?K*H)9=]>^"P*XGU(BI$55>*K=\3!L 7Y
MF[?%JV"'.X?6#E)R.W#&LC =JF\.YC&A4ZJGT$$U) 3T\WQTS7$] 3R?8TO#
MIY[G4VU.\CG#P2-^K4@0H^2VC6%^#L.& ""1#'&%1D8K>VM#3;$X.->B69 +
M:]+Q"*W8E(O1T%.FUAP/PB)A\L.V/-P[.1 J3L&F9HL)0;KT/4\&TX!H[?J%
M;)=+\9B+$^&LVP$NPEI1!1]X;J]HIB\],].'(.*A&[K#?7YB56S.,; QLC,KI*AA?. 5OBIO:
MH(T$!79R.#C(14$PPNAF4&3@,9]-$25XN1S?YI3M7N2;]#5[C*X$)A0[#,=I
MC#,X,/R"(/OBS4Q ?S2E"!D'=.$;YO2A'X0M1WW[=X &8OTSJJR4;W@EPUK
M V8:6G\Y5R?[*.M)\T [C"I+8U)/?>5!KSR(D?2=)QMQFI-:2].\M;"&6V-B
MRE7+!*E@%DH63F&RI,6X77F9T66RM

MX] J=D:JZ\O0(*LYZC%B1,#'("(@4LXD"A)&5Z%@PYN 62@8R=8M*#DM[6Y1BO43Y
MIG#@2J%YS'*83?Z97!A;*OZC%',^9A[RK]HD!=D*(@Z!: &>RX?HO=8FBX98P"Q[Q^%,7,CM*D NZ+[86+3OE$<,><8H2QM?23,9K'
MT0-^CW%; *+P(92I,4M]RW$O3"4S\Y!!)+39!2Z04T$5, LU4]ODCR9,0T/?
M2Q$'-F$Z47AOWW3F&MIQ[) ,&Y<(8T:>(2<=PC\,-Z/HU^U["QA&.#1(OB6R
M@39L@AI%"-&?6UHU2/LF'+DH&&W176!V!F[P-D?'K%OK;/L2F81!2>Y/C%/0
M2QH3V)%IAXA&*+7TL[V9K9\O4.OL4R="O+2"C S(T',=RFSFU./1(*P:9B8O
ME-(GA/,RSG=)Z^^\2IR*-];707A =+4@"S.V"]/F\R!<9J/Q\%=R^;',YJ/^
MDS.65S! WD6,.(6FZ<3FZ4U=Y=2"\F6:RD Y(C(6#OT'7R;XO5O%MSV\ P-J
M0>35BP#8! NG<9ODW1:O#-?"K@,,9Y -%K1PAI Z\'(,X>!YMN^TR8A%?]RN
M#]??,QZU.S?1E3YR'$Y./CP) 4F0?O);W/V3W^;N=[SAY+'^&T@!H G,I6TU
M$./7=%+O P9BP.2I8@#0UWBTR$:C\7 * ?]'RP'(M4YM]M]A'UW> JF=9#(U
M1IJ/]QH;C TF#:4^$)PS:ZX$<,O9?+@K/B=1V>Q*NQ2AP.4WDZWJ+-BB](5V
MI3D#X)*M&\6* ?ADLMFVG]E4LEKL WO[TF *VT# &
M@C#&QI+U#$NS#Y-Y;]A/OF8B2$;9'$U7O4G?#F25O!ADPT$ >9D,>XMIR!2*+-C.%
MB6"UYU%O/H>>Y UX*RY*WQ!E9$08\DFEXGM3'-%TDG3*FH,YW[/:X. 3%A(>^:U$\G,K)8)8-Y^RC&T\7-$#+F?1*&E?L
M$8"/2(5YC>1A$I,":)=< AAP:-Q:^$4V KXJB5J5Z8
MJ1*WO2#>ZR=SQJVH*P>Q>AP-F&0DZ7O$RBVZJ[W<2#,X)T[]TN%A+L 08/)VZJP?9!" P 6NZ!7R6ZM\#O9K5F7AK=Z@:M$L3[5JEB?V3DW"5HG
M0CH7%\)N#"P+1RIL,.; WR(#QW@3=(C@>;H@>"BN.XI7O"-,]J0:H[&@
M 9HA:)3 %!A3 +6(TQ&T]ZH QBM.A-1\^3T:PW'CR &$ QQ60R[HVFSR\F
M(CTGR>O[:*C4H%N5&+7+^%6GO0O0+88P:?1&#Z! /?R2?[FO7(/Y9P\6!<
M0S]Y[O #Z"I>/VIII$*=R\/VX/L-XS6[Q&#DXOZQ4MB:0EM\/L<;6@6#&
M[XPS+K^];00D4RD$)&W)0ID##FK,(+@?RM!9'@2ZGQ%@>2"I9YO!<:5XVY7
M!SB\CS1L%#\)LR WQ>3<(7%U;(\.Z1HR<[[UD-2,3 F6CDRGN
MP;$IQFL5#! ^5E0SN2*82[(E!7UI&)]=H)$++C0D8A'@"S4&
M-CE]PON]U\K<+"FP9$/HA#D[R?1BFKCBI8#[R"YY*$3W):9F4&$ M8^['.-/
M)99U [CCTR@K3S*TB0:@=$\L#J"7DQ=<;-X*?U'4*AB@W;=-<9:KF@I2SE#.&
M(^#H(L,8>4E!)2C)%R!49>&;Z&>*$?-U&ORL!!YU-QO+@[]7:#)UQL'RMK7&
M-S7F@5L6#@3?L"7#3<4$2W&1%$QB0',O2IX8"ZS03ZVO&56WT6Q(M%/=ADM'
M,*5Z 3PWM2(E$?BZ5C>\S4Z1CNKDR52$Q^T2Y,9B1C,I:-QZTRV#U%"4B\]RB$]3B;C[+A<.X9=*C'OZ,=Y\FF
M3!K@P6+V #VMF&*T3,ELF&#U#JJR(>%\"5?9^-[8/@P"0M08B6%RSY)%;^R,
MD/,^9G7W0/ @H.CDQ6 ^3%ZB67+>97Z&DT.ZO?B03I8:V-WGB<' L/
MM)XYW]GT3 -P7<)F3LJUQA,]ZF:>;GF&-V-G$)=(I-PL4C#]GP
MN37T>).S:TMUQV4LY-+T\GJ Q@2UT T0@;I*;)O$:ZF,*(73FM;J1&B*)$VC
MCO8L03'/IW0;9Q*]*2]X%=CG Z<
M+B&.<>#CM "WF": V(GPH" S>[@K(6?43-!C]A33CVYEZ[*3"3HBWSIX[
MUI+=9 +QXZ\,VIZ"N'U.' *7A8.4]'S3O.Q K+J<",8Z$(R"]0H-@=,/!(4-(L
M"" E2'%K(KQIV<:"*?$3EIXX"3L6,R =.D"?+H--A36<1Z/GF9-1E6D#/0VC
MWGRL?S9>\GYOHK"/ 9V$LG#=%\2YJQ$!CNT=,J8P65W)8)C0$H* KO2%6R.)5Z<:>>\$LQ^
M5R9#JI0P3)VI!4*(0],Q>AP'DPD!!TWMN &*! Q$3B>6%BT9CJ;)%,09S#:X
MIF7$9YBUH#MWD@W1*;N8(?8,9AL4%%I,J7[%IV)=[:BZV; /XY UD]%LD7S-
M%F01(1 ' VW;A'8SS\:+ :+\H-LWF\X=IA>($ /AB#"/A@-T!C/ TAG5(H-Z
M!S%U8^!* DE]@BX'3):6'1I)0':6Y ;98(1X37.=4PI?+(;9>#B0+\-.?BEI
M:DQIM !]7B(:HO!^R0)SNGY@XF+4#J. J?(,\-? 7Q\%XN=,A1TLS0*<'*@.
MQNW^(2>3M24.AX,3.(^:LTVXOC?HC,(7Q.@/6T4$WKBI*(;"]>OVG#,T7S T
M50V&VI<5/
M5U]"N^KY)\#@S7MIT)%':'11LUG!/D11\"C^,B0+7W+7DK S[@]> /C2B3 K
MKH*YUW9NDSHCS^YL*.K'>QT=[&#WQ?Q6K'D+0I\ 0Z!7#VRNPAKR O?#4)X@
M/5\@E(TY;"8YD,+VI(RS;G55"%R/SDV!"7W[^BJ ,-@R\&2Z Q*\T$^3RT9@
MWHC G 45NH4, +-'U!*+L%+$M>NE3^HM^5Q>"O$Q8L^\OK9E$0VP J$A:I?
MPVLGRZ#KBSZ5+S-SG"R<,0^#'89AM,-(E1\,6?F;HX"F03D'?WJ8(M=$Z[ZX
MA164 S31$'LP8M19.*5P\4P0JA*A2C$C=3%CM%+X/! ,&+ 4/B]&"\8LA8NG
M/YUHV-+! J29V=P*. X),$EENJ>HD8^63>IY(+X#6(WU'6A V=)HTH ADOYYCA "@7?;V+
M$Q&D"(RQ@]T9H] [[V=SBMT;9+/%,-Y$- [?>4B9PV$ FT[[R7R:34?S9#K.
MAHNQV]8) -VG(4QGV62$8NQTFO51O+W72Z=,\B\87V3 TE2BL6*5\F+Q!DE3Z
M5 S#>"D=#$&FG^&7\S':14<363N^;&OMJTA>@,:Q6% ;?8*'@$^S*89[FN6V
M3SQ3S^#7H%J\C%*UY0I1[&U
M 1YH+WF24#&:]R2*!(4'+UQTF@&30ZR/:QF@&7,@\V
MF)>/ZJ0O<;BMI,A(<1ZQGB .)@SY;O9NENJ,.^A!A%25: R39%5BA4SQW?D
MX;AG1QV/1N'SX 946V/@"$^!/;IV7^)C/^^>Z#@27[4[^9*ABO.UL680=30,
M'[/H$TIN-NH/6XB 0(#9#"APC+#2BP2+ZBK["MX:M"LP9@K,)Z (-3=P6P*
MHSEC,$S>^F6 %%2U4.A@D VG: (9 2O]NL9N(RL)!V<(
M]P<(&3#H 0@>WD*H)?XRN5)JO4& 8G,]:;D-PCU,X*@,X.H:]Y,W)%=2+U[A
M19CF'+CX *2883:?3OT>JZW2K"ASF?VBB!.)/4RSP1S.^1SN07*EG>A\&'G\HI\-QE/#\!=P[\/9I(2S;;Y^Q$#)ZK:S!:H4\&0H
ME CA$: Y[\JSD N2O#"S?(G,F"?Z\A=/]>PLTQ-$S=R$^7Z67J$Z7M7; Z^]
M=]MM(TO7!*^;3T$T;&P9.\3B^9 %#"#+ >8N^[T?I)^G M-;ZURD8E%U5/>@-[%U62A$KUO%? '[5G.U
M4:O@PG""9ALA.8YF(^\50YCMA1,ID&?-R1IT22NS#B0UXOD]M@;TW0
MKJ*Q%--B?W[WE:4*W# QCI!.1
MGRFP2I.G[,QRMO?(4@&!NKP-:WIT=(=&6W#F!%@(U-'"IK;I6E),0 !A=\DM
MR2<]Y \: M.WPW TU);>L YT$#H6> UQWAC\EC7K>49H+W9H B^Y9M$1KAQ.
M=L =Z:U<:O*=1Y>&K%:3Z' >=AC!^S>L>3-DE'$C/7V<52BVJCF9YDP.CI[)
MAOOVZ7/0#WB(GS0'RM?;:?]HLN$+&8=G-!P]7Y2*+5 "8.E-D!"H&< EX8!B
MR R5Y<'1P'^1VU820-5CE4'UM^[(-Q9R7/Q"Y%(]> /ADIRL/:2F(" F/=LC
M5# L%UYBV 4-\7" Q\BU]9^]
M+8U3P(-V\':\?L6"#,#D7KL864+YDG" G5BZYN(^"@(P7!\4PB!OOU=/W+!X
MD1 $F'>.K:.M1 BW*OEMJQHJVR$9PQ+"3E'59'OV>W9M L2;A7PX@4YG&["<(H-SB]E-7C\,G+M#G.7]
MQ9X3^K:6G\9,U8/ S%SL\$FOY4[[3V5*V/&>,0N9%0NKH'0$VC*JDHXG4/'O#\$ OYGR(6SG[#"%::E=)9&
M=*"TIOV7[7FU+Q]E>;"'5,FY)=)C&3B0)E+9?MXHY&38>
M,!%8XAZ@L9GZ'N$XYI3\/Y4&YABN]'\K8Y\GJF,;'EUA2G5 9%N+LZZ?B8/
M?;0J1E=9^]O;W,:Z)2;%I C,*Z!UYH^K <]/FSAZ53E IG=SX7)CJL['3$]Q
MCPKA-J8M*H-+"%-VML!\ 2BB9 ZB3V53O/EP[>]T ^Y&C5##Q&#M*%ORAANQ
M]A9O5(;@Y(=44J&*Q**%S)JL)F%>-G)^Y8[X/68':4]X1LG16HO1=GZ@> 3F
M^54MJI4U03)8ZE[[G+>=1,6ZO:[\IIW(U ']1/)8T)+55!1U#U^$#Y^0V-/O
M,=9V]L/MM\2D0?OXDBWR!KE8@5/JV4#Y8L@Y,]*^&]^'0'*$(AIK]VEQ!JBD
M+']-68:H''40">B#K='.X[R"9E*0'L%+A,DTD3T5O
M;DD>N)TOC&N9!!^('4YS8^MV$SO9YG":G(W@]XZRAO$M>K/.1#NT!F%6A>(]
M\[* GII4=RDB(LHYQ<@> D%J1N&82@X=@WII[!;GIM%-+#(!"948=&Z[@QA
MG<4*4'@7.G;&](GH7S.1+]#]'> 4'CI0D&*)!(& 5:@^TQ&;9!K C?'X\UR>28%9NM0*L^X&(]GPCMQ(9723RC@4OT&!3=X<2$W&3W* [$!M)0',(R$UOU+J]??QA&
M4":=:%T^4@@YU] ->F:=:K 7' &IT.AZ M" 88E4NUK=S,:)I[F?S"2'JM SYK[?-72^R9ZT^B,*Z;X%V^H'
MHQ-[674.?8'YH-""H;"HJZD@V,14XZ/!A)V9OMGN]";#%H7B8^;-4#"VFD7
MB8PI)\T6[$B#KJE!,9L-9#0A4>RTF(UZQ"K+@L+\GE+GN\-^RQ;SZ2O\C2M#
MB\,-Y!,OA9QK[@I2%K8!%L;H+T==F-BQT+*3?$G[PK-)D##^<+?=;S]OUW!Q
M+!!&YT#)\D;<$8NX,SL<. SY#C^ZD!-JJ8R7I'*(
M8H)0NRG KFL[Z#=8VXCA!N?HE)&?./ ?83=@O52@HGUROU8#< 435%1H? ^:
M[9Q-.\/16KC*+K[%-UQS2)GA=(7;RB!&P#0.*-/[2E2=%.WM=N?]D9@&*^FN
M/.+S@F9\"GP+2UMIJEE$"64(4$QXQR?M/"U%:OZ^?;?]4E(H5:).UFADK::J
MMI@I B 0ME&8*&1(K>Z-(\!Y)I:*MSQFTC7*&WLXV U :W[/S1FU4#%-R:]P
MY2*O\6%CTCV=@Y: 8 CI#$1L('CMNC&'--.X2CJX*<>#]NVDP;G[> EG;UG>
MLXE(7OOL8)]AF+>Q*$LV[ZVT 9!B0]:&Q21L7Z?1XH?8@"DW+45$:TI1=7$
MV!& WLX%M.$5Z'SE13:Y%EBK(C0/7-?<&AC8):>[,1K8&=ALOV-R2M-MSO93
M1MYUVF]=W"CO6[7RO R$6BSS%\,@88 T7E)-"!?0"/6P'/=SJ5\SBLQV! \Y

M)RO)A&E1KIE0;0SI0]Z1(& R5Z%ULPN;T.4BEGQ
MY:?MGJ,BB%AG VI8IGE8\VK,EY\%98,>Q<^TK1YXA>EL
MD0I/A8H$';&8LROH01PB(B?M
M3A+"O=@S/DRKS!<7)WC"XWYR3],%AHH.ITI,Q" ^HP&2K8U5W[%CTW1=M+
M='>Q](T_=H/^H/@I^GRH83[@,6.$68Q*LX7\/_\1UA;7Y6R 40Q?&[C? S7
M ^='8@]CM+S]P6%$G"3@(;U>;7V#Q5;5Z1IF"I2$UZ \7)2$A9LT,4D%=%"
MNXDOF42HWK@[$+0V6"3X01PSKB=MR[QY\[M-W."M:U07Z,SF^J.+W(T?AN&T
MX;T TI6/URLJG4N^(/FZV$J\94G\!X N6E,M45",F#4CKY D90*
MB>B&KJJ]S00[5%%\"^\BY-6-:0*N3+?"@];V$)1
M@2UZG:B.[3VFRR&"0/C$U7RWH9-LGS@:W.G#D*-V$=;?T7 [$?\\W[=BE$;Y
ML%Z'#*D!Z*JSHC%C4C("SG B7BA6XK.K]]>:L29=^J=@5#%?A1 S$>;M;BM9
M=.%O*3^*$T34UTD".HX59?G11DCV GMI>@& -C\2X(T] FCYE'![D5.^DZ.F
M;##363B+><3WBSXGCQ X)@#.,$JK(5%*Z.UA1W<2@A =*H\J>USPEI''L;J8
M<>TZ[9=$ UVWMF00WS\<)'A,/<>IBM\YNOZB.$;8"0Z,2:^71X6J 2C,/?)*
M$9; ZWWGHYB6JYXS:NGYD;G8F&G<;]'W] XQA %5\Y=;FX.FP/AG[
M(ASA-N,Q4L&7%RJ73O%1H^SY Z?GY<(^7T';W \4)ULV+E\ ZTZ)OZGPFW6(ZZDO-3P$MPX^O8D;O&DYX
MT_!9?XB3B'.E%$:\QL;G/>JT^4[3,BLFTVWH9/?4,:S9G,J,#)&U P; K]:.B8.DO
M!=R:;>W,5JN40<#90@Z]:NO(=;T=?VZV?&,TJ/?^8M.Z"@G]$"-&T]:?A"J]
M!>LUZMG%?Y=#M<%2R7'/>5:D [MHSP6*W)S/XW!TA[PV(\
MGF+I>W\X:XWZT.PH1J@1@ SR+7Q4['O-GSRJZ@PZ[9JW+\C7@2<+ZRV0:)FT
M:XYK;I)0>@[_$$U4*:]D,"[Y#U>88*N?4?I=;1XHC,'DT 4",#"\ =%TC1I8
M*TI">-:+0OU3]XL$JI4+2M!63 8,FZ$R#+5S'N:/>&(-),TD*.C2E59':6,R
M4[]L-/47[6NR42X=2+7F[CZ#
M)RY??* %ZH9%A)-\523T[AAX6R7X8Q[P" *P8FAY\FEY.P6O9K=L$RN^6H>
M@:*Z/MQ4Y5\/:(A=?4XA 44/'#W6L('BE P(-RBIQC.&M56@7W >O[^Q .@H
M*3NE*=3R\KM4D>3$T'6MBHGMOF)!9Z&!
MOK@>
MY 0ZE5UG/LG=C;)69OA6Y1[8B*J&I[R[9N7[SZT Q7AML6!3*:O*[ZP"6&8
ME,JL?K"[MVMBNA2]@3 ,RF5!:?,/^%>>??N%RH9TA
M&D-5.XA1-QC$F6P/?N!VO=W2I/2"YU[8OC ,J^,2S(R&2$ 'X90U&] #& MH
MD@HOH^0$N CSAER#6CS@;L'*, +>P=^#LX\ 0L'6Y8C2YAP%';F+'6B6R8,S
MIPL,'U2AG,./=DWJK)(P>R"X6Y>QH5+&:- -*?5PC:&Q19BY6'"=5+GAQ& K
M:'4IEC9CT5-(*;BQW>WPTY7 "\=!;,3Z,%CF-FP1S(O)F62P*G:G?\;^V,0C
M8\@)WI=)4;$%7F90SB,JI2%N$J1NL8V(NN7.!>O$EHJE&2)2[+VSE&?7FVB$AY;;XF4 &;BV [#F4;%ETLRK6X>LE/)+4!F&#@4&ZU8 19
M;J]W+%%U^^*Q5H+/R?WALHIESQ7^WB1AJ'@H<);H=XY=AH%F)&"%6Y5W*NW(
MND3?^9[;3OL7T)GN;^7O7:MTO\O%@3(3>"!6'V$
MA^G, /0B;.3E7!!))- /!7;>LT06[>O2AD?@[]^E$?&AJ*B+6SY5J>2\G 2>
M(QEV\!Z&H2ADAY<9%2\X,CB<52(#F+O)>'!=01WCQXL+QQV@(V;R"F\;!90<
M'&D.U&PKE9#F;@4=VJ# ?9&NP[AC9BB%1N7FP!PE\1, /E!9));@N6+$8^]J
M>SAZXOKE[1UDL]=;I]KJL"U]?
MXL TKG<68MHW.105J3TP)=A!777'W5^1 .":JP5>/%:9"O]02!T I54@,P9W
MI;!MD>>!)A0D?6$Q)G8J'Q#B4A%#94Z]XQ!M4(D$!U&\3?@:/,:
M=#"\[3W,BB:&P=-TUN=OJMP#O"UOJNWN1J1@53GKB"9%B".IX);+?[$@PE6A
M63^9[22'A;6C&2MJE?P4U0I>"/@C)6^#TQZI6!-W#F)*\8["7^/FE>3+[>;3
M%G<&*\-)U(G5WH;Z3!IO[;H>EY:>($O#G,'T42]MYHMNE7DZZ>0L##F7]D9A
M8Y(%HD5SB8E]#,W+PMEM[03J,\6[[!E)N-*"!VRU#Y.PFVB"W)2:F<6\:%R[
M=$G0CR8 G=]]4/=4U,%?6*9?&<*Y8W^7(X>7DQ<,:+):PJ2F\#-,,HZB =PL
M/9)-7CB7S& F@G6:TH+C'O^^F%J\T!0BVNY#= LA %D 4K=\S+UL']7]5Q#
M-$IKD RYW[*XT^RT H@6(,N19O+&,D+82]DYA0J;ZV9GW=1]TW5#4>ZJO#T8
M3E'*5K$5%I3R@'X]EY:7\F,EVL$XU0X5 W$KV)JZL$?XQ !-U%@W3!/$Y[,(
MD &V#ES1% F'1YAFFA?:I#JA\^9&"D:E38?\Z6OE)O)A:KY2EH)L%TS*<9FV
MB1G/<60D'@U=I3J@4DC.A8'XEE<2J"%QX+9:KY U;IV%W
MIN%>*\0(B].MF>TY\!F3U';0X>'NN5N5&AQH62XXHP^EU(ZTKBG<(SX-:+7KV60)7GL* 87W7"5&72^KARG'&AD'9..P6*$/
M1&2LLH,WGR)M) 66J('0;\GWJSQUUBV%@R;-=++CP.=I1R 2%!5;.$!R6[1H
M&80-JI9= JI)MXM37[K8,#SH:I;9*X:0V.-B,.@C"O6@F(WQA^&08G*6@;!J
M04OC21^:*+K#80OT5F1F"=N2&)=]J=>;%MWNL#4=PC]CC$).AMW6=4+*MT;=
HH=AVT$QGDXH2/A>)J'5&XR+8: 7FG6+Z7C(0-3-V&IZ",#=[4, AL5((IT>
M!#X"@W>'\ P!N,^FA.#^3#H:UJB@LMLI&OV#%EKKW
M!J)CQSY/%F#D3,7+\C/2:H7]0(EBZQ[P[+-'$#FD C@S:LA(*K8U X (<^;-F+Z:1*#QC.RA4
M@# BB% X' ^'A;QYC&$%"J7]6?08:'$]7Y0F>30;GM-%-.QK"AQIZ'93VG\T
M\@NCE7VP6EF#1]H7L3)G]G3H @M(%.:8![&FW'X'QG$0XK!=>:]3RJ[
MTF!"Z!<6AAP=,<>("50[&ABCP7R:1;,BX&! S)J*?&!S.+EC^Q$6Q*6&[5?J
M[RGHP A(].<$,9)Q>E9:)S)A*85D)!6WK,>X0"HEN(M^3*G;Q6Y;X!ND8S#^V4*- ,E
M*[*&XXOR*#U$XVZ(5>(19 EQ> S[EQW8>^?0,; G4>2]I^FC:OFW(O*KE-U&
MD;7&/!(9;<(RJ:C.HNHP+I#VX5FK/RR&DXE[S-R1J#ST1EW,)NH-1HRU[[4Q
M+ :3,8(M#,:M#W*4W=\Q:0F1 (H!Z"$7%LN0ZHO"HX 9:>-ACY/4!HH38MPM
M^A/$=2T%CS\K7NV3; T2'2)D6/Y.G2@:54]TKSHT>(
MRERE&UT%;YSIW=8 4U!USV!S4D!CJ$&)UFQK$))DZ50\ D*]A' M#WLC4*K
M6U6WQ6[^Q6;/5-;'[)5]PZDJUU)BM*/[D\ !C>OV;KY;?A'MUMPN, N$B;,I
MT38S+$I<.V]H!JP#C:KVYM7YRB;,ZCBL1[;('@'2T= >G: 7ZB]?MKO?8.SG
M@K\'-H3 "W$,KM8&79'NF.3U3GVS>('8/VU.:10<2@:GBTPZ)$8QN=4>2X8B
MP/QT^/.#N30>Q6:N'G AZ/XFF;ZS=^O2UJ]P4E*REXQ[J66?6$FF%-W-4.@A
MO[]GG@I;*8DK:1>'1B4WE'(*B5,0 0 +4ZY#-2P$ZSE7[V>]05N^!-AE8JJF
M3;Z- -:('%L@QF@>RML0=E2E\I,V(0X:=U<)*2$(5 <&89%!#H;S0R).Z F-
ME*:C G17SI>^GB%0>KF9B$"45]NEZ#K&*M5SRNARAXJ%"JF5,'4E2@U:9%>N
MK'P;T,/#WI1>+Y9>EE@#K[JAP0VI6'8P8;T(VO&,Z#VV5
MI'NX9@ 1XG O-3>:YL- -*";DGWU6!?G KS-Y!YBKWTLC"2BE=T1-5YA@P+C
M'@D]NG1+FD7R5'Y%KNEIPB8.Z @SG371[YH4J\46X]7TH U8FCE6$%P)SVJ"
M9"ZVM4.X\B02[=ZS>J1^>2U%O3;=B68@7H< ;SKNOXP?+L<[FN4YP;:57V15
M[&=MKDBA0>870ATLW3 Y(JF.,!RD'YED-80^BE@:\\ITE OH!7(2'<$,KIVD
M>!#*A,^U2+N T!J%HUZX,R@43N"1JT9J,>RN@BFX@\^"YH-15F>MK$MQC^K)
M$JRR(S..2UZ8NUMM=*LJV--76MI7E/EX^O4A$60;=Q9NR\CT0JD-A?K.2(Q:M[XS3$76(R0FFA^T,)
ME'QVTP(U);A3TYX1YLG;@JQYHXI)L,=Z>':L9^!5O!0)36%=JN\KJ2@Y(;%M
Q%S<>^8@I)@KZ1.*T4F):S5E[11ZHKD8XF9M+J;%/!-])7 %I0*>WA4'2W*A
MKA'I1%4:':IRRM%J8R7+$4)S\UDO@MH,<+D1#^9['62\4@"U4W80Z2!,C8W9J0N8 7(7?8O6Z0"KM[U!
M-'Y.'4A'1@,S4 7$:*Z%XB^G!F PXV&^,G:;SI;=62C2I0A94H8[F0EBCXTZ
MU4?!+IU?0JH$?VB]3&Q89L5$#8K@SWC3B([/<$I GC2QRQ06J -2QG]*+UQJ=3^2)"[>"K>&Y-!\C)I3;L /M>%.O\0C=.KS9!-&
M!HQ$@1T7^U8PK4/"]K!BVXB@*FQ3%:&JVGSO&[M/Y4=Z9;25Q]VDM6R>S3F
METY]HG /;MX5BMA[E 6H'LGNSC>I01&@94,$/!OE,XCH7HE303NW55">@V4FB)DX [[6 R;YE1- :]/7MI31
M24CS!^U35-E=K?&YN=E;+^>+W];;3ZT> 7?KE:!$+)FX8@M >K1'].,.#=+-
M !Y/E@F)P<;*G;$W]RCDS+Y'[,SSMS3'//DG/BZPJS%S9V@M(.*&+*;)GG"N
MA&SL*%YW!?=3:\,QGDU"(RR%"-2-"]4;3#PU(#,H,YR>YX/(&6(-9;:8P6NH
MC\KV%Y,F++$1A0T9 G?G6M#B&ROW[C" 2HP&$ WT07Q>S[GZSTNNP JRS?,
M4F"+CA2WK?%W4>J\&S?/AU3BFH(KG7AE^9-@U+!G=^1Z"P(6?"%HAE29.DQ?
M0+X@C,FXV93Q>M<4I1'(U-BHC3>):#)RJCV%7$D1VJTJ93OY.]!"2?$U*#:#
M^(% 05Y5Y#HWL5$N:'#7YLK'<>:$;RPT,#+1F28D#-%T\MY6R\$A&Y[U4O 9
M72<)/\6MB!ZG%%)GH-Z"76<\?GY"$FG%\F7NG.WJJ7LNA)-ED5B)DFUF(SP+
M#MSVB V$OD40;V;E"9A(3#CWII7Q3T%VCRZLER9OZ%)EM#5ZJ$VL&H;9 G>:
MR2NGN)ZIWMI*CLM?R([6$',FKTS4?4YJ1J@SUDMN5\+[0VG/+K]I9XL&9 [F
M53HOC^"A@CQT2L3NPJPT&O>/V^V2C$;[@TH?8">3!F"T+IJ''<%Z6:WV2>F&

M\.A/5YVBV1>I26\13-C/L$U";+O)/;E
M, N3H3ENC3QAAA #5'H[:E%["'6E^CG[S1.J6' 3&6SG&-&D.2II =(L*K
MJ*9H7[(U:C^P=7C2/2M/;U?(=< \EYDI].9-6'6P\A-)#"5@)!>.GE+[V7M*
MLO=FDG+<&.04Y\8^ZB^R+Z$([O&O,$8B-!,^0"3?+''C4J4" !4/+O^989&2
M1P?K,.C\<)7%8.2J+.!GKB&QF #2&[XJ!;##U=N2G$MT'+S.ZQO;[V:X8*Y,
M6E !0UKR+S?(%ZV1I0%<;$5.I?ECJ*[NE'PSR&(,)X,@WWA4)
M(T>V,[\<@:4 :L2(E1D*<\N.(;F:Q [>#DGB/5>/4?$=/Q=)0PR&[59SX:[C
MUS2''?47QXRQ7NHWG#CCZ<(M##+IA6U-DMP(MY>FY5"'XWRN 0CD!.JF:.)E&#*84AD@ V^
MO7B12J!+TOER==J;CY>44QS!!H-]5^Z%USX"4<.W:>#G%$JOS;+ /2,%Z8[)
M)*@>4J1COM9U"Q0-8+)!-M=TMZ\ 7%U255VG?A-]6RJ.Y89XUAI,NL5DA'1G
M \RTF0UL+DV8I-OM%]/^!/[M%8/>M(6PMZU>?UQ,1X/6=%1,QI,6];[5FQ:#
MT;35&Q33X=CETL"O)S/,&A[U$,-GF#U%/Q+JT)$ N^GYQ/^M4DVHR-0B==L,L<]P8
MOP(!4 H^U:V-GK NZQ,3-7?J1T):T*H>,94-=-YU(\]9^)*O[W$I.I@>YBG)
ML9=I4LF[PO"FJG6) CT+'@X#^%W*UVK0EE-ZN4MKD2W-P"BN#-P?$
M5@=+ERD@3-66Z2SE,!+D+F&=""@IOQX.*,"OOA/+68CK*>('=L6C\=#BWEE8
MIX T1N88Z,Q6:!+NP0X3#6\/NYM5=<#TW
MI9U+5>UV\ZBK\H*D5JW8V(\PUV>ADW 5K8)[SJNHTLSD,"%!9$0*ZQB3U>5G
M:4>1I1!9;'() ZL1)N+">6O5KYD05WG
MSIQW84,'5&Q-;%(&4I8I0FK$@R3J2F-MI"#""7'../%D:UOA//-8 (,C90G:Z2\A=;CL' #"Z;VJ>@6VH#OT>3
M4T"16HD/-<.2D*RE9K=D/ #N*(L]H07%VK'/%(;Q(1ULHXH50G'/F!:E-S(#
M!F19&J6L;XN+K.4Y^/SK[H)WC)
M+MV[NG)4!N S(?!>6>V47ZW3OO1]ZV%%JFD]8&LD9XXD1A$DDQ0C& 1M=-C0
MVE!:7GD'2X9=)*Q/Y OP^HWJ&%KG)J\$DTU95[PKEW"IJ.(>/H.P]VW1L"H@
MP?[3&XZ3 "WH>[B\4>M:>X#/1(S-O>VT7UK:Y=4F0:9%SB#58UWM:.>\4'G/
M?B5S]67^@#J&*= T=@\;\ UXKEV&];X*FG]EIR3ZR>F
MXE[FPIE&>\<^*Z>9147^8,(KY"W*R)K?0J?7;49B2>!'Y3#X>6D@E%
M2F\A&3.&)>EJXX) AKS!)V;@$[) ?&")"-TNX0E::E7.5H0!.ML*]PQ6\S+X
M3<+7?V,DL=%BXTA/4I1D-A7LWQ7U?@YJ#M%MV\1/>CSW\P53X,HI=L394GY-'A8GK@^E9"!ZJE6,TD?2YTK+KZ$5&
MY=4#WPOV,**S/NHA?N*:N,W2XR(S)%(:"\$>D\0W7;5:W<=MD%APB'@>^7S(
M?#EDH/VNG.]M$I22*IQVQT)M*Y8R<8O9KPG@/F)9V4AZ3/^RMPRDZ#)FH:%O
MU55EG-;BBXQT)QU=B<:=WKW.S2DEP]X,;V]OD5^&#$1 D];.JY3!.(WNT>;0
M*.K>U ==%#ETZ%8.82=:&C\YE&+R9ZL7J,&E5$' 9@7+ D.B&&)YRLCG>MR
MA\^N7H0?@6$3. P&4]B^+]H&(,530SY?T4L8%"L?H !8U *TJ,AZ,PQ]\9
MW/9C9.W%]X< 4B37VL)E3,1/;YB #NRS@XMN\O493?2JTBOAZF!4!SA67?D\
MZ?G]1RG^N]V*@VP$]123NZ0DK(WWJN51DM-79$3].A>%S.DU'[WHNOE"0\$8
M09@$P[0H7'2^O(D3:\/O)9M:Y&BS&:<@;ZFT@M/Z8QJK])W("3&6@\!5=95#*Y$2DZ[<.E2^U.ZL3\J//&KJKJ
M@#(AV-UMRT^D$L0UUY[O[?E$P+0[WJ1;=/,Y;Y(D80?8M,E G]F"?LZS+Y>U
M9 I5%SS-L@VO4& LT!+LM-G
M(VZ;X,G#)GJVP^D$J''# 8:[@\$PWO#CM-6'B@@L*EWBSM6^ 1+BE"H; 5C
M/@:M2C/][^M]99&0YB(<8'PV3=;IF;#()M[2'8SS!>'SA'==3\WD)&L;J[3
M)2W)GE-4UTW\P$V*NS4\Y^ I-0+:6*UD;&9V0H&W SP(""!B":S0@I(?'2S
MU0..T;;2=Y#)<4'-MO !/"RLAS@WB\C-6 1@Y?(@CC4'ME9HMUDAX.?L%6,Y
M0]%#A8U#.8NT1 2AC#]G!T (/+E6CP2,ZC:&+MUL9
M9L'#G%3"DEB3++.M!NDF%%T8*ID'<)7!XSL!7UM(A0.1L0M$E\X]V9!/HQ"C
MP.4+\ V",&:KKZ*)6]P]7BB$8EU]?J'A5((=[D.@*#I3S!2DS+ CT%Q' V[F
M:Z5!#[Q*9(],)*[01%)3CVXD41;*22?JL^Z=4$-GRF-5FZ]21&Z)F=EEQC@,
MTGEU!(7=,(.KCGJ9'93X8-.<0\)G5K;;.(3TO$&GK%20R@ZU?8#%
M3E7ZT;Y]P%W"Z"#PKN1(4GK)^X O#-+>)YA(BQ#!.3A^G@ZE>&Z5FW0YQ\6U
MFJ("=UC=VG?)]/S,(4JV@#A9-6-$5'I 1 (+&D:IVF=QE?8+8ZOA;2CA(;/B
MC[(-.1\8;2.MU:N*?PQ,K2BNZ\5()&RLJXK=1L"]YM A&-;3HL7C0*J:D>0
MX$R^5G0NE%Y*9VEO$WEX>0P,1#HQP=6%I&:5?3KIR^6 [(TNHD
M$;/,%K2C?KWYE&QLL<:\#9O<4,A@](,LKG 61C?99L+R+M(I3&BXHA=A8&EA(0V79F+\[:8 2!4G
MAB+59L*YF&I2'V*AS=SU'X\\3E.Y\I+";SB-RZ:I6'>D+4TT9!>,C11-DL$N
M8;05B6A0<'E'WB"/+=RQTDOB>D!!;UKEH?#*DV)G3QDZ=AY,08T$X
M"<2G<+OZ;&I&Q/JG/![R,)G4*&(P&G$.GO+'N[Y6G+^C)11@\3HW^?M:MF6
M*TN&HS9 ADVW4OJ)*&3F986%LYX <('6X=YL60$71JOVS&IA4JB-NDAS(8(%&^*T'
M\H;+[6;<6#\F!>%X'4\.L2*>% 0;/FP-
MN@97DYL /AS04&,CG&JUAMVB 9; =@(#3S/(X#Q46@+#[8B(L*IF2HP 4'RP
M'6.ZS0 [.TXVO2/8X/9?#K!GEZN%@MPB?S$6(NT9. $T,>([S148BBW)PT5R
MNK;#,*&D :I6U-!)*XR:OO=F4>5L2[6?(#"SJ/$!8L>8B$!"QE-*M -S3XF
M^(*F+D@46L=95F$GTCJK^.2PU[)"Q%.V4DAV:+6[!%W&9;QCW 8X\/#3@T%V
MABMUR:0W)9=T[3Z5(9Z8!E*!"<20//4/%H.@J*L3&Z3 P[.^(P3E'+.^RS'S
MRD ;<)#Z69& ;M>'^[)M*H&-01D-RH]\XZ8*+[SZIY]H[VD7-1A!5?DDF?J5H* GS4
MU6.>MUX0U)B/(>]DW4(XE4A>Y$$0&$M#OI2[U@O6'S"4R%I !F4JO\HB+8H
M?#*%A0=/#EZ(.>14C\+DNYHCJ.%M+)B)(8MS)A[Z#['(:&VAQM!M-WRAC*.%
M\ .7#@:2GLW 4\6746IELH 0>$?3'A:M121Z6BJG.*DM!3+E\!"$I2!2Y3X;
M(ZAZ'T1 HFKK3B3M] T8]65I9YLS(LP<.L/09G +7VYW1"-O) OH)!?MS^7=
M:K$N 9WHDOJ#!8S,= 34X^:^FR,:+I8(0><6>$\YM=6E>H"LF]^6 G?$Q9&/
MAA:MDUS(8*WL\DCX.P##X34Z%\37$J.'&$FO.) :(=X$@S#M8S9,<%E^@*N4
MV#.QQZ\4'L^5P%M[#VC 'A5\YOA#?!;L\H2+XG*;HR%R$H:'/13Z6E\2T=C[
M.2Z/ >VI#H@V&N93BIYA 9=BZ'PU@4D$I>B!MOZ-[)D,P-!)QD]8X"5-S*.O
M86[Y8-B9*BCPWCAD=9\HRO6GP$$P76RI7YV@ZO+*O84E>KUVHW],WVF=,Y\9?H90I 2LVC+W(D
M 7%$DN>/AR]#^R1574=2.%Q" "=Q^,M-5WG@#39SE.FYJ\KB\;KO^RYD!AR0
MR2%^3\$LUFF(GRTQIZWTQ+M&=M[.47SP!"!J!!?B?KC^I>("8HISGKO]0DH<
MMNO*S'"PU>W<*K8W(+HB(B'C?M*8R;IC<.YW>S=3))8,@P! !OODS$7=OF,;
MI=T>>\=O&]T&.(CD?9$>Q!+SU%<[7/Q.>4MS:\8YX$WBO"WM8:QJ3%&*2DRUH'
M']VE&*\477(:2(-.
M]! >OOR53C0/T7#)8"OX) FUQI<2(D! T!;^= G=QG^2"]0PAP99RP[X00=A
M./=,3Q*[@,FDGN]YYOW97OHQ2CVG/@UON)==2%^ACZD]6?BN[NC\5GR"F49)
M C#BQE#NQOE>>13N8YXL+\?3@(LKV]+,#3V761$SIX:V+ !!A[WUCJH?DHHA
MR(STRNP%%'442%)+H':G\4;07<$:$$-(EWP^#/H1'R:8\5O").,J((^@1^%Q
M!L4VAIJ#^F?3?CB!SOVB\ J:<"ILLKC=?D'\VN1;N#+6[(D@HT11/=Z60FKO
M)9,A?<'ZT40R['[?HVY$7,JE!:M\BCL/ME QP\Q^[HD:<4[G[@54JNAN:])T1
MR=V2:I,B@T68Z(MCF1*W.8^QUNMW,Q9Y<4!&-@1+GCQW;P>O;WK3A45* /
M8H=8Z[\FR5U-*)/D,-5T[9.S$T:@<@P&&SK1JH8G;,J5/##'*B&9!S9QI+#Y
M-Q:&A288%O(.@J>#E^MU7:J6*)DV*LTJ9TC.':1 \:GBG'UC+ZP=2DPF8)TN
M'SFZC3OM/VR X-(5O'/IL[X!1ON!-KJ]+H0E%4QFXXFORMC][-&-B[.4S8YTLU#\C)P;Y?6C$.HG9Y3S6/&E
M ^?2$.Z,J$9&TNC!8^$FIWSHEA/!"O+N*"7K4D"0$+?I0/!,N :'5?5;(V"?
MYLVI(A&O;H=F' 3FTN22V[E44\Q%3,&7-"VI\:6[*(@IF*6]G&+=DW4WH&Z[
MB-J.ET"Y<.E+7#?END*+05]"82NUVK3[D(K6LM7@F%=[4?+H-UBV:<= /N&*
MJEV-TH:1L,KQF1)*.Q.W"L7K:^%S?26 ?F/X7&':V G/4$ FM[2#PKHC%]C
M>$#'M.IJ!ZIRP7RV6!+&"?.I*<4(JH2+]-H4N@+38GL:O&OSI*NL$L"-S:$BXQO9T#2;5[G4
M$W=<38 "-OXEYLYM=YO5O&C 8?YEOEH5[9 FNT=0BI?X4P67Y=T!JXKA>/Q<
M?FG $4?!H1[\SS]O=[]UC-Y]0MS=:0F./]%XNE6.TG[[P E-E8@W,9[)??*5
M;C88S[/>.&(?'<\T;V@]^!&R5A(OTQLQ$%P.S366 Z/KN)&$;M(07G@ S1 5
M/'BV2>J-7QZ6)MD=;!?R] R\[5 +Y]V9#7;3K%V*]T($WZ7='/!9;1>EOLUV
MT?"\-X:U8V4?. (G5Q,/BA@(?O,-3HKYP^/-#C2:5%VBF0=1]%Y;N,#K.^&<
M^ DUYHO?5A2 >(6%,ESA>L6&["F=!DOOE5<.]\M&Q#O9%!?$^@>G\PH!6?GH
M7(B\P/1P*7-F->W'+8>^L(4-]D)#>]69E-U^^P)&OK3YY7S,C8*+V /"0*Z]
MT9#5=6T."NMDQM(M)%^Q]JGY0 OL^G"S9^UM,#H?=%^ WGO 8#)CL?'W[&]5

MINT-KY#<8VCQ/^4[7KNLBY@TRO9/?ME8ZI,70=SV+:A]Y]O;Q ZX0P$O3&LKH A"H]KVQ[#*ILTO 226O.\O+./5+'V(FIB
M<03BM9ZWIN!@,$#IU/"AF8 QA."SZPUGK
MC<-GA9;&DSXT472'0R1/'LYZ45L1J&MO6G2[P]9T"/^,6Z-A ?9Q*Y5VTAIU
MBQZTV!\4X^FD!7N^)6ETT,I@7 Q[O=:L6TS'0 I;L\R55@]&-N[VH1 #8C3J
MT:N<[B8I$(A+VQW",V/XJ3>;PE,3A)"ECM;MA5,H[^=\[HYY 4KQ;PRAK3OS!=!7+>--,, IT2[+M2@EU8AXD00C'[4$0:%2 9NO&2 3O5U-^'
M:DI+M,8H]/^;X(5[)#)9]AO^"I5=W':=GPKXWQC);ZT@R(PE, C9X-%G+
MI6GIF*N)]FNT7E.=SIBX?YQO2*WC5@;^/BG(O - OA)&X(&=\[H^A5RI-1 L
MA=[OCF#!\8KIP1TSA@=^ED'#I30>%K/)$*^E*6R+ AA^,G^UH7>#/Z#!?P1G
M"&XS>&V KYW!+=L%K4DU8'O>I*F"Y,6"TQI7:XSXM\X&G2%UKM?I3EHOHO/J
MP\]<&**>6-;2C1E?D;?1J?X8I6I9^I^$G.4(;);[MDY!MH9[2Z[9&.1D*RLRLVYIZ0K%?S/AW(@5 */1GD:+W$\6;=N7\WF J*\ B
MD37AF;K0'$IO53CM@CF4DLM0?[Z?QM44BF)$LJ2I&X(BGM!06]-B.NVUK#F&
M"OET.@9EG(,E)ND69K+;G[;2NE0+%%XDM5V@)+<3#MBN+I4#GDK VNZI+!
M 1$ -F&&J '2\9N!(OFB%5Y,<$;'4 C]I2[@4A6=\"K8$3-X0OJA6^T5H^Y,
M-TIQ%/W$$*X15&C?D(L2;,IY<$(2R]"">VD&IHMA(8([IYA,W64$0F4RBK;A
M)?1\8W8@ID/OT//W]NWE/WOW#/O#Y-X9#V:I1:;LXQ0*3 ELDJQ \'@W PA?]%#>XZ!G'\(&?D6)*MB+^J3N:X8,C$!W]&?PS:/6G
MQ:QKO!4Q4A!HGB@KT9H&JQIL7#,,LZE&@REIINA.Z!7=+NJ: <&LZ(]Z9*.#
MJ)E$6F=Z$Q49J+F?3&(YZ!8?,%I%OO^7:(=$ZNP^E7.?!G1R%)>>!44FS\Y^
MALR=(J3$2.*CG;P[!1?-P),9M"R9VU=),, ?6F]B5'"8:5R39ZU9O^?]+-0L
M;O>AYV>D9()^C;U"O6(XF<9)3WQ3-G4BJN?KFE)%4D^RK3[,O[AP3FL,>L\8
MA]"'33> P6]WOYVO$!^16$#@TN /R+$S';@["<3P:$I[%O2L>*-JRHEK4SB'
MJG!V%I*E=M %(99H6GEVJ&R%UF^*+C(XJK26W3&N)ZDZ5/H+4F52]-%;2"/N
MPE BZKW6&.8*#OVP6PRZLEF2V1^H(,U@MJ<@#>&@@[R:C<@1]$.6WU[GGQA-
M!6S3\83<:&C,H,KUHG6Q7/Y SA>WJ5MPM>UKWJ]5.E ZIMW2L[K!=N\F':G- 7=
M02 CR2LPSYW=;5Q#M@A];>AB'8-R.8:S-&[]RK5 %5TPPRF%"'AG/;.T.&8+.
M.T8/>;]?]&:C+!DM?BY!%E\G%'S5 I?5M);4C#Q:R9C86Y.OUMPWDF@*$M[W
M2 Q%[% XA$-(*71&^L+@A='<71.Q(O7,/!2T@]RXMAW10//MH/8TG%=(P-:#QW?,G*H8%[7J.U."?2M3QS4:T2F/+Y^)N8:2Q
MY6U*6KX6-LY@:M;E^8Q,PF>P:^&?%[(X^/\9B[\WA+/71?MNW$-!"<*S"YM]
MTAFF70CC8MKODKTQP(,P(FD][/0\E\&87 ;PT*S7IX>Z<&F,.NZB!#UQ/*%N
MCN"6'5%'X:!,NJ/8&*J;^.' @A/?FPYH/+U)JPOSDIMWC.G0''5'.'[0<6'[
M3G/3CG?K66^,)MX$3.EPPC%6"]@J.\%V01C?L2X;-B'@+NBZ),93VZ<7B^Z
ML 3]5ZD>"H,@Q),N/?JC]' B[TF?4&
M0YKK$6S-#^7J @839$G%5$Z0P6 BN@33@7*RJOWS$&,6L%LGXGWR^]V:S*:H
M@4S!(ZQAW[H<]C.FOEG76[-=
M,QB17@\F '0J->@-<"K[XQ9>QSI8X6$/HIP'*<3: +>"]9 EP9XB
MJ%N)6AUHRUTZ6FZYAC/R3D&7T,<:G2/T&MZ T"#"PB;+@OZBQB*)W$(RU^7R
M^&S LCF \=ZZ(++YP,UC>7M:+PW -98QM4ZCVER;;HZP8B!]VOM,?QG
M].S+P(T&4F4T(^<5;LHN=0!'->[TX7/XOVH>^GW? T;^~ &"\3 XFUX?^\'
M^-^'>T*WED 2'J55/WP$OZ
M;^\!7KQ-N!@8T$"K:# I9G#/#>=W9)WY0?3.]U<]2/O=SNC[O-"D@81) I 3VC"YM,]7*,<:^3P?S^A$+JYW42^8P57!?FY\==;I3I 3 P:G>Y@3+IC(
M@#ER<(L9IS??5)YP,9+C J5,[SM+F2$H.+"[9L.1<:F?)&6,=YW .2IE<@>^
MSXE]TRD(* AW!H)V-)2Y\ X\/XAN3-"DAC//"4^/U]V^LHV%4A7OX@(4)(/#
M1;&<5[*W4 Z*2II"B";=T)(:*FU#WB$I\@S"-6YT:PI@+F>738%),9CUV13H
M@Y#KC[IL#.#P!VP,]&]0;]2UD! MMK-FA1;K%$,H:<(,K>)F 48*<5J*"]
M",,>>0[61MDTKQQ#H?+VZ]C'I8>OKQZJTU:301!=<74W7P;B47$E9KA@?:3
M#%,10L
M8&ZCN*U:?R"*-D\:5WAF6.,@T?=O>&@P=3;V.U@I"/)8-!F+C\
MNT'O=WUTI/<[OWW
ML T,D/IK"Z3^3@&I-PH=23PY FX03&9A)Z03?EUKS&Q ^?'D<"AB+Q1?\@"3WZ8
MFA]F\@,(.OQ!2;E!,>JI9$#T,H43]NN;*SV?^=6S*M*%(SLN?>>'22\9@HY.TS,%I8<-I"OWD?#G NP1[U>'3$@O([@&N^
ML=.H-0;+;6K4A^!OHRF&/C!39 HZ6-@E(R,&\-ELG!-DQP",HB'LQMD0U)+1
M2#XELX'"93!&Y0[-SMET7$PGTY;:(7:^=+I,F%>#S?2*;I : .5HTGJE@%6:
M\"LU!19JP=4/*MP81C1N-7,$@46,UEDW2MHJ['P++02Y=+#2!/WO/?>\@5L-
M'Y \DSA? LP\+<>WU/\+%O*K,GZBZV["DH^YFP-,>P 3G184LC#Q@>C :M=
MTV$Q[29ZGGD/[>01[.H>C+@'$QH.(O.:V/O/C$K.X]'C0/VM6PS'Y+N86O2)E-C2FA?[Q6U+=42=
M2N;DPBE'THN-G 0I=,I0RZA/F-%$V2*]01TK8N/GW:E41. E;A5 %@
M$>X$#4"%A/]J1=1>2ZFU1,OZOB43=L%1J@']0U+/ M!%NU >>XE!E@E:? +/
ME.1(MX/9# S()89!R##D?T9L#'4[H+G+(Z @@&!2@/QO5QZ8V#:N\.4NV P
MF>D$SL@(=LX(Q&*G9UR?X9UY(P32NS[^>?YZLU"7^<49)(T=
M #-2N4:91VC&QNP!H*>,)Y\[\=Y J +#UOG^3D W%1TT-C6!JQA-UZYW%6N0
M3>^%8@2?G@U-XWYIV0/S]R!BRF#.*"]P9=6U'EA37
M[V'>0+\S&X-N"?-"[&J PRFY+5=[>8;RO<>= N18%T9FY\&-VIG.6I/.M&\W
M*%I#:P10>=$0-.M,I?!DSXE.M^#"SF1[AS4Y>[,X8>S2.(DZN
MI,*O5-![M5D5GA;&"LPHRB[W-ZMC!+-[GI*R^<^-RY;1U7!^NRM+W\$!-]-H
M]/R\UYF-GL//XRE:]-W><[C5IGWZ>?R\]>L6+V)*'A^,.X/N\ /!K#,>/&\-
M)IUA[GY<(POPI76&8R?GX]@<;O/6];2)AU,)4F,8)N=PWX98'1B"#]U,1]D
M)# 9UY;FTG]LE7N;HW/3^J2M8O] BX)$ *+S?@]10BB +$'P/ ^14D2$
M1IN.+?G[:4 *I=-B1]$O&SD$QM!,"@,4YF#?8/S(" $,N?= 41FT6&O#[!7,
MV &Q,,T=?TI"@9? $&CRW9%<)>@NZ@SCG-C@)DC=(N*WJE-T%)9:%KM]G3SJ'#+J>I@N\-L'P5.O64N6K8##0PLY71>OW^O
M2'U/PIS]=E #PVQPA#"$3&P. O2X0K WMN]F*2U\3('^8-P:2]#CFJ9Q3G0=
MZ.O$BVU4]/%ZFDW0V&KEV M:E)DSZ8((FK5^9,1U3M=J!VMT?D)'?I^@E>13"?>40&BP<11Z:Z)O=DU$%3:UWD9V*/LFC
M(A@BT/54-QU<-8:%%G2R&9Q/UKR1TQ!4; Q/D]\0U>W9A%V'6"?
M#682*1D6W?%(^Q![,YCZB2LF[(^QTCBRA#PTR"933%[QER6R]'E0DDVDO\P,
MRWXJ2KWAA@1G>D^],-)<@ M477PX60T*
M%60GF\@A*3?U5/7[74H-13R0 >A%QTIY%/
M./1];#=&G+F%PEQW1@5MGTF@(USNO'[EELF!B[;/;J29$ +?3UPX\2S">YR$
M8#V:[G\IG3<9=%8VT3SQ3S^"O0:K&]=6^
MTP+Q#D%KM)[S**[19T(5QE#94^NW;S
MV8X9?-[\"3]Y9WS,;$6L#9..N:Z22GXV&*)Z^^)Y\B?.BM3BR/HV37OR#=3A
M<2=TR(KK=N"FY"7 9X.CWE@0@#8X:/4F'4QT&F++.187L":ZZ/@:8.HS" OW
MZ0@X%M5Y4$D[DG"%,R;^CL=VW
M\!0HLSAMHP[NWN?X]RG^T S" WN0#C)]CQU;*2RMA2<$PXUY"A;W\;LHLTM?
MQ1 Y@<,1B&0HL"^X8!4[5V==SN(==/MQ[?A@6$Q@4PPQ=#0C9 >E4N+-1%$V
MZ#.1V,"],B//>F\R!FUBY&TFK?:W!L5DB)F]F&G]AA1G"H=2EUTX2C9-KU?T
MQZCU#4"$ DCDT(F9A+W>S,,MHS!
MHGJ]^DJY# A'I.N)8)A3D-X]T(7Z5!'D?9% 5^W(D/=POML+Q3-^85Q@-4$/
MZ\O(:HN&Y0=?X!Z BQ@S^2;#,:U$]F&4[;.N5(63H)^!;C$[(N M^%]X^F='%[]U9J;R!0IAGLT7?X Y &6C#%>5Y1%G
MX61NO)ORTVJS,=*\%#^5ESCXK!?X &M+X@,KCC.N?*)# T+(ST2*.3:,S
MPLSVVN<\P:(D=GM=^4VT)S&XM-H[T@6&$ U4;AH#/=:GX'#F#:9X7CK3T]G9
M +0S5T^SB5,9-VRP![9NX.G0]#BY],$P]\9"/'$NHWJ\F04]*=!&)@-Z3$6O
MG'H#%^R8S><^YDJQ]8SA)F4ZCU3Y');&1M@;B>5(+H,!>>$ JERK>F.9:* J
M]0W)@PI6(S>3F0F9%9/^Q*1>#HI-!ZR+Q<:-?
M8V;%M-L2%%H7$9 &75.#8C8;R&C"C(9I,1OU. &<7. F]^3RZ@[[$5<<])R<
M!N]AB3C$G,W4VGI NB\M -:\#
M(,QBD,ODL,AJ 2&&8^%]XT!P ;+1Z!PJVXCK1%^H#JGN;+9T>^%832RB+96S
M)I$ 2QZD=:S-3R[.D5ZD -TP!P.1-3AN"/(!3L?+Z*EG:-[-9$8'F&KQ@G^'
M%<>U.I>$ZZ\\XNY@EYN,V.R>#F2CS B!N N,X/MXF]=M9F&+8XQ]JHMUH0KT
M[9H/$3# #6[I >J<&EQ]+AN[M [VXFQ7#@Y98AB9NJ@7GJ4]F^VEX[V>B%+
M-!(Q!T\"SM.BUU?AH32I9VO2=PA & MI368!(A!5IT 1L8C0RB,$G8S=];M/
M\XU1#< ;%TNF=B#8'P?:JW,->C.4;S%/'WE+.S,34X*B4=OL%D3=-VH5%
MG;5Z! G?\"W#61/)X ,M#\J]QX=2B VM+7A+!4T'(:\WNP@DXS< =G CY/QR

```
M :I]]NS%=?D)> A2"&YR*1OZU8&\FNO[N^-] R\$F 4& TS 5WXFG897<2^K
M]M :TN'\6X:K1]-Q ZU];(" ;(2V8\6^'@L)W?X"^OV^Q+-^FP5JP1#Q/H!3
M]G!(F-\LSK2)T'./(E?XQ?;I=M WEKM#. :POPRP2\S[+-#<^9J#:6IP;4(5]."\!G"MB94G57
MA:P1@< "E4[+8!N"GPMRPA>PPH@3%7YJUDUUX/IN]?!@;'08SI(3\R;S@FP5A
MH7PZ>3N%5T;(6?F4(P7Q&C[4RUPE*6"Q)L^ E!.#/7QZD/O2*;=-@@BBRC%!
MN#L(7I3KHOT,) JCT>:C*>,"KC\AC:CAF?AI I>M"M37W1HA$4/B3$@*1$*(
MS\O"=YND^7
M[85NL79KI)',XJ?^;A0%^0Z]41W*'] ^J$?QBEG[?@;7 0
M[ K7@N06B9YT(SX*G5O'[!S4O) >[23]847ID/ 8L-&[Z>^>IL% &W5$ K!8
MJ?!!XU3E1\R?;^<^7W>\$G==0LKF.Y2>1@'BBNY,6IG8.C$@6Q\MR%9DXA/
MUL\(L%6W\$P9<>3E[[#R=<03WW)3Y!+1-(E$ BXDOHCHZOP8 \[CACC=$KUX
MV'7:738G)S)"=H8DGQQT/9OU#5,:TCB3+ TTWUEK=2@OP?6!P9QHXY0VKB[R52,%1+N:QTOS26<@>
M^!,'B?9,:BJVU*GO5D*F)SK[W]I'!C7W$2)3Z;NQQF9\-AY@%>=W-\-UCXY/
MS8@S7Y,0!*;-EOO]6N#--^C<=1G"&B6PT138CELO!M+V:1*3>* 74#6@OZ2F
MRN'8V#9N(7&R,)Y-X:O+[8)C?==5KTBI4^5(&0.'"T%:=8"F[=N02R6>U6;D& '-D.90B;O9G(NC
M^8H E5(KLP%^UW;U2;]@T*8XLBLR3&C?C> I27M ^S3B)V].\B*F?D+LA[ !
M8')#R9M2-815:4LJ?&J:-F&5(9/OEF9L"6V5QKPN3S%B/*2]FOYY4##M'Y$\
M%E]S%"'7IM *TV-X-]6M2-#UHIU?(OS+? DG\R5# "#07J2^UXHL=KFOX9
MCA+AT!%0'8,S'FL 4[-1Q3@W@F?R;U5\R& 5T> $#U>.U%HY+X7&7]\BORG
MZR:'E OZW>N3WSXZ/ D7:SZ7.6;?&/-U-T#R>T(3ZFJ3"^4+]2NFKS!S[;6.=GHH- I#AJWZA#DT<;%J%8JDB,.
MVO;8,([V^^WE +'Y+*=+II/]3\8DL]OEN[$I*7%^1)&,E-2+0$FU7WFGOX)/
M@D1'46]\GF.TL(IR6%T+:3#%*GQQF.0L1F$Z$,$F[B8Y^@&/4MB,85**E&;S8BX"5S^CWVNO>&GH
MRR9FT*NZ$YK=3;DCKIR G.FST(9[;,<%N])[6O*DPG>:L#R=M -\3D 8E?;5
MNHE\::N&)*4F,BLYQ3/SUXN\U[+9B(^R,3W%%$SD^EQDJ.JS9N3GE&8=Y3 [
M)$$*YR921UF[ RTOI=M)O+EM6>?[P^1STX;/20RZ7?]5PVL ,*WUILGGFJWD
MJ<+@^+ZMWSA/HB=ZBG"W928Y'^515I P[FG(W ,4?2[#JQ-I ERG;1OU =R
M31RK)@PZ48Y3(]J=DT=?RW.3'EZ8NQ?)@SJ:F]SW(ZZ;E,/7\MB$\?R;I\B\
MT(%6) .9HJ)M.2C:AE24RC;8&
MO?.LKLBD1C:%1.M@$CYL5W&W!JGG'>5%[%I(6-'D:/+=8B[X^8EW[\F[7S-$R-VX.XCU9"SF'$?X["?PWZ3[ -; ,D
M(XJZVZS- &+^S.Z* *1'#V @,>6WK)V,&/6^<;L\)6;OPG\Q.4D\.]UX=I#
M)/HED9Q\Y^Z\#-L;IPY),BD ]>7 ]QPWGMBXWM[LQX6.B<]X/MSHF/=3O?6W
M>'0"DM/HO+AM\>)>HZ>*KSEA+1X1235I/=-N
ML[F/0@SA:T3P4W^LHCDX>K6^G^/-=%?N,=GV1=[Y'?-)Q=[44;Q$P?>;:\6Q
MQ? 3:^54Q)?;">2:SYV$Y!])-KZSLO&U(>>JTQ@^E+8Z1BHKXIM]OM&HP3F#
MT;;$)3Y^7#R11G^SW2U7&U\$-;AZ,;(2C$]!X!&HJA5N7,N\^2UV87D,69;&
MK&C?X?V>,T;D=9B<<]-$L^\J>8Z^75']R'>1:\B@
M.!PV)6*RWY0[2GE V';C,C%8"TC<"E^,MNJ3^Y)/M;5:S6)K#''<0-%%UTT&
M/!I('@=1[U+U4ML^& ;\YLU'PNK>Z&++A/CY?M^FRLC-:KO+G[& Z\=\E2(Y
M$RL58/\\WW&F#&&U,?+5:H$E652O%HOIA++P?KC^C9\K" OTC
M) -IDES3 ) GB! =?K'>DKQM\H*]5N- CX%.*OW%RD0O?9G[54F B*FUMFFT
M.>6HK3;M [3:+-MG ']F T'^/*]Z=8!T 2ZALJZV;RK7^H,O[(@*KKB*"V
M6:JY5(2$B6&0+$UUZ(.W(DO R>H BGJ#C
M60'25Y>GDRF*.7SJM'MB'*0?^>-\$S5[B;TO=XA*F !X<(-0*1SU/DBXJQE2
M D9*#& %<\EL^(9+:&2:)IC"([EW..!U1/&V'! ;-@JBJQ/? 17!+:C+%\92X
M)SWF"=8JHOB/::,TA!T/2-@!GVB4'>7(+8NZI)/,&S@K^9E'F<0[9YX\G"[A
M?.%6DN$MZI96[4C1A%G=]UD[YQNK?>'?;6*6P=!?'B@KA^@*> U,G1Q"DATC
M"T4(P]W2(:%9,56*ES5K/"NIN8\83LHR2-'58)BADX
-X?=$9R4%)]H;-*?2"\:-F!84Z72)#T'/J-J%*212C=V]B2\;1[5:O(@:1[5
M2 0DB5CC,Y#C90$R\@UE+=Z84
MRD!*56K/#?X>(; ^@!:#ME>FH7[2/9YR15A&<0\,
MA5K=+%SJ0@%?UP\)39WN ^T60SS#31$Y\1LRD;5C,4TE,E@]NDF#4"E$JA<^
MD6KN,GQ (&T@"F&IA*/(>T2^33P"X58,-DRC(Q/Q.#@/ "WMIEOF3[D4C)E
?!5FN()*KR<0]W/#KUS6,-V2VJ4K3AKN F @Z?U>!91-^%03L8T4=:X#]\6?
B$(W\[5:-M;,.[6,K)EW:EE9G[!&S5ERO>5)V^S7:2@ RY^KB7+#=S]^*1'C
\/7J=E^6FS2?:^:=CW>KW
MS!QCWS??([D@M\9IB2/@ZLV8:)"V2**O6N-Z^=C6SQEG[@4RES2 M!KM& N.
JQU0Z8U9\VA!/*""C% Y,,M@=7B]NVC8Q'T>.^3
M6X]6-K'.*;)(8^]'1^Z$,CWNC$?8X6'[I, LHYGD78#CD&929]P4'\Z.I("3
M[HHG^!<8I"D6:;]RC(S1["C.'*''S-)PUDNGK/J2EMPA*3,#>W574>5L((;+O3A+OUG9:Z?15EEX\W6(&N"<+W1WI?@[[
M5%B94I=)QI+.4 Z'CQ'W<.Q[2J8M=L?1+Z BRMU(\!%;9Y.O<>![NHSLI487U+4G
M>^NOF7S/:L#O4K*=*IM7 N?TA&]=;4CXO8.+^L\)V#]S7N=TH>?3(.K'@\N\
M?FR ^RR,\@ZJZ>,=;OT IWQ)Q)W4:/'R3\+'3]+/^$6IZ3?JWCFRY*>\^ WF]UNV2;[) WR8(WCTT49/'<K.Z
OR^7B.D%DXXQA9(V=DWW, NE4GJ'?V]G[4=8RDAE"2U1ORFDUI;*U9 XAXC%
N9IN76W-7&# -IRF+3ME:Q= D'#<11A6/
M5FB+PI^(6+!:'MG8[^%KRQ(O>C#Q.KE8#VRG@] ]. LEM%=J)+KD3HG4K62,R7POVG<-!V,<-4Q66:G7..W:-D7^.9>R ;-O5ZJL4N0:M5P9:F :LO[WW
MNSGM'-I:&]PT5. )EP[L9D8; !F+[7$RX+ -2<"EZA"G(#<3?!& -*NLI9Y<%SS!BX+I> >[W=W9:KXRU[77[9J,OO/*N?P1R YAT;X\X@OLL'D\XP=IZ,
MAIU![#T9!=ACN;\[O(E:( D+809WYHDKI&XL>TD10"GH.VBH>#=6K453?Z.)
MJ]RXKO.7@CR8N\#DSQR8S?W5BD#HSVUC(4C^CW;@ F OY:8--;T*,J^GA]ST
M[493.Q(G8
M/ I0S8ZQ+)C7DJEO^*I0$K713Q[O? PE/<9IC(D;"@.I<]#MA=T[Z^' $?'+
MYHS2:O5V;2QI%9O9%D=75;5\1SPL1XD@P/VVVPWM'O )MJ-U XI'^O*(L);/EGT+ROH@L/\2R-AN -- F3"=
MR2&/FI3*^72C%L+OP0SJR#R@;-U@K9=--$0#'+O---VF3I]RFG'J/SHGS[]4
M[2NPT1?D.<69I(>R>AX^8;O5/KOAR7X!"]^^E:]4]KNI8-;98(CNE41V!'YW
MQO/;X\!L/IYI^":=A \J89S'?=;K]!)?Z78FLSAV1>/'+P7[\(F[M# KC&+/
M16 2&<7?AMGHQ0IJ+Q7'ZW4&\3B[G5GL#G$#>A @+4MJ&; ?C=^?=09Q3W'E
MNK,9LD>3Q. #HZ;9I "4[3=&-@'/%=>W4@FS?9QW>)#RDB0!B3'6U+3]
M3/UH]FRX(W7YEMI^WWW/'>G'T /8U%5N5;M%?0*XVG'T6A+^) [<-VU;ADD)T8Z.*K+QDU :O^@<)55+EL@JRSSHZ3D$2D YKPS]
MR/J4P.J=>M@+#N2B\]Y.1WRLUBMX?A/S-S,\8%([]BAC ' !$DI
MJU%%[OX K3;+V EZ[;OC ];.J$JYQ /=S;U1,XRC>E9^S;(:E*GB (W)CPX.
MQ9Q<<%PDEYII*5+(WKF\NJKY0-A8HC@L)T=P,!P>W]]!2QPY1TN;*(VV3\&
MC;W%HK]\4ZQP-OBF>?!(>P[^0:I K!A;G2@;ZRU?C]DP .,?#YM\)!72YL^
MS'H0]9R B#51*>BGK0[!I(OJ/ SK6D+QN^U^^WF[AHE9M' :HAT>/^.H]4R7
MG&30C2YO^UE)8/<3O%IF :[84V^%T)EH[FN(X/H^)OMSW%B% ?>DE,=^A2OR*F> J2T=3766B!ZO9O;1<>J9%
M^]:#?:MQ%9O[A1WAL=*VGP W>&BVN\CO?55NMJ1Q)?X6P> +EPG.FAVY2&=!
MKK608M F,CV97 #EL0>2,Z^/LI25,? 0!J-)R?67)E@0U=;QLK4+V/34-W1W
M*CRH ?3&ZYN>WG?J-PW2O,-CE3X@XH7)+8/)2,@'=N-G(#7[]^'OR-*0RK5
M0L*2CR" J GBJ7 4.07U:O- FH<$WMZT?VY?-NY(?63**#4T@3MI(PG*HQ.K
MA9*TXJ*KFI<^7%U&/4VQ)(F#C8*(%:665CGZ:+"3JO*O!Q2D5Y]/CH&%K>F"
MO@@Z7*OWZ3]V,W\,.UE/&Q4^ "2L[^Y3FT5$90OW@4AVQ$S)2'91
M*9NW<1("[OGM^G#BITQ /X7 [$ #UVD 7W49I&V8TUO(@H\^>1JR"S9.C?G)
MG E[K>G;-R ??6B 7F^W.PZZG;@%&8.0N"3.=P8YG#!M+G*(-R'\H 7/3658
M(T+\>7=VI(T" <,6NU6R/OK-!I,H%G>2 #['\M<*[D;Q,:E<7!E&UL4$L! A0#
M% @ HZ5J2$AU!>[% *P( L ( !WP( %]R96QS
M+RYR96QS4$L! A0#% @ HZ5J2)73?%(^ P E$, !H
M ( !S0, 'AL+U]R96QS+W=O<PO=&AE;64O=&AE;64Q+GAM;%!+
M 0(4 Q0 ( *.E:DB7/J5\= ( #P- - "!, 1$!X
M;"]S='EL97,N>&UL4$L! A0#% @ HZ5J2-AO=IZC!P S"( \
M ( !L!8 'AL+W=O <X;"]W>W)K<PO=&AE;64O=&AE;64Q+GAM;%!+ A0#% @
MHZ5J2.I+FH A!0 .AH !@ ( !D"< 'AL+W=O<PO=&AE;64O=&AE;64Q+GAM;%!+ A0#% @ HZ5J2,Z.44.C 0 L0, !@ ( !
MEDO 'AL+W=O&UL4$L! A0#% @ HZ5J2.S(;6R@ 0 L0, !D
```

M (!24@ 'AL+W=O&PO=V]R:W-H
M965T&UL4$L!
M AO#% @ HZ5J2&*+5MVD 0 LO, !D (!TTT 'AL
M+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J
M2$ZP4(.C 0 LO, !D (!7E, 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2!,99CBB 0 LO,
M !D (!Z%@ 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2.CL3UND 0 LO, !D
M (!=%X 'AL+W=O&PO=V]R:W-H965T
M&UL4$L! AO#
M% @ HZ5J2%N("E>B 0 LO, !D (! F0 'AL+W=O
M&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2/W!
MWM.A 0 LO, !D (!CVD 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2 YKOW6@ 0 LO, !D
M (!&F\ 'AL+W=O&PO
M=V]R:W-H965T&UL4$L! AO#% @ HZ5J2/]Z#MG1 0 (04 !D (!
M8G8 'AL+W=O >&PO=V]R:W-H965T&UL4$L! AO#%
M @ HZ5J2%+QZE"G 0 LO, !D (!,'P 'AL+W=O&PO=V]R:W-H965TE !X
M;"]W;W)K&UL4$L! AO#% @ HZ5J2/*R6P*F
M 0 LO, !D (!WH$ 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2.USRFJB 0 LO, !D
M (!?H< 'AL+W=O&PO=V]R
M:W-H965T&UL
M4$L! AO#% @ HZ5J2-A&<4FT 0 %@0 !D (!"XT
M 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @
MHZ5J2 =Q !+Y 0 $P8 !D (!UI('AL+W=O&PO=V]R:W-H965T !X;"]W;W)K&UL4$L! AO#% @ HZ5J2") (/89 @ ;@8 !D
M (!7Z$ 'AL+W=O&PO=V]R:W-H
M965T&UL4$L!
M AO#% @ HZ5J2-([#V]# @ @@ !D (!X*@ 'AL
M+W=O&PO=V]R:W-H965TRO !X;"]W;W)K&UL4$L! AO#% @ HZ5J
M2(IK1+8B @]P4 !D (!J+, 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2#OJ^U?G 0 2@4
M !D (! [P 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2"A!@]N @ JP@ !D
M (!G,('AL+W=O&PO=V]R:W-H965T
M&UL4$L! AO#
M% @ HZ5J2!^2A-D< @ 3P8 !D (!%\H 'AL+W=O
M&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2(RE
M+SK, 0 0P0 !D (!?=('AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ HZ5J2"O!#BO\ 0 O04 !D
M (!\M@ 'AL+W=O&PO
M=V]R:W-H965T&UL4$L! AO#% @ I*5J2%** G$.!@ \RO !D (!
MQ., 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#%
M @ I*5J2-]]OH/1 @ 8@L !D (!;.\ 'AL+W=O&PO=V]R:W-H965T&UL4$L! AO#% @ I*5J2'Z-9\59 P TQ !D
M (!"@,! 'AL+W=O&PO=V]R
M:W-H965T&UL
M4$L! AO#% @ I*5J2!\#=BKA @ ,@L !D (!=Q$!
M 'AL+W=O&PO=V]R:W-H965T< ($@(9
M " 4X7 0!X;"]W;W)K&UL4$L! AO#% @
MI*5J2+;!^0JZ @ J@H !D (!]1D! 'AL+W=O&PO=V]R:W-H965T 0!X;"]W
M;W)K&UL4$L! AO#% @ I*5J2, 0#;7X 0
MK 4 !D (!Z" ! 'AL+W=O&PO=V]R:W-H965T


```
/* Updated 2009-11-04 */
/* v2.2.0.24 */

/* DefRef Styles */
.report table.authRefData{
        background-color: #def;
        border: 2px solid #2F4497;
        font-size: 1em;
        position: absolute;
}

.report table.authRefData a {
        display: block;
        font-weight: bold;
}

.report table.authRefData p {
        margin-top: 0px;
}

.report table.authRefData .hide {
        background-color: #2F4497;
        padding: 1px 3px 0px 0px;
        text-align: right;
}

.report table.authRefData .hide a:hover {
        background-color: #2F4497;
}

.report table.authRefData .body {
        height: 150px;
        overflow: auto;
        width: 400px;
}

.report table.authRefData table{
        font-size: 1em;
}

/* Report Styles */
.pl a, .pl a:visited {
        color: black;
        text-decoration: none;
}
```

```
/* table */
.report {
        background-color: white;
        border: 2px solid #acf;
        clear: both;
        color: black;
        font: normal 8pt Helvetica, Arial, san-serif;
        margin-bottom: 2em;
}

.report hr {
        border: 1px solid #acf;
}

/* Top labels */
.report th {
        background-color: #acf;
        color: black;
        font-weight: bold;
        text-align: center;
}

.report th.void {
        background-color: transparent;
        color: #000000;
        font: bold 10pt Helvetica, Arial, san-serif;
        text-align: left;
}

.report .pl {
        text-align: left;
        vertical-align: top;
        white-space: normal;
        width: 200px;
        white-space: normal; /* word-wrap: break-word; */
}

.report td.pl a.a {
        cursor: pointer;
        display: block;
        width: 200px;
        overflow: hidden;
}

.report td.pl div.a {
        width: 200px;
}

.report td.pl a:hover {
        background-color: #ffc;
}

/* Header rows... */
.report tr.rh {
        background-color: #acf;
        color: black;
        font-weight: bold;
}

/* Calendars... */
.report .rc {
        background-color: #f0f0f0;
}

/* Even rows... */
.report .re, .report .reu {
        background-color: #def;
}

.report .reu td {
        border-bottom: 1px solid black;
}

/* Odd rows... */
.report .ro, .report .rou {
        background-color: white;
}

.report .rou td {
        border-bottom: 1px solid black;
}

.report .rou table td, .report .reu table td {
        border-bottom: 0px solid black;
}

/* styles for footnote marker */
.report .fn {
        white-space: nowrap;
}

/* styles for numeric types */
.report .num, .report .nump {
        text-align: right;
        white-space: nowrap;
}

.report .nump {
        padding-left: 2em;
```

```
}

.report .nump {
        padding: 0px 0.4em 0px 2em;
}

/* styles for text types */
.report .text {
        text-align: left;
        white-space: normal;
}

.report .text .big {
        margin-bottom: 1em;
        width: 17em;
}

.report .text .more {
        display: none;
}

.report .text .note {
        font-style: italic;
        font-weight: bold;
}

.report .text .small {
        width: 10em;
}

.report sup {
        font-style: italic;
}

.report .outerFootnotes {
        font-size: 1em;
}
```

3.3.1.900

html
404
562
1
true
122
0
false
12

false
false
R1.htm
100000 - Document - Document and Entity Information
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DocumentDocumentAndEntityInformation
Document and Entity Information
Cover
1

false
false
R2.htm
100010 - Statement - Consolidated Balance Sheets
Sheet
http://www.sunrun.com/20151231/taxonomy/role/StatementConsolidatedBalanceSheets
Consolidated Balance Sheets
Statements
2

false
false
R3.htm
100020 - Statement - Consolidated Balance Sheets (Parenthetical)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/StatementConsolidatedBalanceSheetsParenthetical
Consolidated Balance Sheets (Parenthetical)
Statements
3

false
false

R4.htm
100030 - Statement - Consolidated Statements of Operations
Sheet
http://www.sunrun.com/20151231/taxonomy/role/StatementConsolidatedStatementsOfOperations
Consolidated Statements of Operations
Statements
4

false
false
R5.htm
100040 - Statement - Consolidated Statements of Comprehensive Loss
Sheet
http://www.sunrun.com/20151231/taxonomy/role/StatementConsolidatedStatementsOfComprehensiveLoss
Consolidated Statements of Comprehensive Loss
Statements
5

false
false
R6.htm
100050 - Statement - Consolidated Statements of Redeemable Noncontrolling Interests and Stockholders' Equity
Sheet
http://www.sunrun.com/20151231/taxonomy/role/StatementConsolidatedStatementsOfRedeemableNoncontrollingInterestsAndStockholdersEquity
Consolidated Statements of Redeemable Noncontrolling Interests and Stockholders' Equity
Statements
6

false
false
R7.htm
100060 - Statement - Consolidated Statements of Redeemable Noncontrolling Interests and Stockholders' Equity (Parenthetical)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/StatementConsolidatedStatementsOfRedeemableNoncontrollingInterestsAndStockholdersEquityP
Consolidated Statements of Redeemable Noncontrolling Interests and Stockholders' Equity (Parenthetical)
Statements
7

false
false
R8.htm
100070 - Statement - Consolidated Statements of Cash Flows
Sheet
http://www.sunrun.com/20151231/taxonomy/role/StatementConsolidatedStatementsOfCashFlows
Consolidated Statements of Cash Flows
Statements
8

false
false
R9.htm
100080 - Disclosure - Organization
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureOrganization
Organization
Notes
9

false
false
R10.htm
100090 - Disclosure - Summary of Significant Accounting Policies
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPolicies
Summary of Significant Accounting Policies
Notes
10

false
false
R11.htm
100100 - Disclosure - Acquisitions
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureAcquisitions
Acquisitions
Notes
11

false
false
R12.htm
100110 - Disclosure - Fair Value Measurement
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureFairValueMeasurement
Fair Value Measurement
Notes
12

false
false
R13.htm

100120 - Disclosure - Inventories
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureInventories
Inventories
Notes
13

false
false
R14.htm
100130 - Disclosure - Solar Energy Systems, Net
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSolarEnergySystemsNet
Solar Energy Systems, Net
Notes
14

false
false
R15.htm
100140 - Disclosure - Property and Equipment, net
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosurePropertyAndEquipmentNet
Property and Equipment, net
Notes
15

false
false
R16.htm
100150 - Disclosure - Goodwill and Intangible Assets, Net
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureGoodwillAndIntangibleAssetsNet
Goodwill and Intangible Assets, Net
Notes
16

false
false
R17.htm
100160 - Disclosure - Prepaid Expense and Other Current Assets
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosurePrepaidExpenseAndOtherCurrentAssets
Prepaid Expense and Other Current Assets
Notes
17

false
false
R18.htm
100170 - Disclosure - Accrued Expenses and Other Liabilities
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureAccruedExpensesAndOtherLiabilities
Accrued Expenses and Other Liabilities
Notes
18

false
false
R19.htm
100180 - Disclosure - Indebtedness
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureIndebtedness
Indebtedness
Notes
19

false
false
R20.htm
100190 - Disclosure - Derivatives
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureDerivatives
Derivatives
Notes
20

false
false
R21.htm
100200 - Disclosure - Lease Passthrough Financing Obligations
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureLeasePassthroughFinancingObligations
Lease Passthrough Financing Obligations
Notes
21

false
false
R22.htm
100210 - Disclosure - VIE Arrangements

Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureVIEArrangements
VIE Arrangements
Notes
22

false
false
R23.htm
100220 - Disclosure - Redeemable Noncontrolling Interests
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureRedeemableNoncontrollingInterests
Redeemable Noncontrolling Interests
Notes
23

false
false
R24.htm
100230 - Disclosure - Stockholders' Equity
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureStockholdersEquity
Stockholders' Equity
Notes
24

false
false
R25.htm
100240 - Disclosure - Stock-Based Compensation
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureStockBasedCompensation
Stock-Based Compensation
Notes
25

false
false
R26.htm
100250 - Disclosure - Retirement Plan
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureRetirementPlan
Retirement Plan
Notes
26

false
false
R27.htm
100260 - Disclosure - Operating Revenues under Customer Agreements
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureOperatingRevenuesUnderCustomerAgreements
Operating Revenues under Customer Agreements
Notes
27

false
false
R28.htm
100270 - Disclosure - Income Taxes
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureIncomeTaxes
Income Taxes
Notes
28

false
false
R29.htm
100280 - Disclosure - Commitments and Contingencies
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureCommitmentsAndContingencies
Commitments and Contingencies
Notes
29

false
false
R30.htm
100290 - Disclosure - Net Loss Per Share
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureNetLossPerShare
Net Loss Per Share
Notes
30

false
false
R31.htm
100300 - Disclosure - Related Party Transactions
Sheet

http://www.sunrun.com/20151231/taxonomy/role/DisclosureRelatedPartyTransactions
Related Party Transactions
Notes
31

false
false
R32.htm
100310 - Disclosure - Subsequent Events
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSubsequentEvents
Subsequent Events
Notes
32

false
false
R33.htm
100320 - Disclosure - Summary of Significant Accounting Policies (Policies)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPoliciesPolicies
Summary of Significant Accounting Policies (Policies)
Policies
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPolicies
33

false
false
R34.htm
100330 - Disclosure - Summary of Significant Accounting Policies (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPoliciesTables
Summary of Significant Accounting Policies (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPolicies
34

false
false
R35.htm
100340 - Disclosure - Acquisitions (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureAcquisitionsTables
Acquisitions (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureAcquisitions
35

false
false
R36.htm
100350 - Disclosure - Fair Value Measurement (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureFairValueMeasurementTables
Fair Value Measurement (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureFairValueMeasurement
36

false
false
R37.htm
100360 - Disclosure - Inventories (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureInventoriesTables
Inventories (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureInventories
37

false
false
R38.htm
100370 - Disclosure - Solar Energy Systems, Net (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSolarEnergySystemsNetTables
Solar Energy Systems, Net (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSolarEnergySystemsNet
38

false
false
R39.htm
100380 - Disclosure - Property and Equipment, net (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosurePropertyAndEquipmentNetTables
Property and Equipment, net (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosurePropertyAndEquipmentNet
39

false
false
R40.htm
100390 - Disclosure - Goodwill and Intangible Assets, Net (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureGoodwillAndIntangibleAssetsNetTables
Goodwill and Intangible Assets, Net (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureGoodwillAndIntangibleAssetsNet
40

false
false
R41.htm
100400 - Disclosure - Prepaid Expense and Other Current Assets (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosurePrepaidExpenseAndOtherCurrentAssetsTables
Prepaid Expense and Other Current Assets (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosurePrepaidExpenseAndOtherCurrentAssets
41

false
false
R42.htm
100410 - Disclosure - Accrued Expenses and Other Liabilities (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureAccruedExpensesAndOtherLiabilitiesTables
Accrued Expenses and Other Liabilities (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureAccruedExpensesAndOtherLiabilities
42

false
false
R43.htm
100420 - Disclosure - Indebtedness (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureIndebtednessTables
Indebtedness (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureIndebtedness
43

false
false
R44.htm
100430 - Disclosure - Derivatives (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureDerivativesTables
Derivatives (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureDerivatives
44

false
false
R45.htm
100440 - Disclosure - Lease Passthrough Financing Obligations (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureLeasePassthroughFinancingObligationsTables
Lease Passthrough Financing Obligations (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureLeasePassthroughFinancingObligations
45

false
false
R46.htm
100450 - Disclosure - VIE Arrangements (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureVIEArrangementsTables
VIE Arrangements (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureVIEArrangements
46

false
false
R47.htm
100460 - Disclosure - Stockholders' Equity (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureStockholdersEquityTables
Stockholders' Equity (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureStockholdersEquity
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100470 - Disclosure - Stock-Based Compensation (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureStockBasedCompensationTables
Stock-Based Compensation (Tables)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureStockBasedCompensation
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100480 - Disclosure - Operating Revenues under Customer Agreements (Tables)
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Operating Revenues under Customer Agreements (Tables)
Tables
http://www.sunrun.com/20151231/taxonomy/role/DisclosureOperatingRevenuesUnderCustomerAgreements
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100490 - Disclosure - Income Taxes (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureIncomeTaxesTables
Income Taxes (Tables)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureIncomeTaxes
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R51.htm
100500 - Disclosure - Commitments and Contingencies (Tables)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureCommitmentsAndContingenciesTables
Commitments and Contingencies (Tables)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureCommitmentsAndContingencies
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100510 - Disclosure - Net Loss Per Share (Tables)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureNetLossPerShareTables
Net Loss Per Share (Tables)
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R53.htm
100520 - Disclosure - Organization - Additional Information (Details)
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureOrganizationAdditionalInformationDetails
Organization - Additional Information (Details)
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R54.htm
100530 - Disclosure - Summary of Significant Accounting Policies - Additional Information (Details)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPoliciesAdditionalInformationDetails
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100540 - Disclosure - Summary of Significant Accounting Policies - Schedule of Revenues from External Customers (Details)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPoliciesScheduleOfRevenuesFromExternalCustomersD
Summary of Significant Accounting Policies - Schedule of Revenues from External Customers (Details)
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R56.htm
100550 - Disclosure - Summary of Significant Accounting Policies - Schedule of Accounts Receivable Net (Details)
Sheet
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Summary of Significant Accounting Policies - Schedule of Accounts Receivable Net (Details)
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R57.htm
100560 - Disclosure - Summary of Significant Accounting Policies - Depreciated Property and Equipment, Net Estimated Useful Lives (De
Sheet
http://www.sunrun.com/20151231/taxonomy/role/DisclosureSummaryOfSignificantAccountingPoliciesDepreciatedPropertyAndEquipmentNetEstima
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100570 - Disclosure - Summary of Significant Accounting Policies - Amortized Finite-Lived Intangible Assets Estimated Useful lives (D
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R59.htm
100580 - Disclosure - Summary of Significant Accounting Policies - Schedule of Deferred Revenue (Details)
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100590 - Disclosure - Acquisitions - Additional Information (Details)
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100600 - Disclosure - Acquisitions - Summary of Fair Value Assets and Liabilities Assumed (Details)
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100610 - Disclosure - Acquisitions - Summary of Unaudited Pro Forma Information for Acquisition Occurred (Details)
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R63.htm
100620 - Disclosure - Acquisitions - Summary of Fair Value of Acquired Intangible Assets and Estimated Useful Life (Details)
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R64.htm
100630 - Disclosure - Fair Value Measurements - Schedule of Fair Value Measurement of Debt Instrument (Details)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureFairValueMeasurementsScheduleOfFairValueMeasurementOfDebtInstrumentDetails
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R65.htm
100640 - Disclosure - Fair Value Measurement - Additional Information (Details)
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100650 - Disclosure - Fair Value Measurement - Schedule of Fair Value, Financial Instruments Measured on Recurring Basis (Details)
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100660 - Disclosure - Inventories - Schedule of Inventories (Details)
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R68.htm
100670 - Disclosure - Solar Energy Systems, Net (Details)
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100680 - Disclosure - Solar Energy Systems, Net - Additional Information (Details)
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R70.htm
100690 - Disclosure - Property and Equipment, net - Schedule of Property and Equipment, net (Details)
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100700 - Disclosure - Property and Equipment, net - Additional Information (Details)
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http://www.sunrun.com/20151231/taxonomy/role/DisclosureGoodwillAndIntangibleAssetsNetAdditionalInformationDetails
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Goodwill and Intangible Assets, Net - Schedule of Expected Amortization of Intangible Assets (Details)
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100750 - Disclosure - Prepaid Expense and Other Current Assets - Schedule of Prepaid Expenses and Other Current Assets (Details)
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100770 - Disclosure - Indebtedness - Schedule of Debt (Details)
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100800 - Disclosure - Indebtedness - Schedule of Maturities of Debt, Excluding Debt Discount (Details)
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100860 - Disclosure - VIE Arrangements - Additional Information (Details)
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100870 - Disclosure - Stockholders' Equity - Additional Information (Details)
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100880 - Disclosure - Stockholders' Equity - Schedule of Company's Series of Convertible Preferred Stock (Details)
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100890 - Disclosure - Stockholders' Equity - Schedule of Reserve Share of Common Stock for Issuance (Details)
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100900 - Disclosure - Stock-Based Compensation - Additional Information (Details)
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100920 - Disclosure - Stock-Based Compensation - Estimated Fair Value of Stock Options (Details)
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100930 - Disclosure - Stock-Based Compensation - Summary of Activity for All RSUs (Details)
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100940 - Disclosure - Stock-Based Compensation - Summary of Stock-Based Compensation Expense (Details)
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100950 - Disclosure - Retirement Plan - Additional Information (Details)
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R97.htm
100960 - Disclosure - Operating Revenues under Customer Agreements - Additional Information (Details)
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M\\YO<5/3N*DI!URU8VI>UX(B'.=*<)@2Y&;ZIZ<-U5)^KA9]4HMDHGQZ6E H
M8^9"S[K0=U!VN9BTL:+?-2GIRM)^EX2$>[WF"T59%8%2)1NG(QAMUP:R*BX%
M]Q].1U#:JPUD7$3V;RR?GG G)P

MI()*5H6AU#K,890U=
MDPK&ZQNZ)!+[MTY/3RB.6?W&N%A<*HJ[?U42OKVF)M AK0J;#YZ)5UK;&\
M5!QP,NP NOMG0!0R,H53X?OQBBS;8O+.ZN:IL+;I(LNV&'KR47A;199-,CQG
M\;= SXVNI>RUK .WTG>CO5S]RK7!6=GVI0+*8]-X-1"6WV242HO(JUN#6*^@
M6-;:M&2\I7,RL@?-XA*22XP3$HQKG"IXT-5KA[6P-IJ)5P''L(P 6@,YT1NBO [;5#
MV"< N^GIO=QM$]%VW>9?1(Z?@QFMZK9&+QL'G1(0#$#@G!HC6A<;9XWZY#W
M=S0M(E8G-3T/P>*RD"!##S4 5QC\6[\0V29+4U?O5FO+?*,9>" F$&\PZHE0Y*7@R?&&"[4Y81: LZ%FDFACC+FA(7ZLVL9
MFN-:!&[[K'W'?YVP%P]>N)\JIR@JN*QGKM8NA#; *5OJNTSI\F0N'/SGZ4H+
M7>C+(\PI"DSH)2E9A!K$[V-1X%%'=1>XO$HL&M"S:- 1H6:1X%>E9[KF"OS
M1=,)S]*+EO E2<:MRK
MS6 RGZ9%RY)BIQ]<&]A"K$>BTP(2>ZFM^VJ3&[5YA2 HP:"2QSCVLY$+>34A
M[ZC=;M0N12=YQ<2XASCQ@
MY.)\7'&^\<\$/8)3,EQR:5G(2\0CMI?JA\T/\B:R=\"\7.8C5V+7-(T$'3E$
M=R"3V2Z&[223&QA'48S)C^0%#(=]:8"=5!#<~]*94^UUGI:/?
M$5T^@+ELJW#GF-N:7Z8'[QZ)0=ZQ<9I *)LB>Y+N.9<<'='L&IG/MJ9WGOD-
M:/X7T[:OX1X-*&$H&K&O-E]E+,R^7VQ WD3M *^N#'1S"+E T;57;X>J*^I?
M'-MRQG\ 33IB ^H6 [8-03 $H %K4+KG0-\V/8[L^US >VD-I-!@.
M9\Q*88=:)\7LT6!X/IS5:8\.8K/ CNK=D;F0U#)$IB/=F LHOGZC$"['?9?C
M9&.38:'&)K[,^66N?S6>NO W,>U[T&/RJT
M!N\+ Q-Z+@[Z;/&/KN?BX'B^/8NUR27+)X48,L 035Z"WSZ;%E'DZ,B;";<,
MARU01LE=+C=)9TH3PCJIWRE5%+B1FQ:U33)T&/H@!IDK2@'.WYA@#^"M1
MI?P8XXCK!P5BC(:. 3,M-,R=]N>BSJBH9W4".ETQK])8
MAXLXHR*^T[#@=.6Z\/E +LR,"C/O2,1CE!Z47K<3S)RX8IQV5'.J2I$: IRX
M)IQ@',2^^~,S40^6^2=)3+&4@C(UB6%9/5@(4M!OK-Y#*E;O);' ?,[S:CR/
M5[)*M;<">''NL%K)19 "+E[)QKVHZW GMXOP@>X;+,IVV58Q06[@MUFNZ"WU[+~@-UN
MI#T5,W:;R ;)VNVC"?97D\KV,[%67TS9L+G=/E2VTRG*D&R?DMVN1;RYW>Z,
M;)^,W7[:&*JF *;JT4UW?]/)O41E2,(9L-Y'2RKK$G*^8-(E"6 ;AG=.O'GX
MW3$)9\"&=RY0X4%XER2\;1M^U(5!'H'7NC#(KE0S8+>/NJ'#H^Y3D.JV;76'
M1)I'VIV1:@9L=8>"$!Y==T.JV[;51]RX<;1=$O4A^ !["GU82*TU@S94#193P3F N4[,C2.=45-]A3*>2,/=A>2:7LU1\0"@#DG1&0(YDIB1DS%6-05X2X7S)W
MLFRL+79BG\>,A#]]$P")"T YQ*6 #Q8)K;8W#SH\+Y+0\5)O6N:8.Z.3PXN
M=87C!7 KF3W'*7 2+&9[<:2++&Y@#:0(BRW7N#/>X"YB=6;TOVWLQ1W !/8]
MTMYTUIZ(YAZ)M6UJK>9 ;G*C641QKDV[.X.W:N9Q.AGZIL?[F7U2"GT\9K>D
MV?ZMO\G*4C.(M8G>=G(*'KPP@QH]TO-BK#\1=6^)]>WY\R]$MLG2U-6[U=HR
MW^AVKOW9M<#DN1:!YZ[-U=J%:.;DK !: I+4Z9%5J"8:)V(E&!&-=F.%?Y"E
MINC=F=Q8NX^($Z!'NK^7P2>BWL=C<+L:'%@H'NGOH43 =#J#Y2>FW$=D.7-^
MNALC!KMBSQD9WW>89P]$XL2LP#%$8E1,)$;UBT2%D:3WEDJL>QQ\I[H*3LW#
M VJZ^=J5T*"QN:39A.E(I-# X.;3E(8J\YH[+PI%!MR?ICA4G6O?>9%(G6!]
MFC)0>'!UYYF>YQ*ZD5YTVC6M;L>+'1WN3LO
MJCAQ^3EZ*MLIX2D2AYRX !TK(.FN$*5&+B1^<6T1
M-< U>.:+:;PZQ%KAL]$JW4>BF*YE$ R]*VOP:;@4K[S=Q?BPOBF'#K79Y5E'
MEOZY2%40*;986'$T[#[.?S5/D/FI2+=G4LI/H65+)+EL598MMAA9>B0>YSR[
M5J7,]+TNB.'>:3)<"-D5PN*#:[H@@LDA#D]$<2W-T8CMI;U<+KLBE\4XV6=A
O>+"VA-AO>J!L-:Z$M:-VC*^)%9E";>]DK:C+;R<@OBR9F$;7X%A6HAKS?"Y
^/8JU6=:<&M<$^!BVZ/% ::%MNE5!"[)K&5H=2\G=%F\#UYWX.+-FGC7O0#1
4?'F"VK=E^?^+J4Q+V$,KT URT8/Y,^RHND 0VAGB*&95I#5Q6W+49:B@LY!
LJ5AA([#[J)5K/ RU33H*+P7H/[]8D$ #[SKR]W5 2-WV-U:SRH$TJZDE@ I
M19X/@R8IF>4JC@O);]]"FCVFQGTQ+54SHO+"#0XW.!TW.'NEFIL=)C*IVO9\
M0%SAJ-GX3XW'Z=L/GB4
MWY,#AVR??#]Q/6:K99,RO%VX(XFAE -6@MC^RR)
MC/FW=,YU6ABY)'92$OLFAO457',A/*(Y/,(A[&Y&A]UHN\;#Q"K[G:QU>ZL[
MGCP%V67.DC8:6#(MO@VL^'$)[N'2']-"S UPM\7W9*UOC8D7%]L>96!,"^VQ
M*OP>+&!7O,3O)*2<)1%GK]8O(15]4[F>5P6>A (SYJ8:JN]ILY:F$(!'JU L
MEZGI5QTA-SC.R7V>E-A,/M#+.3R->X>:#FP^&
MS4?S84H[1>:G5\YT&N7ES#.1X;J;9MEX*AU!NG3FC)'.$B5Z/IR"##34WH!Q
M9G\F*K%D ;-KJ/8MB+WB:& DZ5U>GZ $%*#%J8A%RJ[P28C 4?8].]9,*'(E
MN2R0^/75(@1? (?F+,.\[WZ![[>[$BGN0[=XO%B:*)TI/& KM$T1R4!DB0.1
M7+HXK^6UYD!HYE -UJ[Q8"0-
MF-6NPV6Y+$U.090AIAJ=2X->B;+ SD?9>(T%Y[]IAK9R5Q&!9]J=A/"7\R(Q
M+-MV'USETE2NG]Z#:67BHMQI4=YSCA5 D)@6.X8/?D;8*+7/1H@] 54RIH-0
MAOF97"H;%5HJ\Z.]@ RGM92 8.5(2RM%;"5FQ^O)I0K09?;PM;>59JK)"O5
MEEPQNZR8#?5KYNI93CWC&?0C>3/U-V)Q!3UY!R99>2&AQL>1@U/+&WFAH<;'IY0LF9XF# @W3E(SZ!IZ(T2
MM-A?&X W[L6 OA.-1ILNV:(,.%DJV0V0N
ME%TX<5N[4+(=!G.A9*F><<^B@ZG+UJ5M$^=*5KX1E5:>:HY&[&M=MNW+Z&+!
ME&%9.VB-H! -&NH5,V6!S5>LKFK@0RS3"X!]%#(=:>P'KNL7C,R"KI
M#3SY)F/[WRW%'C7[6S1&I"4VQ':PM :;!,<$@FDYV(];N3@QG0(-F7*Q=GT
MD,7=T/F.\+H?>L]EH0M^OC*+"U>=L2T([5=1<5%L3!23=4C]%,7ZZFJX*%+H
MGQR &J&Y :<+0%R;J[5IP)]V5+C^D"T+/M>558M,G,KQ-H9Y1]8J*K,TZ% (
M>5MC0#LMUL5P6G- 6U$(F'8:S/.>35/=B825>=XRDJ@^6"8\[&P>=$#QTE"1
M7&M$XVH3G;=)U^UN#6*];IXV-E#6 MU0B?6%R#9YD&W[>6F9[NOR$BGU2NE>
MOO=\-P2K ,%*+H=6(2O#QU^X(I14A)U,BRL"ZXI0*&WDBI"N"%RR#Y-LMJ+(
M8X@+VW52 147!LJ8.K>@T,G=\6,O*E NSH\PUJ++,'B BW" HI]M:'5:T!]17:
MF/<+>B4VA33UV0U.&):MS14Q"#RLP3\C1S""%(+MLQA5B%(N4B]'NJ:. !0*
MY1LX\O/DOMB:BO@]R3JY7SPYIA+?%'RXCSK8V6#N T-D=^+07J1*[K(%J#?F
M5&?@4 HXU=FY6.N\H=),Y[P^T%GX+*S!61R-(2WAE]QYH&8^*J*T1;,%+N &
MZEK\(!R]' @#]89$$L"V)BO+=[1FL?QF5Z"Q>E2^\L6KZX7!80%;97$6J3
MD#Q2=&2AH #3KSC3 Z;GD:(3+ F3 ^8GD>* C#]AC,]# !.ANE%PK\38?K1
M(KYFF7[Y+EMJ=!'T^1W V3PO-X,!6%\([B?TA5.QS KSMV"^'>$
MO0CP5WD5X:[YO#1=6S;4S]HBE\-LKVU'D2O#X,(DZ,A"]AX=#K!;K75S0PBU
M30^NI2QQ";]#;#Y(D8L1H9.,]G^,H7: QL7Y'G,V>'0OUKUE9>^\;2NL;#R$
M"FH*B>U8FN+X,>'OAN;8CT^ GX!F9F+>9>W,96EO-?3H+#U")/S;[74D$ORJ
M&7YLT*' J%K\FXMX1W0T([4IE+V.!U)0O";UCLEEB-'8WI14K(1-JKM:^G#!
MX/)0 XZ\Q)+^ESCYP86A)XB*.W&GU3"[[X#:#LEA(%#3C-2K"3TO9(E>R
M350\\ N,H.6C7C)BR09(Y[U!N(#7+. 11I03\1+LX@I0DP+ A[@"=$+Q:Q+.8\/#IM96G;: 4V:.N>.C\0+<(5FBOT
M@6'H5HKZIM*]F5?!9ST486Y'9S P75K,#'.3FCL*F,OV&4IV-7=4C+FC-C2W
MY\QM7G-98FY2H/=R;,<%7N#Y5&@WR)PU#V\OHK1
M$98)NUNH=')BSJ6[Q])]W#Y&1?IU]O \72L=.AL 0E>,F<%&'^=J70YH5FR+
M:M9PJ6 A]G+
M>WB C'OY=#"F?6FH82!B=T[',S NSORB=.F;[M;DXA<=D=5 ^4>;!,U54<'-9YTAZI('%.TBV5$)S3\TVM"@Z;#BJH
M:2:ZCF6LAOJ;;'TC:)!OOV-5*CD]0Q-6Z.;0Y)3L2PDQ.16STJZ8=-Z:G$JH
MVZZ8L!GF;K?SB&PI2Z#)#7DCNKG&.T >[Q0@RPFZGH+"IS5A8=H!%126
M4 -!K0D+TV[H5P(9H:P#42[5E69HMH,K4F DY!U1(<*@=,$JVGZZFJB!T
MQ*UT31#:WUD6?Y^Z7K+$T+ ZK7L,['&(9
MLOX(I#!<\D2L-TTA=X]/7:E\W8]B.9G((42G:F&S&'XMZ]K"M Q- DP;46DV
MWGYERI9Z:BS/)47WF6ZYQKVS)!;-YD^%OU@2E,2Z^ZPL;K#9#OLZ;+!'S!KL
MTV!Y*P;[N$S?8[#[S=]C&>Q6]+=(A-V-E9VN66Y&EG7JBLE/2TB.9^O9%Y-]
M4?QI2$2CWH$1YM DV]T< 0.7)/E(@:/FOTM8/\?FJ$N9%VGVR3W:]R/]>7@
M=%9ZLFA47)+V4O*P)BE=\XW-IK%'$.<>K&.=A$#W99&M29'NY"I=KZ6WPTN(
M;(02;"]8]%IV^[5 RDHHP06Z=8'NR)O"Z$$E][>AQ)'WZ?8JN,M>IJU!?KX
M YL&N;:(JCE=[6%R&*,+T:1OBU@8O 162K! :F?$B42K7# %V,UB6+^=,XTG]K
M=Y@8?P&PN!"S(\0I #@M$:9QZJ6AXL$ 7^[X)M43=E-0KA-WE==GDT ;IV[

M*=K<3K,JV"=@L;W$X+.L:'I"I+\0!S*(^X5W1UR.>S.(>1?]DA*20J3#Q)7=
M,97=%U*YFV-I^R.D6A:1!Z*/S]KZ:QC6.FM-U^44GR>;5VV>Z
MM[:Y#^OB2U8E:=,WVU:SV'3$I/5$;'IC;3IR8+LG8M/>N>VZG127ED:DI=E"
MKKI=#A>"IH6@@2WX+Z;Q"EG!ZH:\.,G>'M?R6G-DG6)X Z)KK[1/6P>#TQ0<
MRU8&95"B;Z&H/]+BWO(K^@*;\+ T'?/-U!U94WZ#6 ;,D<'@@5E12,.MQ+3P
M?11H603@-A9$0!P$UF# 1: N$1 'Q:S @ D1Z(9#Z)@(=,<1! ZHSZOS=5*
M'MI.X$J^.7>Z,PAE6-+4C&@RI* S"2L'29U)-NI:,\F
M050SD09<"FNR9Y-B4A?W3L5NELP%$UJ:!
MRP 1#/[!(@MB641-](#NR#IO)H[E,O@T2O1M5??R7;;4Y").K %V[+!/=^+U
M&&(']/\N=&BGH\%Z>>9W9(^P.\QO;QNP//,[X@&ZPWQ6S#Y$-3',@^)FUN?
M@N''J"Z' 'TS 8]$AQ>I# #9S;,E&[:L1$=[WQIKQ-^;7'WW];IS4I"!7PF9
M2*4"%X5N!0.=$X7V8H+J5H%+ -.9?W4=YXQENA8CA[&/M]=/IBY;N&9%+$63
M]6O36IN6W,FGT3*S5%U,V$KN9.%F3 -/%;94W8NQ4?28N;V5C@CZ#
M6=G8)49QD=A+LL/V+?<0NN2AZ#1V-"&@D\!;U2>@*005J7\G&
M-\UX]:]KR5UW+MYO8ZI7I6X/S"L:HV&C? $?LJ7AHV;"6ECT9.K>3?4O%\B3107+-)7TW@DBNE:-D'67+Y:A)Y;K4N\)8:E
MFE5/<9"V%6%KOZOITG&JA(XDN(%=YA+<9PE.VFBIF(V6>F*CZUL&Z82^M)E3
M\HQ%W%P O>?/R9?N/W,
M)?RDXL^?=?DU^AVQW'<6LFX3[T.Q5^XBY(V;N?6($?WBL-P7H 7B>]^ ^ G/
MFJW(.HZL^OR V$$ I/(Q#^=>/>^CWL0[GQ^5.[SG \K[>.1=V\ VS)V!7H
M:;-Z,?7H)\?E/OGX^U?OF[$7;K]S2Y7GD;QJH,P0IN&$SNCG)N4^]^0:H.+"
MG:%<>)]->W RZ]= "DO6[PR5?/\[V40 /RWW^:B3V/O^[>>O7E>]][T\2X ^BZW\WS'=P\+)M&D2]LVT7#&\$C'DY,+Z:40+L>?\.'SQP
M'\G:M+ A-#8MBLF[6-*2 1>Q8WQ(?7\2BG^8NFN >=Y\UG1BQ3Y?TL#%B9!X
M; *S]-=K8,ZK:45%4"QIX\"MGN@PD=&I,HB#FF$ /"613$NZ^?8S#:].7H <31
M?"S-QC')R0#" SA<597M912L/'-)F1:EG+27BN-]WZ?G@0C86$T!J?2X!ZF0PG(YC
M;,X"HA*XPQQ#7H:R(TF?32L^
M["9NBJ0:O8PXA\!H*"9TI1QH]2%6HT,21[/1<-P$8MC5S@$+@AURU[@ZDD"B
M1K\U<F21N\'XAJX-;IUX;B?%P1W,\:O)-\T=X@Z8?LUWC5@"F>[4D 7&>F
M-)P.X@!G@U$5Y#J3*TD4QY$UZPCJJT?2+()E2W%:E?[\LC#7:^K$H)MQ %HBH
MM#>X>Z&]N'16GG 3LXFB!R!9IJY#=$/W@2%&M<$?/Q*5D!5=^4B)XI9G8Y"
M'&W#^=J!/A(]:O18D^FD<7I$9,ARB?I%DU \,XY!.ASY*8IGC5YP--^Q1D6@
M.0R!<8U.C7;6/,LB<.,/QG@D;\1P4XS(N$:G.9Y/AW&2IW^^+(@UNLW1
M2)K/"H-(5<2 BMNU?I7'W"SSC2B,-;H245I/II0573]TL#6:>GE:;C47$@
MM[LSJ;-64YA>HP.>S1/9>38452&N=5]K+I6&V)]C'%0083U2"IOUNM;A8#8.
M12#]RV4@JW-Q<3(8%H(LK ?S"K#V0%:C6Y*D89RSNU >THRR^T&V[>>E9;JO
M2\B 94,!?[L5@;W*/LDK3"@#]!3UQR=G::!JPB?'496+=B?BH?B$%8];U[LK
M.9.\2HERV[7B])Z3[GZ[#&PY+JNUX!9;H8^$1>G"7V-^-@V6/O,AJ)I
MG?G::%@-TL"1/\O?(W? :IGV'J";V6F L4 J?.@@]IAA7#Q<#9#J'&U=IK &L!@';$0T>1%?C>QTIPCTK!/6H>
M[KPM"G :M% >?+G"3:XH0G7ZQ]%4E.+J506Z>O&KM4!D/! -:L8O/LL[6?\^
MRW*/P3'>8+#XM0X.^WY!7Q0]L@O" $; 00.4^V:HETIX8A1(@;\4@C/6#$$.
MO'/6#$#D8$P2V'F=N>,@GN0FOEH,M+7S" P@P! JLH]#7FDN?S1'5M2;"2?L:1-8.HM[)E@*FV(R^#&!%/H4?1
MJ-%KGL^FPU'2:^;!<@CL-7K$\ %\,) .@IWJZ]+456+9GK>,PEIC=C@>CP:3
M.)UWOUT&MAKS06DX2IXKS(/M-\TP+?@UB#2BD-69] T@8XJK6?++1>$2\[H@
ME*H'%*?C<0FP=LD)!D%W\?2HOWAQZ7BE05DU05%D:LSW)N.=4S7UP-LT#>JL
M5!GS%//0^G0;R8*$O!Q=S.$@=6B^:!4AWPABM,RP%^J>OF.T:NGTWKQG1?
MG(6K[QX/W=FO%7/;7)3!8C)*A IE@*H)GQK][C3A=])Y[N/,C6O4432I7&
MT $HJ?MHW@<*27=X6^R7<"6(&'G@,$%PK(O.=V'W*$$R0H$FLS16R&(UWSA
MTG66X&W 1=0H(;+BCF-*1HC]/L232%1$.+,9RC$Y'R \G@Z&\06J0 &F;6)B
M.&?%/4TR.6$." +8@[*GEFQS1%7WD+6CF:CY)G+ZNBF=G 1,YO,L,?;O1U@
M2F"<%2HQR^6"B' 1(!Q3Z6:M=X% A)!8CQ,SV^,?1\&8O^OLQ.IP.6>%9
M2ROMTF"<+#.L@QX%8IK2 8%8#14ZOAV#F[Y'F6W%"L)ZJ'<+6RZ*\W&BX*@ZJ+O6[, -
MB4ACR.%L[Z;O?I.6#^&A+8M"GH^2>WG5 $PW8X>V)RI#QR*V+!/6FCQ8 8KN
M!379>T',["#D/Q4TA]+>+#]J$;LJPV-^K4%3JZ!@/M^X34FC<; J<]N'BQ
MT=I<$8-N@,(JZ5%HC21)F+BC'2!EA-B9B>B5M NM=4WF\RFLURLJW?'$C,;
M'W5 + 9C>G2&@49C8F9#)O9%;32#B!NGS3;A5K,;!'&O+2((VF\4X)8D$"E.OB*F9W+F!>D
MG4Z;378[%C,;K+$O4[.=-=IRQ$H]#R1F-GAC7H#&H\%HLK<(J1#^G8Y+1].1
ME#AYDM7#*[./GIC9;8YY41#%P3#=*1W27%#,;#G'O'S,!XE#U2UV,Q0SN]HQ
M+U^SP60; G:S?Z*8V9:/>6&>C(:3ICD0T9,R#0 %S/:!S,NVN#M4IN$.D6)F
M,T/F19$.;*BU(V64-)V.Z:7I:"IE=FTJ3(=.Q^O20)S.A ETV&G#%-.23D?G
MHCB>1DUV#,LBV'WA6H:(T&$T2@AU\.A^@O%:=
ME:@UGR7[N!4'**EF;)
MJ*-^P'/<:R5!F<\3/0M* /XK)(26K,.=E^I*,W !6D;#G@)Z7O K*L(R&XT2
MC;!S *H,?5X3["H2,YD-$@-G&H(^KR]H);&1I.$AM+]<85N2?`GK$,F1D5'@
M\PJY*R4)DX1MS :G*NAY==U5I&8X3'1F*@,ZQ@<8&?@LB0&;=T*I"IW'OVF6
M2,;2(!0',.]@4A5J2A(D%W4!F./*ZF9.)A-!\FB BP PW![V\4M"F/>B(H^O,J#V\12JS1(#/ZN#]PF%F*E
M1,EX,6BW'N"S9:ZN3>R^[N*X">\IT["OR,*T "ZNS)W8H. 6;)IJ9HA6YL[
MAZSLW'Z%N>U$JP4*>/IJG+!'C:'3"MV:6# ^%R?3<6).=- HUL3"]/ED,I@E
M Y*CD@U>X"NQMW<>07F8U^.UFHJ-AXES6'L *0UM$TO8Y^(@:;+K CSK:#8?)$^0!%\O E43.?:Y.)[2<^F5H6HB
ML3Z?C$?SG?.K,;#H6#!"?RC2/;=DZ?$PK\MI)1$8#KU1EL%4LYK!/PYAFDC^
M9Y.)-.LX79I8;)B,AO-1PW0)% S>GK:*,LSLAEK=&,Z&B3;2L>\7 RVS;VEE
MBS@=S!)I>170FEDQ& [$HI#%&SO=:&^:2@PU665UMUK+2M0W9 8+K6SXT/4E
MS'EQZ#(H'K8P>#8C[53\+MY7LJTI4=0:<>MC290R)#D?PMK0:RO^R-&&(Z+7
M2*"1K5%EL0N&A01]N^@MN%6KZ:X3;=0TS&S3F2F+P[S^8N>#B EDBU .3)41
MJ!P'Y",@78AB\PA4=MA%." .*R+P!]%>E #KY1ODO* DJXNEW/<+^F"D050&
M7G7YZ["7[WB0R*RJP5@SGKG].8N:N[!#UW":R#G8P+.N2"+ &S?$TMYH]8%]:6DVO/K&M7 8"OQNJKO3MH9Y742K
MYN.)&HGZ<2A&(WSC(U%BQS\NU3]=FX[QQ*6PR OKN]@WTXC42'0C)O?:&D!B
MIR]?\MUIV#:QHW(^G(N3G>Z1^Z"I!'83.RLI,5K=8#>QP[(;>Q6&^IFLUJ8E
M6YNTN:3Q /A!CG=(&&;V1?4 $"8@ OL!+M,@.%(73V-!+IZ76V]/8 W+5/N-
MYXFN^:41;792UC"S46LAXODW[6LK7X9<>8/FV)LT-LSL(%N&?I%TI!KQQ.X1
M+[.Y;1GB[1D.6I&0X"&E#HIB9A/>,M1,3LJL2$9ID"C#Z 85RXS7R32(U'Q7
MI-UD+,Z:GSE8; '*S.G)(EZ=3G@\'4V'':1E3D!KUA;3YK*6P;5&4M461R?<1O7OXF*&$&>3Y>)HK2I*RAMQH3L=%4OCVR=
MQ&HJ]NP#;7)60]M%$:LY$DL[EPK\CZUY!\4@>KK.C/:*] :N<1&KFM&=!.5N
MU=#=DBIYP2T:D3%M6>23I0AJU0E15 19BX$X(MY-',4^ /QM)>IB
M013G?E$6G[JBQ8:\HN0W3JN,:XVDJFN!M1Z?R!!E,IOIMHU@6'V3>A.\V,+^
M-+B+^.2^V)JJA8X$O:]L*"2*Z<%!9//.<2HE5^RJH]X$">L*+1LAWGPH)K;N
MVJ)>$[%GW+!BE0 ?"T]E\&C <4A<=
MFJ=N7?%M(W2=8$>XCA*VB3*'8]$C4K6:70!1I$UOV\IY+DGCO8<#\^L>BM.B
MKLAZ R9H3;4QS:#/5+1\)*3S.096%%AQ/D@[VUD,^'C5>;F=OT:Z]9Y+@^D@
M;K9*PUA?S59F2]\&3%:I.IKY)-$J@+6BK&)
M5U?(7*<7'D^GPUD':9E7[%"N:&LJME:TE=GY^Q@Q1HU%6YD-P1OW]P$BXF D
M#HLBDE6S<6T:;R =!'^= A.=,4CLXUX'6PK?0KO/'&8NAQJ=9&EKH@Y50)*
MTZ1YDM"*A>BCWK\=[%7[1!2X$V<4T<,XVT-=,8J5B9'II*/[!84ER,Z> YB
M@T:^FRI21Y7)G-"[+C(>B4-E O$C<2@WIJ &JI$DS0L5M3'-KS*A K$T*A'O
M5F=/2N#;,?:4R2$.8$^GJ;SKDE+?'25KF>RB*WYD&]+-IH7JD O2K;BD1RHQ
M8M1N]#ABPWXVBM/!E,@C3%W94"W. PG1EH@T,3&B87P\
M0[(/(;:R'!%"GD(.:Q>I^HZ?9 ZR:-\.#*>#:6%I:?BD3N9(C:,;!J8HT\0,
MJR,A6.P,4^8(D!9,QT!*6?UMZQ!3YMR1]FW(7!H73XX;/ZB3.>SDZ%:$+=HT
M,C^E=A1KJ9G-G+!2?X5'M2[%LYD4-\%,E1UGCG>IT#=
MM3,T!YI/!TD8H[6ZK:ES$$ #5BM4OWFQO-1?-& L;IM*7,,42T;6&4J[#I7
M72=E#DPZ?)&JS-I=!XEWM+KM4D,D9]]LDK(1QCPUFZ ;+A>IS0>#[M4>2YG#
MIPZ*?,K(X' TFW3O&(N4.:&JU@RTS&JD.$WKJ724HF4I<[35,1QL.&)C-$LT

M_BY;M"QESL)JW-F%,S1&P^2!D"9:34J9X[5J]4Z5!@E(XU&A :@C;$9*F0.]
M#K&9W:=,$Q,SCH1@H6U:*7,DV,%&H?0D(9'.$JEQF :1X,*;XOB&=[MEY1N<
M8'K$'YJS1)>"$5.4/$>+<:L->$^$:%6PK9=>3?63ZPEYFAC+WCB6.P][/WPV
MK0Q,ZPHE:[(KLV$6C0IC6- 6O90YA8T!TS*A,\X9*720,F>Y'=^P,$:RIST5O^"<372#6>C26+B*T.E#%+F(+@Z\ QJU!M-AXEB/;:HU\1@
MN0:1KG]'7,$LZ'\36XKA0L2)G#]-K7SZDX[V8EB)0YV8]U>I0_D"+5
M-HROH1AS+I98"JGSJ(Y4VYB]>N+)]@B1.3*/47RRSBQ)M4VMJRGSG*0-K2M^
M9_G;9N]YY,Y0786BX3T<)4*9*'G (=F;2T.]/?AT[&&$W#WZ68(D!]&P3)3<
M-_V;,IJ U$/36DPWDG!^5!+6TZ5C/PG;I\2EG;QM9S.SU-@\
MM@WV-O:P/J;J-4K*=%!=,F;D2G*/AD
M+4>I.BA<3[<*E@Q>RP0M$[@?U?P=3)?$!:36V-RE%
M-S8RB)S:VD9I5KHMCU3?J,%#A2WL$YA2,W40MDU1KM$F&Z7)U@K5J.A^)>_T
M2HPX;-2GY)1JYR%T(W8+D(9#D5)+-1 LE:B,%5I0FE0?,6K+AHTL9S=*"J>
MS4C%A;&"D>EH5F+J\1XJ%#ZZ=OA0PN8WU,[%P4@:-S]^10
M:YN0EQZYE=P>[-J9N]H&[.4G=V5&4HZ&PPY./Y(R) Z8T,"'@V] BLR%)+4-)\;=K1X0I2J:&!+0Q7F(J)V:B'X+W=-D59
MD>TEQL*Q@#QSZE U@ZK^LN[.EPL E+,T68FH(VD\R (HH/4- 5^M:/0(RJ6A
M0F0,'/Y7\M1,YIBZJC2#:#TQ-#X#F$I0YPR$JT;8^3BQYU,SU)G#WX85)Q##
M0XDA/H6A?K#,-PTWK3Z;UHWIOC@+5X>0#S.HJ!1GSGFK7AR;&#^7!4PUL)N8
M0S!.+ +6#W7.>EDE&1&GPY)0HVT)G/"]\876[6L&V&)PSE%H&SD%),['VQ*Z
M?5"4@S/+45:5!7$P'(QJAC/'@U7B F3DMV,N!J;O4I[E[[??\0PCN2(&66C1
M(#1SJ%/UDICA?)YT;#M0E(,SQ[E5[84X&$DU YHWX+32;/KQ7"P(9F@8:"#V
M=\U04U*/S-D 5;D^F< CO<)W02@#8A.](H?2;%0CB#ENJ9J!'R>V)/- S#U-
MG3GTIK)E'\\2[8(+G0K/A37'"U7K S],[O 7 FJ.(ZK$ >$DV1LL U0T!H]$
M=17\Z<[S @^0&3XO+=-]788.X?Y%UU[EY+FBO)$M%0 93V?;E*8D<+5@U42>
M!K<.I5:QRO%^E61M/IX>B%1D!YJ>!PW.A=X900CZ2!2BO>&Z4!2;'!=9T2"-
MQ;C[*0+507@T,JP$GIKN[.\WC$>.JZTH7:/:L;@SWHCAF%:\WC1S"DA5<1I-
MI5$> A%P*D+>Q @.")5G]0'^8)$U!" W E*B'W%>&MXNTJ5MDUC.FSE2HRHO
M9K,\3A2!LFY,&\E#Z?H/'?Q-) '0@YAE)5M!O8H%@")')4=$/[.\C@:@A
M>G9QE#FNH7KD-.."R@02M!BB,^FA34.]XLG4Y>M6X-8
MKYNGC>V0E?UL7A&ZN*)&T6QB,00' 2DTL
MD4C#X4 :'8+2=H]@$U3B8,,EBX X@XPZFP==-AQL#0" KE>Q*O%19IO\RL&I
M-!@F=X&*PE8'3DVLJ(AC26P3IYP8I9KL31,K#;6A=.7:FD&PB(EVGD;CZE^)
M*51.V%(Q,QHGUD[+0%7:@UL4 C
MCJ=S!E!K9/%E+@W%@W&+%.^%SP<%TO>+& (2=?^9S)HECQ,4!3H1[+VW?PNJ,W4QT]GT[CW28)0',!F
MZC &@X2#J Y@$\L+$S$YEB4+NH?8M3TG0T:9G9TK1\JC:;)H>S\P5:#.:\-<
M;>5 GC@Z7#?0363YXU&BFWHNT$G70MNDUW
M6=)<72H\T3(G7^C]%8PLR)OP;4-QN(4[#Y@B;F+OF:HH)HTX/"!04GC*09@N
M4.6JST:9'7HKR]=P+NX)I/T^/=XB.5XWXJ'#V:S60UX
M19UB6;R:..(VF\W%V:[!* C=?@,23,V@);S+Y.R.46;CU\JV;SJ>#D9[+48:
M2)41R&S'6EE[)O/1?'^,7R\"3;A[<3*6)/$0!,*EO3SPFW#[P]E4VK?672?L
MC50^BO/),6!O8CU^ I%M>=BCVT;A4O!7$[LS[V\\,,KLOUGY:$W$EQ>#Z" 4
M&BE)' Z&N]MQA;!(4 6<4<6C1KI=[@QCSH7H 2:6 ,?3I-ZT" "C90?BN*\
M"@+)H.H.7J)^H,+L89ROX"@'J2.KB8&?]"4,6BX8"\CB&5VG*SL&D IND!
M8&E8]R 3?#&-UV=BK?P6$C0$2P\&,]M*5EZ6GV4L,.7 5@M231QU%\696]2
NV5@V\G#21EL(K>?37-K>^, 50> B83^7/1:?AP# B86LT<3\1#R[]G-"].J
PON/C?1KG,X@K(ASYS" FT*^B:7U\7"G%S*;R#>Q; W#N>%-IXK(4]?Y$^+
BJM+%+%&Z@#%::)6?C\L%6#.[$YX@"0FSD#7"W,CAQWGXJ@RR%'@\O:L2\$T
F<]W@,K^?([+'I;QU//I;)>-27?FY5 8%T;!:*H53?)8P?;KQ>!JY,@?>-2D
3RT+5Q/)L#09)X]3)\'"+(#&]6FEJI>&&E001HL'O=:!:$H39["PO95W;,4
YQ>U^GG=UZJVL(BT7VL0D:-3JY%S@:/!=-1+:C6R" "AY/RXU/(O%)K'C1 .
Z^\=I5%>N[MJN9PXV@I4[= ?B3!-U,]-II/N$Z:1WD@3<39OFC)A!N"UV;JW
'F3+\?^(C+.FPX+N%]XI]*#46HQ2H)G:AO$X<6ZM"I@U8]K$4LEXDCR@=SBB
M]_CLD 9J: M-D8W@+<^6;-BR$GD+Y'0VI'U>-O>K]D:,&+Z-U$/,IHDN58=
MVPS>391+3"?SR:AFO-,&ENZMW,GL@.C#5'0 Z]XZG$9GL>XK^0E.Z,;7X+VF
M&E$"--(W>!*%=S\<"4&U7F7#;W"+W#5U30V:W\(#-G" GF \!=BL,>TSQH;
M'(&BF[9KD6= Y4I/L+G<^LK? D-W?E*UM]X=7[Z' V; C76K"=C4Y^^;"2
MK5?-.'\Q'<=E\ZG%U-7
MO1\6\DK3-Y\N+4#"^\76 D4^B?@"[T \VB?#M(#8WBL=5($% " &L2[ZTV&
M%\!W!/ &#P@QEK8)XH4OI2>B\'&-5U.Q0=@G6U0BR!6#UL?/A^(!*+$&U\,
M1W U4'IR#9 E 4+C"^&' Y!7ZY ^?38<#OS?PQ $GP33$L""")%[L'6>;&PB
M-_THO,LVW*D!KK*N;P0$"O<$X&$P%N"@+U[*NP>^&)@NZMM(";*CT98JG^ 0EC@F/WQ!=?IHY(/SNT&QI[IF
M7Q20)'&8*DJ[O#VR<$5%2?:"!."<:P. 6.2APM^* ^* Q'2\HB^@HD=R)+,M
MO&O.4L#7FJ[M$Q5OAA@4:/.J*<(:PA-D2IRX H]1XGHR$)!=\"0%6&RYN'LB
M$ W]H/"R$7QXS<@?P7O$Z4^V$+R< H*O0:E0\69G*V07:4]N,2<8! >2NS;?
MX8^U:RE+7#R57RU"36P* G=+7U!R(K2Y#(F [ZGQ(N@[?%U7&I
M*4O!V:S!Y:,^+JD& DPK%.3A0-@0V;(#)(25"1)I6O:9) +P?Q[V\+\NLM2)
M4/9"N,1WP<^N[N#;**\C1SQI] P#8Y%Y)7@)>A ME!I0?. /PM77VBZ3NGP
MXI^V%"YO;X6G4 CP-DM6OF$GZ/"6)T->?\5?A1\42#@(;AP0'0Q'A#B W5['
MJ('&12>>+1$^DQ?+E:V-@)'5692G GAA4[")KMOI^HU K2T36SL"3VXMU%<"X?M@))!SHSCZ%!=X%9X
M[!4=18":C<*'(NW!2"GBH^]I*YJ:(/1$,LKV)^$'[4>/NN)D\),'QQI"YG/?
MF,*S/VC16P)K";;U?*&C@44ZP#W1F XT0<<%[%F(1 RB[/S? TBX*]\%TR]W
M7\KCGDH5K@$O([!0N 1H.4#1+U^N8T2YOKV-4@4-,3H6%ZVO2E;42Z#+HA8#
MWJ@*KV@WO+@BC&N ^9=K2]/1[(S/D+^VNP:3Z% U>;7,=W"$OC4-C!T^Y8\&
M LD LX/ 4.@I&[C3TP3Z4^ ,\.O@?+Z#U-(X;,=61^ST7M.'#LL*+/D6*SM
MRY/.K>T3NBX6,6W>N@JJJK00"XP"5F(!/;R,BS+3?04*4&Z&SDJA8Y(?9HK
MH2&S\4VF% 5]O7RZN?P PJ^Z^0*O?"+HN\!36M^(XYL@O,O>K""IB7JSQ]^
M1N0OHH3T7WY2%R;9F>SY]*U14%1Y 1Q0-U(A>CLE@+>BV:RF4
M$!]0[46@0H!(H$,00+V!#2?$@&"1@$?VXDYX#C^!X0Q->GZ >+KP32I&Z+*B
MD#6^4MX*R7I+R*A#^O7R\B'FIY'H$#E0@^)%X [T'+Q@;NM^?/<2VGR:E9DV
M36[1?D7#O*CO\<,40,+/*Q+1(G6(P?I A"::OQ7@!4Q^-H+W>N/~,,K,?7:;
MDZ-%Q7)]O$^&V.Q/6L4?(/5F.IYE#C9/T-L9F(C!31?"?T(.!L',6?[W5K+O
M#KF&BE/G=MJM2D428^F\#6;7 Y$P>Q-UX^70OP6^RE,9,0CT,B
MVH7BNQ& AHB))W@X&L;V\=2HA7VAPUH 16OC25G*A3-DF0I &9XF^B"=A>^"
MH'GC<0&E^0";86Z,/JJT!:OYC
M<%MLQ8 ON8*ESF(A=:!,I.&[,,$$&980TQS@Q?;M%[H*W5OMIZO!I1<7B1A
MH>7#FRW:$9[X) F2G^!N"C4P68=\"=P77=[2D7Y1+/ U @/Q[(>\R;I+F46S
M]=VU'?P9]4"@S@'^^]6D^3SU'DA3@JL2P!I@,:%+-)I#I5\S7$+O>"'9',\W
MR#';Z+7C1AKKD2ZS0#X*):5&L'84O!7":-U7/C^>%YSM]HGW,HCID'E1ZT\P
MD35D)[3 6ZOEK-V'3\CT3!;900 M03P[3GU*\A[<,E!1 PT)PU+3,4Y)7G
M0;?+D27 ()GUY& J,N, MV+#&YM!S3/J2E6;3=X\P(R.TX;N;Z2OQ&!!,3Q5HMMVUUYQY%\2P(98V!X?(D""$Q 7Z/@
M]^F;%= RH/$TL-5"W Y;Y-6%3!T,-X)EQVSW7A@C,=Z9\.(Z- ()5M\3&/GKK\$B'5U>4 (D@R$DWDL\+^%37=O.R "NNC99N#I\^ W>N 6(P[YU!.5@2(KR8?!(7P8U7W'CV'8;WT
MBJWO2H+EI*1/H93V&!TN7P,77] G>.2G]*4$1?\/,7]KU/'?X:(2DNFZ^
M>^X0P#5QY"I\F<8#:KC"*7\/:1NGJTI;"]&M&T\!5&]5PBN-1P!9FF*@37!#42!&7T:]Z*N$E#E:B^
MOX"[AQ1#]4,6K$XW#80&H@?%01'VEN%LFF% UT\"(QFE6$('398SR15VH=
M[ZAK[$O&'TUUX>X@HP;!LGU\J63CI5#/ ?P <@^:D=&D-6ZXB/6F*21K4RDJ
MK'%=7&ID0#2T@PYZ.VWXHO7M ? !9?T ^X7X"PP/WY?
MFKZ?LV-+!X: [!VZ*B^"QQ1^[5IKT\]!4/,5#RH0=].U%/14?RPQ'/;M RYL
M)+*=M*?\O!#@A] >-/)NQQ+A4,""<,M;:$T#LO/[%OY, #]Q"Y;W(]O-R 7<
M),9]!'=-+3YX<92V4++H%D4H45GC8!FG 3/\3?L0'XUPG"X>2. CAD9)M<#$=1WY\1IYX
M/WDPC*<7H]E?? *1#;A(547P;O226ERP-)P(N"' *?TIM)\\ %,4)B$1 I\A
MR'$1P1]8D!+CQ5[E-A7<=0VF"1>2(?QJ :.[(0-%-5/ SZ@ VD^B"C($H *

MZ \P?D(S?,G^.EJ2UF/9:/!A9C-LH!RQU*IMAGX7P0\7NWY/4)*]+'J#/B?JE;S...B466A(YIV*I?$L6+
MZ63+,B1SJE?BGFO+82Q#84/=N)MBP])54AONK[AQ[!^'L5Z>#OWEQI%QXW@J
M*L&-7M\YC"T5V-"\XMD7-XZE%CA6FJKJ),JYZ\^?!Y^O&]1$?\VC&:Y484*]
MB^KAM% X%!%!6J<#9XWZRL7#@X=FJ= 6=T-&/6/L/^PBR?!L4"AV*\BL0)
MM$2YCC"A?>;-)F>2-&26@T=,F=KG14G+UT(P#U/Z K /0 W/+U@WD0ZFT^X
MYV&"%QWV//U4#NZ*.L8P[HHZS+S1Z&PXFC/+0>Z*:E@<9:WZJQ?,NC-PRP1/
MG[&QVM'DL\B\<1A .MGZ&$))Y-IE6SVOYOO;:/
MH(-37>ZR6F<*=UF<9]QEU<7(X>!L,&*F1)*[K-Z[K'ZJ40?L(?=AW>,9]V%%
M&"D.SD9SD?LP9AETZC6OHG0Q990UR;)7?X3&@2N[O!:);P!S \<4P A.<'X<
M(<[.!H.JR3#?"F8K[^4^J.\FC?N@CC&,^Z#\(QDC<$$39CG(75 W7% E:,#
M)H[[I(XQC/ND7"Z.1V?3T8!9#G*?Q*%;--+J:SRY2EEP .SVTH\<6U[*Y9;
M+);XX<4)^WB!V=BZUNH7&'8JOCA#H3K ^<'=R"%ZDBEL\ELRBR#N,)TPX'T
M4SDZ8,&X@K#%#^Y1PNEQ0W:YQ+6&H2I.?C@ PJP'?X9>RZOV)QCIS;#^!F1
M[O&,GQ$I5-LI3!23LWH\FYQ-!KRS*[L<8J;FB7N]
M3AE([O5ZR%3N]>KQ>N+H;#QN^U0(]WJGX 7ZJ4<=L)C<#?:0J=P-,K*$S5TA
M& K(:G6R:KHO.A&&%Z>2&#Z;CJP+%GDCADO8V!=*"UU.CB\=V'8M[]!B7#S!
M2*7STTGKXV< Q1I,#J;M-XT<%]PLM>(GI *=J%0C#L[]@PD=W;IF&CP DBZFK!17O !RN97LI% ! D@O^^&(X^FLKEH+BH)B&K=F.+9@+X44V
MO@DJ69NV!C\LB6YSW@1E291OH-^T>MR6W^"?MB KBND:CGTA/"^)<&VNUK*Q
M\5X&Z@[7=5U8 K#Z1M"U?[H:ONF-V,X*4+:%M6LI2]DFJO"N.4MXL6""!=8,
M61=6LN-:FK-!>)RE18BP @26)\EZ,2V!<<47HB@(.P$7@RVC.S >\6R'?
MP[4(/J!81-4 Y[STOLBX;"L%G%) R2N*&Z#S1N!)X64C
M+ B@!>#YU %LX-WX4/S#+T37".)GY#A)GQ'Y-.:#?1W!!N,K[;0%&#(10$1
M$AE5@4=@IZ4I#A ():GCRA#!ALJ$1=86L:FTAN(!OD.7'90#[5^H$+8#*@'"
MH1/'0:$'D?78?1:*D$7P"16E#MZH@WM##< [[7T'-,P7\,ZRHX$N"2Z0Q1(4
M8CDR:.("-,10\,L4+5FA-W59ABY],R(\$H6 +J.GZ[8"9A-^%\0+(=087 =34=K:)$7^"GRW"O:)H,*D Q*
M0"K\P9S! PJU2/#KA? [%2+9 A1>B6> J=D-/WU&+>(6$F>S!NND@^V6;316
MVVF?(1R^%?7M7B$1'';:Q"8XI\8OX)+< 2#@!DGJ/OT,C@>-V']5Z"DJ*C4
M 9GOGM& SU-2R>NU#E3%1]>FA9J+\K#]'C!E20QJ8PA5;' FP$3D.03-SL+5
MXQ\#>Z6M*"\ &TW1UM3.Z*:-(UJIB 3/A#$00(AUN.E,^,O@8AS\
M1=\-/PRWE\'5("M P 2-A^J[94]"!(#%(8\)#'Y%O!!C7Q&37QFD?^6B2/3:
M-9T]HTH:#6F1>0L3M1'=Y@\:"K[IVD ;^\=/.13H>CH5315I$NDGX[]\&'R
MF$+7,=T&LH1 ^XD\ =M?(D"[3ZQP0<#/YFD@M+;)I^ ?/PE>QC\=1'OVIA=0
M-5W\-AK556#L(5 'LA +(L)")6KI\L1F%H%V MTJRW;-\P.@ CH 0R8?&"G]
MSBH /I8NM&MY3=$%=X!SW0^ZT.#@3QU6/V'%M82N5Y*ZCUZ:**P-; #AUUR&>B5+;E1E<6 C&)*M,N7>6
M?%>R XK1.O&YH6*)'R?NUD=GTK3M[II<6?C>8L>(SY6!\^/$/?0;CE@I#6*86SSI*Q,ZL*[(+15; #AQMRZ>#8=MCT7DRL)W"#M&
M?*X,G!\G[CF&9]*H[4.*7%DZL4%82[.17G#J,NBW2-OQ[30^;'E]A9&.(^VS
MJ0/+D<5Z77$CR!+/!G4RK9]1Q0 BV614-2%MS0Z>D)K]V/)N)?=1W;%WW$=U
MCV?<1^7[J.E XAZ*6?9D>*@V=T7W)L$G-ZWVV71DO>65H]*#O K*C XLM/+A
MBX->%1,G&AJ"8#&-P+ ,@196&B6C1B<^?\R70=G3FHV
M3E?15C*EOJ.<$;FIX*XX3P[>-!T;8'@\$0+)YK2J:B /4X-I!.:*7X@
M' #0N6;CH&?$4=5P%O"+ZXVE7!/+G\9+YZOB!$T-1Z("77 <<'CEW;2^ >[G
M:\M4B TH Q' 05A;&A +6.E/!:935%/' %/8WC5 YL6'#X=8;\>U>C,X$7AP
MCXY&1[7Z "&G)BE $:$#? %'ES+-H[J]&8 XEQ1#TN
MJQ)\,.5ST!*Z9Q0G<@V'\Z'3L\&SA/T+E1&O8FW)N6,
MNUK[VOJ"AFGA.C@>7B4K?([:%,^4 64]+H$.7P7/ \W!DN#07U^@PPFPGI5<
MR2H=-8\C94D,1-5\- QYR5IH+KWIP1WV=T]4OVX] 7H*],L@3L>]W /.M%\[
MW?I1:Q$WS%2(]AMT%!-OH'O4--}YWZG&RO#<*D98J.R8[%)/[,^C%^PE(6!3
MGO8^K-G45%D:E>&%?U$@ W2U-9T<[MD@A%HS-/0CX/H Z>!"9'A].H0ZNC59
M4=R5Z]T)?@.>UWS$4*U6..OZ7 2'"^$F>ADCPS1:(=2RKOAOI'$%&#H9F7RN
M:P;Q(HJM1@6#L%7T:)KJ A94NVQJ/[U!U^$MX+ZQ,%37WD@X'SAD4FRF>>!E
M-3L^*WL)ZH5FVC--]!WAN/3A 'RNC!Y:,<&@: 1&ZET\A^C1V/,S$,FL @C\
M3WJ)SVPH3G^RA; UZB68=6]L>WP ./HGE>!K-.IQ4,2\L=9 [>W$%C8EH<.!:RI+"LR1I CB/F*H ;1Q/'PZO(RTI-26#>"# >FBQYWP
MLW* QAD=8N\3VXLB%P$82*]]@+P0O(K^E@B ^N!Z,3
MR3G2 &W29 L&E@"4RT24(M*6<1Q('BRXT6.H70!
M"9;P60B %QBBA'/-\3.V]]TML3R*YE$<67X6A' 1@0\CQE +B1=#T,GH;]0*
M1)4%Q]4CS*%.+$A"!^("E^Z, 8OM*'HZT3X&$S4ND7O4V.?P:I@N@MX#(U I
M7/G(.R%$P*[T<&H O"B$SU'0UP!MR90:UIYXE\E^8W
:>*"%($ $* .S5"*2?RZGSUC6H.B$P0;.%*.NF#
MLWA0@QH9+P^,P$!7'SQ2;5^'H7F'8^<'" $!X/$N VBL3Y$SS',2 RS8-6'
M\I$* T92@K;"1,KC\!GD9!8(.J1E9]1L@!^U(@L\-+I>./C'&?A + 8&N!?"(UG+6K @):-I
M,ZC"X&M]=Z3Z80/-\CMO[M+YB\H?<[/[8O;0G"U,/+"U#:/M3SF4Z?K6171;
MAF[8^!M?OWP8?!PK1*WMH >X= ^IAG]V]^.\^9PAIMO LZ9 J24US;Y%/SC
M)R'8+1U$SY6GUV4"%0 8WTMN[F5MW@[G 3WE B75G!VG2*4,#WBC@5;(/AWT
MB^Y?B&T3:VOWS,7VWV&.M?W)2[:V?V/6E?XPN(GM'S)\Q(G<% D@#24BCV%R
MO/USNX:S7:3!]&7B)7FMEK1SZ^FA]#D(^MC37&XPN<&LN^$CMSS,\.(Z,\=D
M3R^X.>+FJ&:Z2]P<,<.+W]*7M-A3"&Z'N!VJ.RPZGW)+Q PW+K?KY^RI ;<^
MW/K4?2CFO%1:QL]AULHX<:U$]^)B=19D+ C1',W?^E COJJ&!2'X)K].,'++OHU3X2X-*5S8
MC11+9&X[[BU"ZG(E 5!%-EYI"?\E+I'WH@3W,Q:[D'.LT:3U0@&&=!/]NM:
M-/ 80UAT(CO"0M:L2-D9B*.-6Z9JVD9^O##U+O4K145K;T495KC(MK ;S?>X
M6]KCYEE!776LK1UNC;@U8H3ZHVW:MH*;EG:D;MC< GM<*;OC
MFT),KI"O\(A6L#7RQ021 T(7EKWU\HXOE>/Q;$6V+'IN4J8]D>RLI@(ZXN\M
MK,O^?L&V\4SJB5 S&YB==QV7 [T&PADMGPX\YH4[1X(R:X
MFD[>O-.>500XN*)9BKNR'9FV#0*ZX[X4B7OW"(C@+?^'AU-]>%?R!NCFX#%G
M#" S]#U:=/:OB%Z#%P##)@OXYW@1 '"5 T+X+"N.:46:>] 3CBKQ
M=^94$C2 H >DS: [DH#-"K9X> 00WDU7#[H D6B7 \$@KS(]5 U8N[9CT49-
M@(1AKC1%<"QBJ'[GDG@UK4N&]@@(D)-']] 4CPBX7%&GS1>$Z@D$;&S
M!)%M% %[H5VMM>)BA[]\]KNN,!"FTYGO]!D>RDL
M<(]D"P]^+FRZ <^^HF BS\/=0&T' [J-AQT68D]'V '/ ^L]JA/5VPO= HD[
MHA&.1/&4;;\CV&(!+*SG2 $>2?^B?>$U 7]H2+[4$$#! +'G AJ&5E+KZ)
M&VQ/V?YI\(:25T(#EUBGXG@$]']3^&K&44?C^<[UR;ZQ*8 10H%#*@JM*A+QHM/!.2Z7GJ^FG+Y^NA=D) L)CJ@%
M-(\0@Q8Y*'E\PP?PCGB[DZ#[4[AC"2R X-NN8924HB["Q&NR6$K<+BV\%;
MA3&WTT%M-QO+NJ'FU$:A]]?H3S'2?O'TNMN"2[Q IOC7,]'I^X:&G^"14 C75X1,&]JJJW ?/ET10W^L[F&H%<:#X0? N8,
M!S A%?@M $7\Z#/UMT /@^:4QK9+5RP]VR>?7D -/A;HA3V"?'%#ZL&7J'$BZKF,D?WKMN.:
M7P*X;I.Z MUH@A>R&X %W0Y?N]\6ZCFD'E7PEK@U1,T8;E%'S
M&9/M:#H7E^*D8@OH> &7)UVHBO[CATQ]2IWWFBC
M-Y1CK(Q[,,X:^\G 0:G]C(X3BFG
M)*99,&.9G4->L6TN9*Z)IH>JIM)$'OZ/>'F;QS3,P['T-9+%>5^(V1]JOSS6
M;(U@P-X$'V7(O398X@&ART]2 ^$%I$H+9)&PJB! 6Z$1FQ HH8*''
MVW8-#KT)+J=@--CA*.R&8#MGP.41 9';]6;W(3J6ATZLBU6PX+:@;A@M.@U3
ML ,PO(K^'#SF-SFDRD,9C*# ;FI (#G"QJCH:T) !C^/+(ZI*N>ZLAM+]<
MI!WXUD>X:[A&34W\
M:-QV^/>[VP6-PKVV;4&FB"3$CNNZJ?B>Q>OT XKQJ>$9U%<"1HT #,H6QT@-
M.79.MAU/1R,C!J+> N[Y.NKIMP%BH)PKX*E7M^OUR3;\QN%/% 8D$XCC@J;2]O6I QOA.45-D8;IX3 !70 5@Q^= H
M5XJ,KLL:&7XL 6F;;<'F@B")9^VKT-$&DK5-]K+SR+BKZO;/N*]AB!.AKQFV
M[VN*3M8\:6>$*T+MZQ9WOBT:M$IZPKT1MX%]X2LN<+>OCMP&'GB:XOKSY\'G
MZT8T"F/SOM:2AX?A@U7UBJK0(/GY.8JVR)[K1]J<9WYD5OV%00X-:F-1Q+-;
M"$@=CKU]GDG3P=ET7-6[-ZM;)Z0Z!Y\6X\Z%.Y=>:PAW+MWCF22*9^)<8I!S
MW+G4D$\VN$+3YWSR,;4,J[7U%>[WF2,[MTUL<&)0E!7]=- B8'@V&TX99 Q7
MD3*Y(?<1O;-,7 %8X<3)^PCQ3!)G##*&JPC?,FR+'7?/UWR7D#7YYXM-)\^)
M4W?6P\G9;,S78[NE(GRS[P0L$U< 5CAQXCYB-CZ;3JJN^7$-83R?8^0L5B]X

MY!WK;[TL^M39P/3J8+&#O=RPL<&M09WLZF=X(,[.I'%[R[VEK1Y7K6/N$W*G
MU 4SQYU2E[C%G5*^4Y+.9J,)=TH,LH;=CTY.38PO2I: L1\C'\G&%1T]D,XQL+/*
MW1EW9WUD)W=G 71G8W%X)@[;:P#0*7?F<2)@Q"ZGVLV=^5S2%)5,PZ>=.0F
MPA.=GT,:8O-*L0D:OV/?]]\OGBZ$9XL.5-P$U &0ZQ,=#>"AGYBWLU[K6C 1
M;K>9OD.4I0%:^*K1,5&*N2*160'PS07Q1U3BA">]3P=1! .OZ2#6^@P.CJ:
MQV AY'7[#U#!^R*OE0%J#WQ QAM%$GT+'03P(NMT7)&])"2)#YU^YP\ #29]
MP.6 %O;VF][[?9S\POLX-R(8\O@")%AH% *9#DI!)I[3*3 O,@XK"O>!;X&@3ZPWGQ7FBM=;!6WHS/SV)7LE
MFI8 ^A7D-7TB,/RH^OP'I=+U8/(:?9@.! $(J6!;Q) :BJ)/1\N"K+E (51K
MM'LI3>I
MCOZG"27 8V$(C^SI IW!&QH2RG.<@7).<%H4 %0J$!.8T.MM\#&)V9YJ,7'H 5< XL(.H43WO;3*SJ-4]ZJ
M U4IO"LVAA/@,($^5FPJ8\9LK$R7\Q!,GMKW='3JJ.\$0# U5 \<,Q9.7J43
M?M(&0I[A**L=I-]E>SOW+FV&*A)C]S& X" BA2B +NK![/" #"[FVQ\H9Z-M
M ^D@KF"(\ A%VL8!T>""=/APAYW0$S6TMYZA?=C.[Q-^!=JC4I.N1XA1J7@-
MD4)I#0=9;0<- U.U!4: *PB=5NXJ[HA !8,0Q72=M>O00-&[!3Q*H$9A*.2'
M7P(. PWD/NS>>?EJ$6H%$C';RH2GO.GN)-T/XK"V8, H3N&D>NP-3-]%P /4
M\XDO! VXK"PUL--J. P\'"T7O-3>3K8**;9]HP^-3P$P/#A1+'CI&B^$RYC:;7.M%/USTE0]:LIOQP<74E+'1\$/<14^
MHS:SE)',,(C^K$/TE:;/EXC@1:[-\32WKP!
MAY #^9)WX" MERI!$2/:%3,3R9TPF%6WJ&L1A'T1B,F./]97LR+SE"^$Z^VH
MXMU1R]NW>TH>J@.=VOOIDV9ZX^C\B(+(E@&R2>?U>M*-H8)%EB#T"*)N@B/6
M,$.-PHVI(D[3]+,V4%K+BRR$)5$AVJ%TDJEM],P9F)'%PM,O@4XZWKI^^L09
M 88!JH>3+E<076)&J$>(1Z$.H.U\+'Y% "Q$)1CKF3*R.$+P[0S6B,B^./GU4]1Z6;
M,L:YWES)0*)\CA256?!I]]ZM:FR2=H N;46/ @V@Q00MB+ CU*%1">9RJJGX
MVB/30>6Z%Y4OM3485N*\XTS+0,0\6F U+1BQ3<4/A M]*37\[P3>)7OCE9$R
MT73"?/G3%V)OJ"2=$.MY,YI).?(W [5M11-N$E7 8@NX
MD7Q11E+A\GTJZL?WM3^:TQO&' Y\ML^V"NYLUIY+!+)W$%9O043J6"1<,YT
M;&PTA0RX>9WXA3Z!P[*].=-(CY? %0=98MQ.>7EC"CGV"!7(KT:AER$M ,?I
M -H^()+1HA;&%OD&,B8?'GCV./6#!A+A 4NO,GTF.%M;5>"%'$3ZPT,=U>N
M-Y-SGSD]H]..D0;R]S.0&T?3MV:8$I)^SELZ1 2B3*83LP.FQDRH)\,0-]'8
M+43Q%2)9? ZJB:'$=I K!FI;S #X0$U2OAD*5N;'O7G,\'K5I& WZ.CIAT\O
M3T;H5RPB>P-6$U9%U> /QS-JIK\("6@YVZ % B1< O,6)FBN[="E0?IM"ZR*
M3DD(GUK 'SBYVC,>T; *^. /T/9''^]$T\I6H';Q3Y?B[53E)?@-G$\>I;2Y
M6(#84C(H<6'-I* 'QTB,OZ&T"YD#P+^0U]2/: V(3D VD8;JQDN3H).L@@R
MG&U4C-\UA!^T'S&F3TL.X@$"9.BZ"9A9U3"7HWC !) 5?DQ^!- &2:&1B^8M
M!YX)'E2H?M3@D> $4C2(L' "O^ E\):(.4]B$9B![<)6^#&ZBK+K1^*8RFN@
M&#AEG)T-T:RW=JDYWCH.1=1SHSN$1A.TY80:.J<(!9944V&1"LP?F<9\@=O
M5&3+PMP/31Q.AT8SN/*FHO\ ]MZUN6WDVAK^GJK\AR['?LI3!^(0O(FT,ZF2
MY?$Y3LTX4[:3U/LI!8$M"3$(, !HC?+KW[X!:%"D1)&4L &LJ,U;DB;$K" -,K3']QG)X^1-V5)#VD4#Q
M.NM:6SHEE7Q5)L[L/ZMOJ3??ZBQ#';^H"5I%H?0Q!5K^D A".?R*Q;R9&YEJ
MK2Z?$(MQ)#WV926M(K-U7=-CEKVJ9>=>)6^6NVTO6">L&\Y:FVGX;MP8%4[V
M5..M='$B6X6;\Z@TB UOUT+"I9FH.5F,9&5.#:3S)HZ^" /+6)[IM9=H$\=\
M'DALUVZGZ<6^=+$0")N 65N0Y4/^S-RQLUQ=A(&O# ZT;6*O6LMK8-:-[4>X
M$1RE16RN%XM:A)O,?GUI>987I.E*JKLUP34+/T@LUX9MDJ\YB*69H,PH*7^Q
M/"DH'=#RSO*O2EP+?\@][N%2RLHS.Z$ UZC'5K[K5I146&9-;)E#)KW$6DV
M"SW V\D77RP0":4R!DX$:JJ-^B*>\[#)KI(/67J!L)OVB
M:F\1VKLI^53Q/3'=2WE.(-A3'D-[\^]B!,*$B%=ISJ>Y. /N;D1QGI2LN;9%
M+2[)=ZCF'M*'$LA'6=Z@A0I7,,:*LBKLN5)>@E),53Q"\)^5=F>;K]H3J4:
M\'X/%@)-=7]Q!R6B% +@3Q%@$&G <&0\O&M7KJ([U ;8A[,O[Z0G5WP8""-"
MJI/L6FS23H2 V=VAF+X2MN*'^FA:LNX%AV^/"M@ML T)E
MGV\" I^WC-.W7VX70A'KG]=GPP[3F@YW? ^&(/.+.F!W"^X=O/T8%<<[J\B;
M WN5JJW0?U:Q-#65$DRU&:[X5*N>5(FC/G US=XX2VTUIEPAV4:5M'E2K>"
M!V+ (,608DAQR :;I;BD6\>2Z)T$.A7L+<^+-XKS/7>K*H.';B0?GC^UXEK4
M;V3YG8UI45QD61(R8,N3%I'8A25B+QXGGMD:6Q<9.TDH'4^/;W4A/2%F&Z0]
M7&'U>%WYT,O PNJ;OY56#K17(V0$VHLJ,EI[#)>]JKT+.[3V#PZ2'-;@4JB4J
M(@9MD\(([MW#HBU&B73YBV>DJZ4\5M8Z0 PMTTHEBFVMT3M0V)OL;*OX9S;[
ME<1&-US-M2/>,3MJ.1?R0%"[JHOH'.=.>(PCMW-9$ERLM* ;7"@A%B^ISG&%
M)M/.Y Q"1\GKB"BU
M-DXN//^;>"/!/*ADG,0/.#I3+&:\F3=.6I
M P$N0\?EX8$\%!)VCOO)FN,; GN@EI$\'"J .^>A^%ZBPY:5FUZZ?*6]8(*;
MK;.YA$?JB-O19T/E352TG2?=B=IQ%$BA^=V2R,)XI/7P7?KRY*SN5\-
M;PU-F'(N5#I$UTMC>9=;N8*%!IP?L&SMC+%!;S)XM=M"UJ@&F2 > ^&U\3C8
M W9 MD;#% 4#HRM6MSI>RN-TU&%7H$+^+HLK5)QS'G[*O"(2U*E>L2'Z4UP@
MN 59CRV LWZ()KL^R \% ^JCXB 2U^L3^,M5-+<8VP E=2IP5,BO&IY0Z&EZ
MDL?R6U*8FB0.ZT5+X1'5(3?Z%==RU\=A@2WAK=ATD<^T?W5&S-X24A1*Z
MDF>Z8HR%6BRF4FB/#=!!6EDNI?X1$$FBC,T)"V>O\]D<]- ^]O5OQ6 NVQ D
M*KP2ZR/*YS^,Y>9.D+5R4OOF?>1>S0K4FGMRS18'..J(3.IB%1&8?U<=>G 7
M20?Z[/4 JR#)LW'N4?L/)X M&#'-7F>W2[E9#65Z0*F';[F7I# DQ\5R=VQB
MEO,5?6O$3)X3I.IXUCY]*P/"5;1TH%(W*O&Z)C.$2VTOCYO$;)0+7INJSH0:J766#\$ILS
MP58J+$^*PJ;5H:-B-F/?8[K?J:VMJP&.#RQ1.Y,Q7ZYYU.(#ZU9+OPJ04&O.
M8T)HQ?ME&5<1+?I@]QD%MDUK;B$NS8I\U9S[[D25J-50)F29&-@-C&>V3 (K
M* U+8J,9U1Q%+ (MK>96%39PI:.UBD?FH9GY>EA?D&?K =(J,"J7(8UK55KL
M!\IE(^..8A/"&Z^E66S<6&N30$Z25MKW7:ZF4H5,FN-[M4)ESER1#UC$HZFM
M7B16FM)^RN(18X N3));PC*&2^Q%529F?L55HL*!5'Q-Y07,4>:MUW%Z@2XC$*);\0=512S"22YE/LZ12[U)Y:,BKCVA3(5>ENE ^6*1&E7?
MZBRMQ)!?ZRBB4ICEV'BDXZJWI5H%J?V**B$H5[5BZG69@%SG6X.44>W?XT!N
M'F^MX5CK^6X*TYJM9&(@RB^KG.I4*2'E'U8[R$4N@=KA[LD@-JE5Q&6\M-&3
MTJ "0O+QQXUIYXP4T6;JY"Y^4JW%!!P&!:E ZPK+OL L0HO7667GQ!0.(M
M9>*5>.3)97 I5*69G0TO8?&S9VVS-CROB$-*JX%()ZV837JDUO6M+JY4U'AT?= V'-RAJ79H]QT:WN]3=/98Y6[V\G*
M4EWLMJ NL7 R#;NFW--B""1 4[T+S=GP]TR%#2H;7P6C2MRL%"KEO!(WT=]:
MJB!58]+QWWW.93*CK&L@R"G0Y2R$!:67W-Q;>%?&6!53?))[H ($I\8OC*]K
M2M2R Q0I;[+ U6G?'5AEJ)Z80@V6T&O2"97 <;F2#D!]1'#VY9Q-1WU'Y03*
M%\NG[*X#RYQ(R%NH>997R(]Z[-5J4'\L@,57A(K?R"AM(1JTJGM0ATGHQZWV"MOQRPBAOZNEH\%6::HGX% MU
M,]AY %]6BX51:%^LPY:S,MS\-UGI(%B;('<"Z'3>NS XALA3(D\JHE\OC9)
MON"B>"$VM/=.4Z5>@S$:\L2,83'.P@#7OBGS7S0\7E#Z?
!YI[)778#%H6AJ@J:/VTW+WE>Q4.?%/U05MI%HE24EX9*"C9I+!J9+*3$%89
M0"N6K;![TJ)4AHF9X=$\IQ?]!MIG'/Q@YW+(^.14KL]"$6W>LA8J:-9 M>&X
MS,PS7\N+61?33"4B% 2O8HKE9E"R?ZNN2/<*OE)+V[Y6P&>:!NLC)
M*P#-54:,-DX?:XUN#KQ7%56T&(MGR!V29IO2(2@])2$O-%E+W4C
M[4FO*%KGGA5A^'&NW4O&"&^\<'[U?N=Y&O^])[J26\=(I[X:O1G8B;EE NQ"
MV\W,U0>NDW4?D
M.7#%Z;#T]3ZPO=]^7"[5PVNW$NFA*TI6G.7FD=M<.8[V&VX7DAG^W^+
M>VPJ$^JPUP/KL>M?R;=S6FQUW3?QE:'U%6V1EPXH)Z KE%./S)3->*2\8[IP
MG-:@IL1!?FXAXV+B2+!Y A2UD1C9+U>X @4O+.,D]U1=2[VJO@3SOA5RM-'<
MEP.77B?%HL8/9VSCS0:B6;-:!LTOYJZ68CM IZ22V83*
MH .]JVNP97IF29^4[:83C3T>HPU-?9DHU7M,L<:%75-J]V5'(V *]7OAB
M&<:WG)L2'X6O7E[08U^VW5C&!9AOJMV)R599"P74%?/5P?"&$!NA#N=YH&P9
M7)8?(!MOY'R5Z%@P>:2DC@WR%U8N$QVD)5 '5*NZWU>CGLE>EZXT^:&,C+$.
MH^S7^Z$JI-5#INJO]/SIX9NA79F2WP\4Y2B+%>BR')7%JO=N:P%X^1QM>?.R
M5+<>; G\:M3>@F?7\=Q,3EPM+L-H(C4VZ2P,^*\C>K
M2(J+'2+T^.2F7OW)1R6DJ2ZI+[-)+K ZB@FYSE>HVLZJ(\3
M,B/80A 9K5&"((XD*X%7]H$FG5R^Y+N59Q/V 8M[:N%LM#WQJ9HJ]3%/E5*3
M^)G/.5^HQ;[MNH;K^T];,L5DAP!S.%K$.=HQ.>6%QBJ)5,E(G3"H-<6',L-A

M/0Q,1I,9#:"C/'G%DQ1D6S(3K)"\;5;Q@^6]-T50&+.J:#Q@A7H5E?Q,\4L[
M#:.=:Q5B!4OIZ\I"CR):/N-'M=WR[E!D?G
ML^>Q.N9X B*.OQEFLU7A WR[A\55:B'W'AV^'L1,2I':$:ESX3S*G;*HUG%
M,,>WW!4>#.>CPO4$IJ%RK58K1N9O7(U UN6=;,QUN*(ZY (RO9"JBV=>3CU @+'8QT*@+ECN)*V0F)>:,@405650Q\4:>NFA2QOF#USDQ\
ML71O6Q-3A&^MK5\5OMY@F :C)A-U#-YP^ 2]WJ% $KM2Y5K$G@F8>OL
MR] 57T[!JFTZ+3+KTRFTXJ^N&+(,M+W6NGIKZC*D@21=(X
M* =D&39E,JI4>[<\TV%N>NFHF'9>/JVZF*S1; !L)CRSJW7+Z%CSOIK"Q;U>
M#GO]PF&:9]$P.WFC1-(I.H2H$>WXW;6Z4/J8K;TL:59:Y*RJV/9&2]^+4G
M3S-E%(R,O(U 38:)+LUW6H*O5I1F;O(6-%+::WY@VH:*@\)97:-K[/QY;EC
M917JU6=%:]VQRC!V3G'NY[7&:S'GD:9>?'$#>CE4+5S5ZKRC87GV=]$[5?7F>FZ2\I^KT
MFKVEC#GWBJO+"%C5D"';.#OK^2FJ7[]56:=<
MU<85///?]83\X(X#H[K5D5D7IX (NKA#\^O\9!>(-4?<>I1"HF621*I/",WY
MH\Z:*U,6E'N PEP?LZ)8L(H@S.^C+K4]B?*OIF%M:MINY(FH.=.4GI6-BSUE
MEFM@$Q:6J\"D.Z2K5-K%I2$HGJK(J0B4UCMEQ:WI>@DL3[UD G;BK[SH22 ?
M?Z(??R(??R)1-H'3\L"L(D*A#&%-LZ)?;][O1(U!O?RX ZH83%Q=+5;*C,Z6
M],+; YJ4BLT[3ZE<8I-*9[U L0EO]*2 E>?!I> >:IZLB%#K-!4KOI12+S[7
M)/\ZB'+SN*AI;D>:]"J;9:,MKZO*HKQ:A:YK=K'F3?O*;= E8HKVE[5Y=YS
M#WY8MJ?>DLVSN:G"@SQA)1,I:E"/K9[P*(6K)+(PNU:)#'N5:8)YX'+*[X:[
M*HLKKX-@8HOEC)F^>%!<=1<#6I(-WU;NRV,)LV/ZLK0ZJ7J7VOK6&48Z5A
M^Z1J6Y K^Q.MT[PU2-[68CU *D\/,TTTQ)LI2TI)EM357^-EX+.IVV^5"%P&
M$AG+TE#=YH3T"XUW45&N0M>5/7-LG6#U79$=RW6MG%3U9]%>*-4/2!!-HDN<
MY^UGJYDR5;KDOWNJS8S)@+GDLC)#Z.B5; RF0])A-*S5RJ^8H.3K71]
M!-5SVOC8KS%I\NL')VCSI=&O=HBZ/Z"PCI ,^84I)Y=4;
MR)SN5%F+/ 45.2Q+]&+TPHD5$ 2/57*5U'+5#U)FA6F19V2RPLO4JY6I:'D
MF(-L95D#LDM5,085F9BJ)E^Y0U%FA$B-GI]*R)VF,BA, B/[H(5.["#UQQ]E
M\0:E$\]-**C:K!>?*ME:[T%2YL$HOXRI@ZHYNF
M5*84FV*!(;@3M7TJO*,4FZ%C,36A5TU-9]U9/]!UT
M%QMI1]L7J:Y!YCIS3*0*5< 5YDWGVWA5T:L8N&7J0N&$2+:ZK3:V32]2M 2)
MQK9<^5*,\Z!-(1#GLN1*G$2!Y[# \VZ\('"$B9[O %R??>LRX,/=)4"OMPSQ"/"V"J*SB$$(1ZT(8J='>YD!+
MG=#^KFP:,;"7XB&]<36+;C(KV["WJ*GZ9^ZKZB;LH $/E[O:+\:WV73'N+"E
M?O5NK752\8=O&" [^W*^7K+P[,O?*T?NG^)>N1[EK4 ZLUV]$9 M>I3GYL36
M,,]YH4!M-P5[K2WH27 R@Z-].JHJD?'(!*D1 'NREA455I]E)6M&RI(OO"!%
M0J5I@5-QLVL7AET==,MMM:[QXZ3H5)3OY5OYK=)SOK'$I*XE*>ZO4JSNYH"J
M3.HR,;>:?:H;&YF:3,9SKH[ITV)O6!8LRQT/:ZTJ*VV;=&#>G;>00Q3?E([P
M.R< MI$D?S 3GO?/:R[\[:<#Y0(SQP2GUBF!/L#5?OWU4X'JF8%UJ#ZOGV
M(P/+P6UV* G0=*FMBB-?+1D5^:*:T)GX%W,^P]61805ZM3P\NZZ-[O*0-\H3
M5VNWE-WXVV[**'UJ?J Z[N9!EOGKWNU);M,ZF."L"BZH6=.;O9E $(> :CF
M4M-KH"NW*??SIB/;C8Z$IF]J/T:58\---:E*?](Q.W,FN6NZ]\9S+*?^G54GD
M V3H6J[U]*G;]U>),%\8 NXG)>,4^=#K.O1>.S+M:3S2L";KJPJ YI'&M@'?RJT68 PGZNE7C98SZ,2+KAE=AO%=!%<"C/'
M*VV[8G1<;BJB(DS:(C-A%2UXR*5I8R+3+&YSC/UGFJJ+<1?O5+R(W.4L32]2
M 9EYM\(/6^W2O?9F&U6ELOAV5H7:]M..]XW'I3N=O]ZY[>3>]6J?KD0$\R
MF]GU*FK37F3JM,,@QV]UB*Q-RHLI?) IMRT6QD7&T[YRT;BJ6E1
MP. .BE?.BE^9%;W+S]\\;[0:&5'-.XR;ZJD23L^T0E!6Z=T';3VL-9-;N%=*
MR[,,J]?*WFJKQ.;Q2C;:4'AO>>)N0UNG!>4#-8=\4OW)^^;]7.ZH+C/3C[;E
M)HYAFZKVRJQ^\,I<6C/6H(L.T44?^$6RDN7G'@B.Z@]V545G8F[F1?B1-OGS
MB900G$E"3(/-I\Z%4O$KWZG8IGE8L;SUC7=KV?KR2R$Z6NOIE;A.LW4FE<$O7
M(MA:=,9\.8?FKYJG?6G6SF4-1$XN:7Z>6X<1^4ZZ(-JWUO
MGAYC^>^Q , $:@D?7/O#1X15Z%5@]]=:+%=E7%]^ 7O]1>AJ?0@X')\,^S^P
M+SHBL*C+ =M:2*"RY# FI%+F+YYB9;@@HOLI*6='D1>;!VMKH2>\X'
MXR-W-T<.F8;*L/6Q4EYRF/U:C;O8,"/L;*V4PB]B^WP27YZ8"GS
MZ?IM[QMOX:Z>7YF ZNQI5VFYO]=5JDU;:6W)5"*:\\"K>Q^Q 27[0-RSC^/5
MM67W:J T.4^F +E@@TOI+G?5!*9%^7("N]P$3-M%W7WLK7G.G:$D)IU]?>B
M I@=MSJ6$:6)#B@M0J*^ 'Q>QD#%Q;EM89WEH\A%(T VTF<]\O6DDRP.52W#
M:A^R"B8)OQ)FHRI;*B[(JWF6R4DR&FV5*?-2W*DH:%[X#E7M'VL-%GI4-
M@%O175/I ($W"M)4L,BS.*5\K&6O&'BUH[-'*RR7]P:6BL-=?M^IM6 #KLS
M:WOCHY) 1MNZ-%Y+G[EZ2>(V)UM3NQSQR; /]J 8ZM\:!7$28I=?J
M^$X%VI7UX\OF+.A%0"EC;?BS%GUS,@;<>EA
M%>]?9IV(!2O7Q\EED(@?Y$9,^WP]86;H2-O(#,,-&];';Z.V>JR7I>,9?N&C
M[)@F6X5/ 57LFAY9!GW-)BGS/Z7;(T?"4:N;J KE6EG:G%^>&^51F:9RWVNK
MVGE>:UIRJ"RQJ MTZ@M $*I35\"S"+Z0.<\\O%#Z$WG47NG+L?"^\?4JV+(G
M@OH,5DI:]4I!4AU;LKM!1U9'IAVL4R5*I(FW"HU?67MU\FI/4\&T8:"U@UK
M;RKI2=U,ON0JU5']K^*UWH6Q ^TO? P#8W .O /.A!6*";XPH8.EC[7X#@OF
M/[WX*]^OS^:NB 46A) ^LPO?WIQ+C]U1Y/9<'+Z+TG ?;?OJA ^R#@;"J+QA=XQ4>-'B8FHIRQ8.0I=MU:>T6B/:KX,FA P
M8=/6J!HLZ DY>ZCM3CGZ/+96SLJO8HMFM D0BK=LC2<5RV^R<).\D"=7LBB%
M4B8%]2+Y4,M(F>5Y8U^W/:QX'1Y=>:9^@*XW*<36R6/"\DJ4N=FW+>[>?H15
M5O]&%3J2H?351MB6:T]J L6%NKGL[I 'Q=C%.Z %;E+5SMM6:[/Q!H]$J2B]
M50T2*4I7F>2M'+:[2:7I2C9\NY%S6HTJ.YV6Q>-R'X*9[Y>G8RN%T?@N[",5
M=^"<3@;.=#92Y5*X*<"Y6,@2]+)DDJQ&9]U>W$*W2E 5,;@A<7FQFQ9\Y@
ME4EP8@44F;*ILI.(BH+K]P;K;WEICN3'IQ-G>CHU!9Q,"2L31%YYIO'5;7G,
C7>GRJ/Q7%<[*GA6I\HR ZX0"DE+$>Z50*E<*#=F=(\3'LGD3'/E+K7OI'=$=TDO=AY9$&R
UF%F\XO\;QS/U09BS6J6NX.TF(BR[I[:5Q=Y,W)KGGG1ED>JH92S7XM<-PRNB
@Y5/1EZ5IQ*5"436&^4-QNSRXGE=&^4+L)=L8NQTH:VEGHF3;^+>EKV;WDJE
'/!J0)MJDY;7&5F;H?AR*QF694:4NR+?^&^,0/ZNBOE5JISOW$G[XE9FOFK^
"?2Q=A+[JK%B))=E$(KU) /P[LL%$W]8"(94G<95NT1=>%@!+.XH%U9%A B>
V!FH#9 B5K';N&]\5TE\([:4LB[[7,7KF'+'62Q/]^423DRREEX@MK(JBA^K
$PC/](:ZD\638UT;9=48(Z]N
GYL4O UV9FGK,I%M<\5=>]FHXX!-]5=;H4G+QEQ:!%/5N:SHVENM.KFKBGNM
=[>K5%R0 O#F*;:7SS5'I96[-@JSSU, ZZF[D.HM^>E%7VP:9=JHE+KHJOA]
J>5) 2Y$\"KZ86O#K=?Y/.A;W"B$F"6*7^3 "6W03S[/K-1,S!B *A2?GC
7&*D;JDG\P6[N!+?CL7; .G\PX?^A /B(>8U=,UP.6GY!Y 5M/5[IV/KPZ\2
B>I'[TJX]&M-A;DTL-]L=X#M^N7R]RKB\@,UBC= ZJM :ED!Y\+ 7/-&9',B
4^ V9J/VSOQ6;Q"=^7 U5IC>&3^1PBY'>9-XR];B\9(L#./>=+ K%&K,ZEW?
*/MA>UN%)F$S=D:C/EE\.B4FNZBM'VWVWI'(/ZA 0.3[NX3O) SO*3!/C@1X
O>;YA*BA0<(?NI,IRY9?" O1R!X[-0//1&U8]@HVL&@=>Q#@ =HO01I,!2\
/B$+$ 0&& ?:(#C2Y FCNL.R>(#><$.OG9!!#8P=/$I0B>7WJW7IX>[OE^(NMC63F@9.UD<#[V*< #G%^"]'HP
W[,YT,B,+4*<$!CMV4G"8(B#
/?'8LK=]B]@I+=4 /$#KKUUGW-^7UB$PE&G]6$97A<--J=U\IE7M=J8O-/W
/-DVI[48%=YY66J=SN&[S>]=AZ@!V\G[0+BUU)X8.=/1
OBEY1]:&NZO"#DD:? >DX/BHWB:XU%WO\RX/FYL[D+72X5:H>Y>4*SHYL; E
R -6M24.!*V=AL1@XLPF([((=LHQ03TS !X*"ZR\ZQL-&QP>B6;L;N&1:!YF
\$CLU)['=4[W+O,+CP0-2:O3-7&?=3&/5W+?/NAUA:^F/$!GUWI%N'^^(RU23>ZN)>]*#.6[CGK;LW]33/
I+V0IS*F[,9+V4O7'?4&3 PJ5*W+4[;@7KJ2=[Q,XH6ZU=S+>.5YNB-XC\G&
VR3[ALI6[EZ:Q'ZCNXC=!=KWE[>4[17'&4B[6N;@X
O&6!?2@S7 %\A$&4\:M$MUPO[KBQ5?V2Z\O2'BN7T/8%,7UP0>1-N W8%W$X
WW%Y'+ 6 AYYJWD@Y^^W)&8?Y% 8QTA^4\ !#D.;$%[J.W1A7Q4SL!0SH$9>
7=/%F@MCL9;,DA6K[T(LKKG\0:X-^47UAUON)2GC8N!S]I[[?''!$S9T'25R
ZE;BAZ$^\%/O=.UEZT+ 8M]?J1@D3SWPKUZT\I+;LEVZQMVPV@O>$5+B&#PA:/G-= ?"#146:B;;10"N';[,N#37SC$?)=4]^,PZ2B;)S$\ #/3<#
I(*>![72LSOL3:>/]R=VFK E3I&& (*X:.B^O<O&RA'*L7T(2[\7#OF%B/G>%X
WX+22!>I4 750/S'H9Y);SIN!P1@G[H! LT&#QW-'OF>WOEP#X$TPGNDM*3
^WM:OAO]9&*D:G;/8#M*=?ZAI6CAH8F R[S^VIW(/D5U'[=!9!ZJ7$24.=HI

M%0U079V2BP;@ 2IY/9TZPT'=:>B0F,-KX.&<\JEVALS+=+*92@3)8ID]LX@C
M,=;8 W8=AW.>$"ZMC]TC?%S Y1?4OZIH/SAOI0/B2&Q>:R/.-HI% W07)V2
MBP;@ 2:1[=+[PP%9A#HE,4?>/.)8\4B;QZ*NP99M9 E;"V?!4N/%3Y5]L\,N
MO#3P58F)>1"NLKW+R>,@MNW>VDZI\P;@ 0/H]; WPBDL"2AVVTC78.<@IA>2
M #S '.LA/+W^*5E\.B4O.VZ<'U%+< M\/*) G3U2E3W[0,FZ344.*=?S5!4S
MB]J%ET'D1;YX,@NL.HY!*K>'?,[BJ%J ,.'I*LQ4F<&RI*7\[=>?S]5>TBJ
MJ2MB>O- K])L(<: 4VUAH-HLR+KH*+
M4+=#R[NDR6NR0)5*%-^PBR3F-4%-R="')T"6 (VXS]-4S**L 1K- U \];M5
MB#1;B> Y8@ID!H2J*[IY@H)(/#$0HQ? 7JZR5<*E>R*(YRF[]N9W"CKJ&XMG
M7G >J?O+(I29QF-;>#NN2:EW1\Y![$?LYXLG5+?M9()5DJ<-^^>5\AS%1
M+BCZ,6)G OA0 C1V*L)1K.2M8W>89[#G"9OSA5S?\G]BL7D)$]^:LRL>F366
M5Q9UE)"]'(Q[7*%Y*5UQ3+TO?1:W<7MS>Y>H/QE:O':H1:2$E>RO&C&7KJS
MGIN7ZG54G5-QL1" +.12QI74B;7.^>]!FDDQ7'JWN= M .>?>^QO4G:$> GI
M7D69(^YX[ZO*8KQ++YB;=QZQM5>]X4*6@C1=*9U@S;:6\T1,6Q#)]WCI]GM]
MMFDFQOV^(S@POZ/T&,H2O[)8ZDW,^']62C>DF9!(I<;>L)<;7UE0M[VPH-Q
MY=9K+ LW/XMEY3GYNH7V2KG ?&X 4,ZI?&)9(?GNG<6$FG=?
M! Q[L:Q](9AB+>6$):9,D8Y$-0SE \O:V$$D;\T7RS"^7? B-WYK L+E,BN9
M3+.6G!2A^)53:GL?B[6$6>7*XGJHJCYA:V
MBD)9SUK.C! U,=** A&D*?^U2PI7QEL=IR%$P9L74IRU=-F<)2Z0K^-+EA(3
MR*-K0:M\:T%L?GD9^(%\E'P]J>:$OE" ^KXI(7XMEM*)E+X@NU7J3O%HH5AT
MG>4;@6KR3;SA3O1'>;% M<"Y]N18 7 E4<^4'MMB=VTN81[D9IMEF0A]DG%M
MAU7O4A19M^&4WS$@&^LJ?\B69K3Y,X62K]SHVA,&D[)CBF5LFY:!,(@\\1]%
M,6Q#<6O](GD3.W$302ZI&H6\4M:P+LML+U>)+Z9.FG>!;\1"?BYI*C<7U?N7
MUN/&X9G%+MYU)0127J7J=7N RR2JN(M:8JB+="B!ZHX&XM-VFL[+BZ*[73GZ92^K/ZJ12'KHVBAN+K
MD[V*KZ/)^(';+6$PD0T>0?-P!.^@S(;IK-5E5 UH@ H:)("@7J6]JS1^YOO2
MAR9-?9\'W]4Q"=63+; Z3A:!!^B]!&DRG)%%!])R!'K'+OW0P\,U)R59:QCD
MCMT(\ "YER"Y0V+BUU)H8.^ZH[GII.TF9K0H[)&E'-C'@4#CP
MP$"^3' 9>'9<\^9X5K(F.GP*]19-0!>NA@%6-270CFL#BJ?.;++;640]$@>!
M@G>"(EAYBA,-"QS^B&;L;>&/:!YF\$?L N1P[)R.]SW=@#^"AJ35Z9BXS[J8
MQRNY;1 TND)E7^/,V]>T."X@&TV+SN'1@ /V'?:Y]Z'80=MCW Q&,GZ+X^'9
M3IMD-'1.W;HC+K;9)%MU:)T2J.'(T;@+5[TFR7-7.VQ?;<.U^AYW"P:NU0L4
M5 ,T"W1]O57*+U:DI)Y)6*X XJO*,6-4;OXKZ(,>J#W*Z5WV0
MX^HUTS#C ->313UZ ,?@GGO%FIRY^'2>=;O:=[WN07N65=W,?Q>GT7")5-X ?!'7)41?Q%:)
M9AC 5G%M>?.\] P[#^.E3$C@ G4DWN=JMVR$NV2&#NMM/S1&J. Q/.W/U2\7
M$8+W@#=V9BZJ%9" XN!=%(BG[<0SVDVA/==^J7[,QC3#7;IJ19^O4O'V/-$E
M^&6/A>M@N5L9C\;VR:2*10,\0*!W6GB@2>;(&>Y=O OR0LL.1KOR<
ML TA3F0&,KOE7L)X)-\]]OKC@"1NZ#AOTW;&C+O'%39+@8B7#261>L RL
R&V^6*5!Q-.49;'ZPWF\6'K1KCDR/7G O7$M"^PJN/,5SR(
M >HE K44G9%C8\R4FM:5 &+FL7>> RV,K 2PY3P(7;X0UZB%>";+)" 5Y)U=
M)9P7?SB]J*(A]:G:BJ]2-PV%>M9!WPQL1JS2 BQ ,IR)=Y'/&/.?)YD7A"Q
M5(&QO .&M>9#!0;SPH1[\UL6"PLZB-1?+F[-,IP>&)>H!8\-^$=M*WVO) 1RQ%
M,Q]+,4'!2CXU8?,@-9V^U,WR@?78IYA=F1J;2I/)OUQ%0CP*;1JDE8=X:65%
M*X2M>2@FMCI;O34N-RS]YQ]7ZI*O96K<^L2.]J
M]:F3ZX*B]9U3]+W+S0%'W5!(3F'UE'WRA!83+Z\LHECH-?&40*GV5*[YI9#<
MWU7^:&J+1FD(B(2:V&%G"B5)5:[0$=KJ^I+:VU8WD(ID#F R)3J3582T?3>
M(C%/4P:FIE(?1 K"S @4A!GW>\/#:A&C(,PS%'6LOX3W'0*B6?Z@* @SJ;4@
MS□FZ 20C4=>\T70$.RGC$ NVX$VJ;46BDF4'/-QF KKF)$0^@(ALO5#5DS
M*JW#4.\"IW5$G A5;NSWW#U"23K-<>?&MU1R'*E"C2"X)BG)O20.6A1:M.D(
MJP*YT*"-P(JT!J6R%6@(2%"9C448AF>S\'JDVA0#@]79!,"@0AN+,*S.YF!%
MO<'X5L$TONJV)H#\$D0J#,Q/^#S(]A2?9RCM.D M*Y0Z!AX&CYDR%CJ=[CD;
M.;/3?0-O(# =$Q@0".0!>(! 0" DP: O,""0FIM[=$H>=JM64P,,X(W1U!G/
M3JGBTRTQ.>Q,!IP!SF@1'N ,LM" ,^A@03U#HJL'49]B,0(O^J8KEH2Q^%K-
MA[G@=:KS#X5%"@\0?%&G;$ 6) @-,3Q (I 'X $2 8F0!H2TT(!$:NZQ"7D@
MA0=(9.BXPWN: D!(! 0" D
MP: O," 0A/8"#Q"(12"#D3,^=:D"!('9 80*[-%R;05AH(4'V /L00@,9%+1
MQ.5=)8L*H8M490.AO, #Y&Z%G 2=TU&?*CZ0%V)X@#\@#\ # %'RQ\"9S 94
M\8&\$,,# (%X7N ! BCY8^@,I[OQ!^2%EKP@=ZI;R@K"0 L/D,=P[$R0/$4#
M"R1/T<3E4YQQMO1NO8MPWT9MB#EI>\0H-!4I/,#L8EO8'\^HX@-Y(88'^ /R
M #S ' :QU'BR6TDFR$OGY07\@1!>X '^*#$:S 1 [.M9A+P0.I8">;1<64$8
M:.$!\AA,G5E MYAJR L!>:DS7ZIR!L4NXF3.DWS*TS@,YDQ?R-2(EUXBYK:U
M8'V)0R]A7IKR[.3"\[QN?ASQNON267S?-H^%\620-%E^:@ LSD&2$[N1I^Y#L8,FR$NJ6%8M
CV> LYVFR7@X=89NW:D8V\R2K3JT0Q)(1JV"ZPB" JX#UX'K=N2ZD>OT^ M6
PP37=4BM@NN:E-, KGLBKJLM/P5<=R"^@^',&8SK[@H$KGNJ(U(07>V(@.B:
M "J(KN5$)S9UX]/=NF^#Z"P\J/F:J%F5\U#[[O,2^5:7A5&>C7
M8,%3]HG?L, QPHNVO^3&1\H'#);;9,=^Y+@W&+VJ11S.,O:>^WQQP1,V=!TV
MZ+MCYD5S^D$B16'$67ZI/SN/%THMNBS"%T[2UZ6TT#WPOX .RGU[*O.4RB7\/%N+S5%XFGN![27(KQ$0 *F47W/=6
M*3= #2+Q;9YF+%%?$4+!U'BDM"3F+EYFW]=\[*\2*4#A+?.^>T&HOI#%]C!Z
M;-,D/&;L%Y5N@8[*$E3(QNE019(.\2Z6E--P[B40"*A7*R/I#UW^7CJH,[]BB^;GF[
MNV-0=PRB-$M6" $\<0D/0[82 I6HO "O .0#=EUP!,O\:]OUS: D
MYXYYEZN$JS<3>MJ 9D$J/EIR)=QR9N0URR3PN:73 5LU,?)/]BAB.3/)-Y[U
M=M L+F758D$I9D/BJU3$W1499&E5OEEZXRU3MDJE.O#8/$C]>!5)%>)[Z36[
M#.,;MHCG B,SW9$?)\O8J(9(B5N:*MC,8DF"])O\62[R)4 DZWN1@./BU@"P
M G2FGY@(J+);+<,1X^72N4>0C)4CPPB-4PY#K$N@^ BR]\K>.L57]Y7#TOH
MO53IMW@EIV:Y4C/DARMI1XA7BP0(?K;R0BTVSMH A A^Y^)3\R;I,N'>7(O9
M@GOI*M&:6JQX\= PR&Z[M=9N!--X4M:"-%V)1:77F;SV72A4],D7 SH.Y10M
M)20G4G#E!0H:C==>.II6G4B-2*.VEE/UXLQ+)(
ML]A7" BEZ 9.3YE8PRR]%FK$4>OLY%*JG^HB$!>+;;K[RF'\]R7WY2-+P.5?
MAX->? A**["$+[P@RA>76%N"SR 5/80I.F&WW$OT^BGN)>RL0(^9[!^(8:K*+Y(>?)=D8::.3UQ0;2.D5F@MO":.12OY%WH
MMY>3*?^R9605KD))
M/4HU)>)+8I7(!Q34%HC+Q10:,V/#B#8A;2!6:RYMO$!N-JDN@TBH7?$&%#CW^8[@Y[MU
MDG-,=B$)U)[EBSB<[^6)>GI(Q%N)>1"8N*,7=>9IC$Y[HPY$,M[SV:>/!!\XO9.)T 5HJINA-Z745)YN$?
MTS=[2E2KNN 4#0V99-OM:&SKW=;.5(8& +*#]="AW"+Z@.V89-3E!"+Z(*(E
M'#$\0$O$ $M-0LPT%(+0 0M$<,#M$0,$-!2LP #+;4 1- 2I1CJK3"9L.JV
MXO+Q;OYSS:=(C[<;6@$$F0-T**R#BNP^4RN;SG,[B38UD)7C%*2KCSM:+"$@
M$S)X@$S(0C,;U)V=!!D!B;0 $ @(2*2K)((="45 0":-!00" C+I*IE@1T($
MB"8W6G[FDC+U@ 5/4 "TYN->.E5^ZH>D$6?PNR010N<1PJP: '(X;.TT(@[?
MD3YURY'ZLT*)H$1!VHY$6RV6)0HH@<=:A!EX##P&:0./=1 E\%B+, ./[8+C
M>'Q*0S6"ORA+&?BK"2B!OUJ$&?@+ -5T=(YS4OET43#WG51N;3U]*%CNL'=*
M%"]"U1HWF1I/!DF3Y:?VR(O'UD.MH-A!TX-XB-,SPME.DX1.T.TVTV2K'NV0
M%)*)Q#T2W[58ED" [1(]$&"[A;;^0&$0'XBO4RB!^)H *HBOW4*[OS,:Q$=.
MI8+XFH 2B*\)H(+XVBVTKC,ZG8+Z=L='HY&#<1>M>H]A?\P\,67%5?/@^Q[S
M4IF&5Y6!?@T6/&6?^ W['"^\:'V!WO .YFW^ .,J/;GRO.6;#UZ0 ,,+5 Q]
MD/IAG*X2GGX5#W\7QOZWO SQ#XS].; T8 1=O$ZR8/[3BP $A"-
MIL,7S!?O)/[TF5 ^].)F;=8\ =N#?(R^%:
M(Y$PID&:L?B29=><7<9A&-\(S<%>!Y'X)%ZE7C1/?WCSP)"?8ID V=&3[$B[
M-AY;A)5P&R7YTXN^6.H\E(W\?#$MQ>]&P:K?C>K632D+16VTK%!NH;=,^9O\
MA[=,:^+3OEU&Y+GK)IO6@)/>[($@JJ)%.S UC5IWCV@Z9TKU(T/& ;V+ 7%X>25@]CR858V)PW%K
MISTQ=08SJDFX*(Q%,!?I.1FKS;M>D!8P VGMN0EVAM,A#7T(TFK@F>U]&V-4
M,B&U^7E2F\FXW9';?# IZXS&.^;W/S41:9))C?35JM/
M;7\\+]>U>2\-NJ,':N-/F4%W#VS"A\YLQWCH)]>DS: [U/(X7BV/^PITZ%(>

MR2IZ\R4.O>3GB"=7MU]NTXPOT@?J>8RZ5L]CTF-JDIB>)6:FR6$1STH,&EG=
M0X^+ZW&EUKCR6A\IBGV@V >*?5 X^T4@S.Z@H-@'U5PU%/MH?*(@?>YII>2T
MC8^Z#!(RW!N+,,I T!4KE/]H XI0CHU%&.4 B(K5/E8]RG\H9 %=#1QW/YNT>@H!T)+^:$<2"LR)^EM-P0SUMW;J@#!U!M/=C(KGKW2! ER$
M#N%0-9(F+F"M-F$&UMH%R%'?&?9WZ]OS 4KP%HX/:6*BRH/R=(-Y13('D[@
M.+7NPR&$6#4*,,1:[5!UNC]SG?&T[@Q)>-.;U&1#C6)2!4.-8E M8O/$W?,, W5XM5Z&5\SN9\F7 \+(@CI@7S4L0
M6SA\:ZT6/S%O$2=9\%\U S0.=7#$W8SC4AP6- \S'!;L N3K@3MP)J?[MD;$
M<<'30 0##6S 5^"JYF$&KMJ)J]S1T.D/J+8> E?=RU5MJ$G;"HS.YO,W
MJC5 EJQ\N1<6[W>R3.*KA*=UGW3#UFC4:>J1*BMV2$$V -3]^D;!6ED O7"'
MCKMC'-Z3*U08*Y1/"1$]3A,7$%^G0 7Q'07I\<093 =MF C>HR&*5 RGZQO
ML#OLG1+%:WM<^EK[0FK' T\&5I,EB\SQP*X$AP[/5+%$A^3T5V;]^I@/'J@-KY4-ACOP7+:TY$S&. &>,^?)4Z2\30B
M.2!W$:MWD ZC:FQ>7&6W/&];. ?U\<1"[J5\SK*8Q0D3,L'2U<6 9>$V\8G'4B&OXJ G
MJU3, $ 8F;@;5YVJ;H+LFOGF\[3'OEYS=AXOEEYTRQ+N2^E;2Q'@OR]YE'+Q
M5YT (!ZP:1 LOF0O3X4\,S&GH?BBPUZ.1^6O:B0O1 U>O A$S!G+Q/-ON2?&
MQB/YZ+RE= GZT'68[-.I CM2MQ$ #!WQ0NE2C#CXSL-;/9"-[WWCI>+2^\ Y)4 $->Q*0)GIH;BCWL :BCOLS:I#$9^,GF0H:W)N)/C/
M/R:KZ(UJ0 :SFO@O>M[?!ZD?QNDJX5 %8GP7QOZWO SQ#XS]>96>7'G>\LUO
M2;P4R^?VMU",[2R: YQW+=OP31;,?WKQX5]"U8VFXQ=R63T7W(0?;?OJA A'A2:Q/B8;\WW#&\NRL YC82$Z81#3E#K^'616NW4G+ 3^T!J>"G0:W\
M)':T1PM\Z@K"<@-,0P!!7#1TWUYB ^4(Y=@^A*67DX:$0CD^TJJOX5"WY56%
M? 7\ZR#BR9H+EFQ0&4H*DP 01"@* 9Q0P'&'2L+3?MW5&NX3M [)40/B]%!%
MF(!(@'O /:T SW7ZP[H#^L$]3[HS1;^;PW#Y1<827L?AG 6+91) 5Y&"J<,N
M5TD49*N$.]VL$^S'B^4JXPF[]I+YC9?PFGU9V*M3G7^H<5IX:+NHTV9/WYE,
M9F0!@L#0PF,;@;13.!H " 2$%AY@E(DSG$[(X@-YP1%O[;C\@U\'?LCW+9[;
M$-3Y<9ZA63=2CA8
MK=NMAX2E1@&&S*6' ZZ$!8&T61I8(&VV:1" A0 86.@(4(#YW36)XL@6 CG
MN33!^H6GZ1OF^?YJL=*=,RKM*3J946LWWJ#A&L/Q=C.Q;KZ23?J*"[EM/=8."X>V +.TEW&HX<
MC;MPU7MT Z-J0%Y<9;W=N^#E%[OW:,7SG59OSW
M)8]2SFZ\E+UTW=Z B9<+Q5\<]G+2&^6 J2^^'/;ZQ0?BT2R[YNR6>TG*N!CE
MG.7MD8Z BHF0"?%>
M=,N^FZIJ3.@,YJ4ISU*V$B^8,-];!M*+$LH"YBF[";)KYC$ 3N1DQ)%43Y4
MC I0\25[.>Y-JX!8>#$ONV?^\YD?K< \V:;%D'#] EDL(4Z+8:A%,NX-[[[$
M?:N!W7F)'OLM">0WXCL7B:6169,Y%]0:Q1F[]KZ+MQ ?W#>A\O;BRPD7;\.=
MXKMB]0OUOGG9;QMI$!7#V3*:86]-,QJ=]^^#U C=)7PKV*5OOMC]M? O@'QOZ@+P>"A;,WJBVDK?C=6H?K=
MV)NZGVEA71K34%ADH;=,^9O\A[?,'!'T[3!V,EEWTWYOT.(>4*H^UPMA
M.G '; J12LON65:.^ ;Q 49\AYFH ;"T@AG#/PH!& 0INR@VX7G+-U%%J5.
M"0OU=(6N9AINP%YC0^4.1H[I^-3&MH0:8T-=#'<
M9W!T+F5NN]^AB%VC$:J\R?#H'%J-\$$@XZ-=C@QD?!P(\/34&8 V;8N#C]D
M?#Q30$X+,CYDN'!0QD'GP?MLE
MX9<\272,?! Q[8AQ5,J&?(5\;JR7EC'Y@7 'EZ/[S,OKY!^:G 3Q<7V*5:BY
MG%DQ@W>3'WPQ T%:S+@.T)8AW C1?N(0[=D.(=HUN#K& =YP\U&A90'HH1[#
M!*"P(&B[GI[P;-V>4)4=LX]!UN[9?\;S**#Q$!JSGKM/7 #C:2M !(%I%!K;
MR /2 >GH/!J@$ (006!(H0$ZH84'I(,0&J 3\A!!8$BA 3JYBX=X*[$X!2"#
M%[5BTU?:K"O@ %,]FL)B@H4UR.#U-I =-($G(@2#&8?.JMC:&!W0AXB" PI
M-+ [H84'I(,0&J 3\A!!8$BA 3JAA0>D@Q :H!/R$$%@2*$!.L'9"0UPO.\\
M\:XX64F!WFKRT4E'4"'*)IA]:*B.H8&M"'F((#"DT,!6!%L1&N"2%14H+DIH0'%!<=$)^$++XBDYBJJZX3!)?S!!*"A
M[@^N.' K+5W>!*B>M9I\ 37 &P()+=;9I49Y5YCI/$XS&M($SFFL(FNE9$"U
M-1Q ;Q$G6?!?3Y8PI2%G4''UJKBNK'RHKH8#*-!8U>T=H-LDIFYTH-OH3SYT
M&U4 7P=1Z06]Y5Z2$FD."$W7N&98]03+[@/"L?M>^= ">-]ST&=HI=WF9N?M
M:&.%%E7UXS2K& <'0F49"RWJ/C7H]ZFBAT;<]^!1 ^>#=6J7![.6*<-V+T&
M[1!!8C?? -@&; .V(8D3V&;'EHNJ?3E5%+M%.@W>Z[180D!' R\!%X"+QW[
M.*[9M6OJQ^5\E8JWYPE+>*C"#=/K8)G6?*J-G2O5^8?.(H7'GM5L6D3T[LB9
M3/9U>$)>:.T]P1\MUU>0!UIX@#]>#YR).Z6*3[?D9=\#,]!&R]54M\2 /AZ@
M#7?@]$<#JOA 7AK"'^T4#OH*#)""P\0RFEO1!4<",LQ#JJ0-W88+N Y=Q[&
M2SYG&?>O($^5[=DCW:Q7\31.O O1<839SI &'Y)*!H<(1D%^X)-1
MSZ4*#H3E&(=4+>S\4C]87Q-OSEGD+7C=>55TFK 4CPK]H(@'JKHB-9L@9K.=
M:R9WV8Z8.+-9W3E;="LGUX\/F8A*$%:3E!\(JWF8@;!V/'^;N76'^X.QCG\H
M!Z+JHM(#434/,Q#5;B=^ =.ZLYG!4]W96;53BLAH0XA28T!ZF)\>CU,[I6O<
M&Y) #&+5Q/RW^XX6Y 'J(N1LT.O*5NMKG'EAS4?R]U@2G<.#?A#++L6>[T.Q
M@WOCIOI:+6F@NG93W>NQ
M,YO4G1$"JCO^.288#@P'A@/#=9[A!@/GM ^&HPM0VS9S[10C:BA!E.B#M/$$
M]$"<(%V0KAPD#4F.R%W(ZCT' 3'SQ)055\V#[WO,2V4:7E4&^C58\)1]XC?L
M<[SPHN=:I7]R)WUK!C:.1[[]8+E)-NWQC'N#T:M:Q.UCE'G152!7M)>F/$L=
M%O%, ,SB2 :>^WQQP1,V=!TVZ+LCYL=1&J29 &-VS=EE'(;QC1 <]CJ(Q"?Q
*O6B>?K#FP=FI>DHVRM8K6VC(WYZT7 !?!Z&4@N(:2E^- I% 6XTER^&R)-"
M3QDE(V0[])8I?Y/ \)89!NG;!2@V1Q;4$'JZO;*N14]ZJ,?@)PH+@D) 6>LM TGJ@HR?&T%2""P#0*C1W*7$$Z(!W=1 -T
M0AXB" PI-$ GM/" =!!" W1"'B((#"DT0"=W\1!O)1:G &3PHE9L^DJ;=06<
M?ZI'\SE948'B>F129ON/3IJ $U&"P>Q#9W4,#>Q.R$,$@2&%!G8GM/" =!!"
M W1"'B((#"DT0">T\(!T$$(#=$(>(@@,*31)S@[H0&.]YTGWA4G*RG06TT^
M.ND(*D39!+,/#=4Q-+ 5(0\1!(84&MB*8"M" YPSWU\M5J&'2"X2<$!W-1(/
MZ*XZP#GWDN163 1948'BHH0&%!<4%PUP$K[P@DAJKJ*Z3AAQBJR5D@'5UG
MO46<9,% O2R((QIR!A57KXKKRLJ'ZFHX@ *-5=W> ;I-D>M&![J- N1#MU$%
M\'40E5[06^XEZ6Y-SJ#I: I;G$X]9D?^?YW\)XWW/0I^]#]X2Q
MLO5//IEN+?>=WSS8.*Y#?9%VZ %7 TX[]OCKB"=
MNN4!I-,DP, ^#X+8[[E4T0/]'..PK=F5:>K'Y7R5BK?G"4MXJ(()T^M@F=9\
M9@T383^=U:K<*>#Q9+5J6D3P;M\9G.Y[B@9YZ9B\@#\@#\ # &$?ACG]\9@J
M/MV2EWV/PT ;+5=3W1(#^GB -F;.P 5KD(""OKB /B /P /T46(T[8VH@@-A
M.<:Q%'+ #L/E/? .PWC)YRSC G4DWN?J=L]#*<2MM#P, AJ+%AZ@]YF+O"X2
M0- 7%I 'Y %X@#SL$ZD)0N9)(('T+"@IB$$#\ !IG(Z0TDL""/K" O* / /
MD$>)T0A)4C2 H)XD1:A=2 U@?4V\.6>1M^!UITO1Z=A2/RKTHQ\>*,6*3&N"
MF,UV+G3<:3O"Z>]=T+#]Y8[KQX>,G(&P"(("PFH19B"LG8[:II.ZXS#!5\<
M?P--=5'E@:::AQEH:A< IRG(&PJ(+"B2'/D@/T]'C<6HG)>U
M9 BQHB%6=6:UW7>..(]7%R%G@UY7B.IKG'GAGB>(QP5DH^'0.3SH1ZSL4JCY
M/A0[N!5N>@>!X\'93GO$'3O#:=U)=]M,DJTJM$,"2$:K@NH(@@*J]6!ZG8\
MM!PX@\F,AA8%U1%,&P3#@>%:+6!@N'8SG#MT7+?NE!0P7 .T*JB.+BB0'/H@
M;3SP!$[D<&J(,&E(>/F2>FK+AJ'GS?8UXJT "J,M"OP8*G[!.
M89 CA1<]URK]DSOI6S.P<3SR[0?+3>:A/9YQ;S!Z58NX?;WF[#Q>++WHEB7<
MERM]SKQ%G&3!?U57.A9?LB#*O.@JD,O>2U.>I8S ON11RN4?7PY[ITR\SGH#9EX-LO$O6^YEXC+(WG;]]SGBPN>E),W=!TVZ+MC]3WQPZC'SE)Y
MT^V7.NK9?K;3:\JWX)Y +?\JW^8R^,Y9NO)]SJ6XB]]3WPO-2\IW$!,("\8F\0QC&-RE['43BC $J%5>E/[QY /6FKV);0I7L&AWXTXO^"^;S,)1:
M3DQ@\;O1G^IWHYE],42>%'K8*%&ANT)OF?(W^0]OF5:TD[Y=&H-,M=]IO]5%
M.X1$[1O?^@SE4F8MKK-,QLY!!0C:KBUWW)L..EXFQ1GT]^WY C%I1(#CDR>\
MM) (]ZU=^@Q=>$#D:"P"/,#H1V%TR$LC&!U;\X,9?4K6Y@6C8\\!/,#HV*,3
MA)[=)JX"$;?-WH8> 2V[PFAH6CA 48?.L,A]N@DH, >G28N@ Z@[M17,#K5
M^8>&HH4'&'W@N.A610,*ZGOT"GUWO:+=UR(JM&9SV&;VKH/2@#TDZN(V#S-M
M): P[D/> HD[H*$,48?PR>MWSSOW$\OPG"\"R:
M?RS24,]4%NK[(/7#.%TE *MXFW=A[' [RQ P-B?DU7TYK>$+[U@ K/.IQ7?
M IM,03U?)7)UZ.\7WV+! *<7' XE\!M-3U\P7[RP^--G?OG3BW/YJ3N:S(:3
MTW)--F^VW?5#^Y@Z+[XBWQI\\Y ,,1YM LC8LXG.\H[>LG$]QQMFLQ\Q<
M,3-9*F%7314J"XWT'-G*SVJ,$YDTIL]HE7"TY#)
M(1H ?;Y4R/B]B;PD>*BGA1,1,"E&. : NM^ UAKD&!;T
M'5[=!],# ,Q+;K"AZ]"0JV<\$*Q[\I *7T>->UHI.>"CID)2L-&@5C9RA[WI
M'N5+.TU7T]K
M/E>)SQ TN+$B(,-!1)'Z#@>)X#38#>#H,M'WV/''>YK 2"NOVNQ0TN@$#]S08O)$SGH![2$!!/:>LJUO2SSQ87*R2E"]D[$["?1Y\5[%M

M]?ILL#6E.O 06K3PT&9 EUE^.-RMNC2DA9:TU%))#/M+B 3P (%42X],^[N5
M,X:\$) 7G%P^/RY?,B C+/-^/WR+V! G,E4D&N%!AL:BA <8?C38=XL(::&U
M16P(>[1YBPB1Z!H>(!#7<7?L80=Y(2 O]5>G))$*73]8?]M0&H!&.#B!1+3Z
MX6F >Q)U*IN'634TZ7#]4Z)X4:JNO,&^0'5EBKX^5%?N6 H/JBO?# #$
MFV]!-!/(&!&>^'Z^B+/W-NY6#%;\F*S[ )? N@C#(I[F-[,^
M*CL3F"<4][9;#4R[UFK [?>8F;^\UT!J-1NP)K"$YH=- 6 ZR
MUC8#-5671\.!!SR):#B N)I&[*S0<.!>F4+#@8JMC?*E:#C0#O ZQD<-@015
MMAN+,!H.T!6K]C0<:*7H0#FV'6&T(" J5BCD\?R>B<*MNEB&\2WG0K$MI(/5
MRX(X(GMTB(H>Y(A<<1. "?4A'[8&G"=X7A(%D&D;.G*&[
M[PX3 D-KA]D0 FGS#A,BT34\P"$S9SS8-Z45\M*(?2).,@ #Y?SGG\4N\3^K
M(WDV:7.!)GS!">9I$4%+B[@ :JW0!H[XLED\8&\X#P2$! 2"37[I GD4\AF
MKQD.@@Q2 T9 F@[< 5V0(#-T#A8)I4[7SS=Y/.PRB2]YFHJMHQ>R2U[[@2.=
M[+7Z,6J QQ(EGYN'&4H^[]1=W1E-]]V>HN0S.4%#GP*:N("T@!E(ZWBD-1RB
M3P%=?*B?J:)/ ?H4-%U^:C\X0N7FCF7VH'+S UWH9XX[0J,"N@"1.>U"HP+0
M7=N%#737^RA>XB+C\XBGC6\ D,J6 G89:";1;/+,8#Q0;5%A-97VQE85UV9
MJ!6 [#@<8K< VB-J%B(#D>DJ'* 48H! /DC! 4JACQ%$AA0TZ5/NL,.'^/5BF?4Y44*"Y2<$!Q$0/$=7N3+FFKLRA:
M[1WE#O'HG'B /BC!@:TB?8P@,J3@ *40 V3:K>WA<;) .Q+J11THJ#)Z@!1>
M+[=?J]MK<-H;=4FQG7M)9=2
MN9V!4!6OF >I*HU"0M9@Q4'/-1,E4KM2:+G*\9LL.G.?*=CQ N"U(T12$79&
M/LC, D.N:6BU#?XX]MG+.,2&K-C +J *(!G!P::G;J6%30]5E![P9T.A6:"]
MOU>AM<'?W0:4R(@6%&!+K;M=2]1W6UN:FMXDA! 6(!4%N)?L0$-"0[80X5]B
M.V?E*T\6) 06RI*\LNR,B$)MAWA0WJ=XNB0B@#B#*0+L[]+VSV(1DW@3 XG
MG\>K.(@=B D8P\@;0C9''<$@S
M/4 ,W--&T,]X![:&(![@!BXIXV@@7O /;0Q@$ D,=T00F$)+Z 0%SU(]!
M'4*QM?D$I !2T!DI #70 @3V$SU,("1@#MH8U" 46[M[=$<('@[$$T-N>7$$
M E"]\Z)O+ PBSN)+YB=\'M HL71PI'([X"$3F;S+ =9]!2BZ9 .\I(K59.FA N:=A.G?X@/>2I'*J)!VL 2%4]T::] E#^K4 3XD<3
M5FKB!RYK $H/FX@'U6]LDWP->Y-3$IA!LC;B\ZH=[(2XSNDAT9\U1.4^:1E& L"HWD@LL@HW;+!^BH:8B!CAH,
M'NB($AJ@HX8C CJJ'3'048/!.R2 FO,FJW=#2 C+;6AP0D$!**B(!' C*
M1]+#!$+2%!Y!F&']Y2,[S.7[1!0^>;YDVR,*R43D(I"0*@ @<&* P,JEAPF$
MI)X,&] &) * @#8:B@F$!+1!& !(! !;=##!$("VB , "0"@(VZ&$"(0$M
M$:@#HE F%MC9 *(@#8 "&PKFIA 2)K"(YT$H :)0(P;8MS>5B9:U9#>"ZD#
M8/D41R>5BGEOJ K,4VJLVF&@KZ^>D\$!!S4C%XA 0+IHX+8ZCZ-5(@% Z+$&
M,(&0@#D:CP&$ H" .>AA B$!<]#& $(!0, <]#"!D(Y:&. :#=RD% 2"R "
MY@ @,*]HB@(A:0J/P+Q"P!OI@#>![&9^SC"<+%L;BBWN*
M3$-J49+%@GXA2A Y,4 >8^VVE%=F@PE5=" N*&9,&P,(!0 !A[QU)S/G=#BC
MBA!$!CQ"&P,(!0 !C[QU3 O.9(*VJC30 (\T#@,(!0 !C[P=.Y-^GRH^$!BP
M"&T,ZA"*K@7+ ?+QW=\^*US^Y$[Z; ^G '$@INJ5G +YY7P6['C6$5+8]6(]^4"LB]!!J#T"OCT(;
M$P@)\E%H8P"A "!@#GJ80$C '+0Q@% $# '/4P@)& .VAA * (F(,>)A 2
M, =M#.H0"L3;Y3^.> W^J +7K9%S[QHG3RV%L@'2!GNG1$!>
M:$3.P3+K@*I"Y-SQ(^0YNY D-YYT3<4N*L;!?IAOQTC#F3.>HJ8$#3! (XW# $(!0$ C;X=]%$HE P9HI'$8
M0"@ "&C$5'V:#MP!690@-N 2VAC4(11="[N;] ;CYA4*:BD8#9 /D 8M0&!K
M*15&%9Z.R4OSF 2V%4K./1$B9\LD"M1 = PU) 8T AJ!
M4'0<$<- (:(02&*"1QF$ H0 @H!%XMF@B BYI$@9U"$77 N?<@2I+US21:"D:
M#1 0L 8M0&!L:1U&%9^."4SSJ 36%6K./6/-.7=ZW.@YU)P[$*0O<>@ES$M3
MGIU<>/XW/B\!:N-X+351 "0NR#C*[=4."$$ .F;#T <$1O ;H3,<#*GB X$!
MX@QM#" 4 0L\M;MCYWQ^)0J0A 9\ AM#" 4 0\(GADZDQ1MY4(&N"1QF$
MH0 @X!$4W*.)"+BD21C4(11=BQL<]4;]5^R$G8=>FK*SQLE&2V%I@*2 /F@!
M JM+*3.J\'1,7E!Z#ZH*\8,&D;^NPELVZ]&QPT9/%:<9R4^D%W$R9PG^92G
M<1C,F;Z0J0$O043,;7LU%YGP6UM? 14JJ-Q'\/>AE,]>EXP ^J!IH EXN+64
MP,@ N9.HV0H1XE9#\DX=S-5JBQSD!=! 7DT'$N0%\@)Y@;P &LBK<4""O$!>
M("^0%T #>34.2) 7R OD=:CXZ-C(Y!IJ9H;]X;3,H;R73NDJ*5849,I4%(#
M4'K8W'L\4"V5+ZD+26 &R2)9UQ$V'FE--WV4INN.6GNB",YC1=HB@M,&ZVN<
M>:'X)#I)N!^ODI2S.; (:HZ&1CAGHV+4+?M!SNQ&YQX7#
ML3/J[VOG'U>APLZGG>X.@[]I.A+,UT94P7S'07HX/'5FPS&XCRY$X+YV /N
M:Z.X@?L:B 1P-'3$ \!]=*$"][4#&'!?&\4-W-=8I,?.9. FE& ^>J((YB,*
MS).+#\)8NR% @ EL!)2>+H(50$&G K,';1@ N2*IC[.6X/P+.EU'=(J.I3
MIZ1M5:)=DL FU!]X#-NU5(Y ?VT4/M!?R\5V/!PX,W??DTLO(#W-"@)L!$P@
MP$:@"@)LN=B.AU-GZ&('2!BBMA$@3G= >83%#937!$\0),(&;6HK2QM#5YP2J11LT2!1O@G^#+#_;HU?I .-2@L6.
M5OTQ\\04%5?-@^]3$UE&EY5!OHU6/"4?>(W['.\\")[2OKYG$!#/$)G?2M
M&5#C$6-C9C5*$,LUH*; +)V?7O1?,)^'H52O8J45OYN5IWXW\V(6F\ \])8I
M?Y/ \)89E=X7DV$]9F-@L)C#XH;Z:^/>0"SENTI^^Z*5. R6FTS=+6ON:0$(
M]6WSEZSK'=+5LO(*6D..A9;XSI,L\+W0[!,D!,KWHQ:,^%HA#O)[Q2\/J;C\
M-OM =+31/SC9ZA5 B<6=V$I(;,*R:\XNQ5H/@^R677 O84&4\82G&?,R]LO'
M=W [S/Z'#7N#\2L6Z\O?>2EGG[V,BS\,Y!]Z[&OEXR!5UUV+0D*/>1@@L;?9(92;Q<#<#
M8FLS+8MUK."S5$[;>^[SQ85 :>@Z;-!W1XZ*;6=^'*5!FO%Y/K>70?$-T)!
ML==!)#Z)5ZDG9OF'-VM*L(5*?7\];@37YW+!'U>MUW $,)ST)M-7# A$]%B/
MX10I09 =L3HW+I"6^A?O.U][5BS, %[$X7R #4+;T7BV?3/@V.&\TMUHY$)D
MZ& $D:$&!X2#$AH0#CIP@$ H8P21H08'A(,2&A ..G" 3^AC!)&A!@>$HXJ&
M>"VQ-@4<@Q=U(G.JE%EGP/E[M$KYG+"80&N1@J,$@D$?C6FW--59%*V\D"H8
M$ UB:(WZ,"!#2)]C" RU." <)!!HV.F%O4ROGN$=74%%F@M8F@4;BVW7ZM?
M:Z##$"*Y[PN"\
MBY-$I3$0EA0H+E)P=$8VZ*/1L2WEN?A+XOD97/@DX "Q$P;GH\DI)2PHX'52
M<'1&-.BCT3%>]7+5DF0W=)T%%>\PL 51Y$H4F1$Y]$=2#LC3,UT*=\'8SYW
MG8%059R8!ZD?KZ*Z#3A8:P3F'DJN!5M/J+C*R9HL$W.?R4=3PJ %Z\.H,\)!
M9NH?V*!"HVUPN*EZ:A 9FB(#@X J@)2D!B1/WQ#KC&"0@0C&P.Z@O;]7F\&;
M30,E,J(%[==&NTY.\RY-X;JM*L]7B5S25"00ME]VF\OP8%Z'IL(<* Q';Z
MR5>>+*A(*SOE84W9&?F !FP[PE CK/9X;YP3-D@Y=D8RZ&$W]@H-?Q^@UB!U8"1G#M-@&BZ7$5)&"$I &B) ?T@M%@3P)9V)/ ""Q'"R+8D[3J
M1IY ^-# <(ZZD?O&YW(7B4I5^VPW^PI84^.P6;O;QOF Y';:1'.YR% [KFG
MX [="YY:&V;7@-B.-OP3@#;I3]J.&[B''B"0B)K]G9 (2H \IDLAY 1RTF% (!%U K"UQ#0P@!!T
M" #0 B5 8#Z1A 5R@HTW80 ::SXU6@)0Q8P*6N^\Z!L+@XBS^)+Y"9\'9,HI
M=1X;,E')NYQ?W5=OHDL&P$NJ6$UV+K7YZ(2:1+[3,2+(">"G"R9-!^Z@;JFC
MFU)#!:9#[&S0%>@*= 6Z:CA^HZDSGIV"J>@B!*9J.B1@*@J@@:F:C1^8BCI"
M8*JF0P*FH@ :F*K9^,$%V!R80%<-AN1YZ^@<5B:G30KNMR18\+(SA.J?6/SV
M/^6/;J ??]4"X6HIC,2D#335!)0>M@$/JJW8)OD:]09C$IA!LC;BTP9J0MPE
M3+ GA.D]] GB@B>ED3?HNY/C1FHVNUPB 9!4VR*6V&4@3J08S/UG51 (PT \E
M1 V0XWA>FU4VI*74=+C;%7&XD$0']-&/V:Q"'K<6#VJRA&B@/
M@ -\ 4 >6Y<14@.I(0@(&59!M" ,K8Z6;>QL,""9P%KL"*G./JB;$B!/5H@<
MF$!(&I8:#IA 2, 95&-?NM+N(&0ZLA46[HZ'J$.+<++ K&,IXL6!B+K^TI
M,TVH/$D6!OIE)\'AQ "!Y?MVT$=S(AI(=*)N<5MF'^(0, >;P?.;.A2Q0<"
M Z@.OL0!P " G@[=-SAE^"H^$!CP!]79AS@ $/ '>IS21 0LTHS9KT$&D8C"(6#4?5$B+SG/E]<\$1O
M]Q) ^V@/Q@=$A8GAM^>RF\$$/IR&\T#W\OX7$7%E="T<;"6@BA^.B@.L G!
MRTU @^[L=\ENHO\([/RWL &^9C[$A9@'%>S1:F4%<2 &"-CCK3L8.A-W2!4A
MB P8A.KLOQP "!A$,,C(&9 N&TL.DO&#=';V(0X ! SR=NR(1U/%!P(# J Z
M^ZC=\N2(/+QW=\^EZ?5 V,=7(N9>E7^>E+^^%6>FQ: G35+D%J*(WW) M$0
M P26V=MAKX^-/0TH]HTA;(()UNH8OIADSQ%#>(^:0FF)HI-$V*?,?M@[[8
M@@8=]#"!D+0O7Z8MLP]Q "#@#'J80$C &51G'^(0, 9]#"!D(SJ,X^Q &
M@#/H8O(A 6=0G7T4;T#07IWE':S30CJ)0L! 8C>CE$X?4!@\KYU
MG=%PWX:S$!ABSDCP1Z05%<2!&"#@C[=#UYF-QE0!@L2 0*C./L0!@(! W@Z'
MSG ZH H0) 8$0G7V(0X ! 1RA):S$!NP2&=G'Y5-GBL9#!N6)V?EB)!7S9
M%<0 @86E]!=5>#HF+PVC$83%P:AZ(D3.EDD05F+B[G$BUEDKKA(QR[B9,Z3

M?/+3. SF3% (U-"77B)FN;T*[%.<<;;T;KV+D-<<85HHKLZ#0C H]P&4\MGK
MDBE 'S1M.A\/MY8RV>$.S-HT(N2MAM04\%9S5"!XJX&@@;=V G(P<\:3?5O,
M@K+HB1HHBQPDH"R !LH"94'40%D-@024!=! 6? .@K? 6TV"Y*D%9 J@OGL
ME98J.'>@*@LV7VI:B@\Q,0+ - &EAXV[QP/54OE2^H\$:! MDJ4(G]VB:W4@
M)HRZYX!I4]%"=WK< ,UCA=0B0--&[FN<>:'X)#I)N!^ODM0*TVSC>"V%4OS$
MYOPBJSG0& OXYL3>6RC)F=WHQ(2#NFFH5O6U$%9QW)*?>=.KTQV]PA"!]9H."5@/J(+U""'MSOK.9#P"Z]&%
M"*S7=$C >D 5K$<(Z;'3WSN YQ'3Q3!>>0@>6K!01A'!RO'&(&#@!+B=1@HEI"=1ZO+D+.!KW.[)UTA.X!(:I/G9C0/4C(9"4\HD1"
M!:4N>FA?4L5JHW%^ %PM9:U#XDIK4X%=$C#R-1% 5/24'X@*1-4VHAI.G,EH
M!JJB"Q&HJNF0@*HH@ :J:C9^@^',&8Q=4!5=B$!538<$5$4!-%!5L $[).P2
M1$5/*X*HR$'RU(*S\3S^,:BT5+6U2G* $3@(*.UJV@$H$D!!G-I/3(BR)&K5
M=4=6[*#*'S/5$SV :AY\WSHS9;GR1"B*O*O-[$8?S;1 HD-Q^CM$!T .B[ZQ7X*(L B2
MG2=\'F0[#&;RX&#N3N'VUS N@OH8L;RL+AOTW9'#LFO.SN/%THMNF7@W+D;)
M@BB+F: &RRX]/PB#[)9Y5PGG"W%)RFZ"[)IY++V-YH'O96IZ+L1Q&W%;MDK%K<4%2^]6?.&2>1'COP=I)A0 "\TDZX
M]MA7,;A[QG'MS<4P7H[[O3X3,(1!'(G;+!9!EHE7+;XAV-F %I/BAZLY5]]P
MK2^$7%R=E" /TM7%2?[='OM;Q,Z621 RUY$S/J[.^-(+YFHRY(>K2/UZX85>
MY*OI>#F: ? LO5N/VTBR+OH^P/R'A,<&;!R:+5)W>WJ :MN]MM?IZ?:Q/;.P
MGP8I,E5B-T6JF625M7[]BJ]1N M!0^DYB\"-E8KMW]&X2BG0!K32HV9RT.Q4:2&J#R* ^&4K5/CG
M;F]8*8S6RIW/#223PLNP1;,UZI),H3<@I1#0#4-\JM85$7D9VC%"*Z4 =
MPKP+@Z9^ "")^#,+$NV]ED*D#-\49 B#3)/ 2X,;,,7X1D1<69ZV.7PT7JU>
MD4LZ$>"CU#?Y,W-;E1F8*I?:IN'%X%30T-$D5 2N(BK+Z#U')Z,FNG%D=IV
MHM1T#D8;>2!1@ >^4$ 5BE;K!@]EW.P+-$DU"VP^6&;+IE:% 5SIHT[B6U-P
M=!R\QG.WILNH1-AD?@U^YQI]+R\E'.+5OO+U3'#HGL=#$?D\84L :W&G=?,L
M4M=;?,NU"2%8@?+7FA5#O:VB4H?\927M]G,B.,BR# V,
M?HVCURHX^@HVQ7Z)X;;N!T8 2M "L*;PANM-C]JDBJABVR(BPI+WR D,-1V)
M53,#"BD$(>67175[46%2C2L<9VH/FURQ2F)/"# 763"5V@,QL)B]M?*8HH
M@BSM$(1JOB\D)&V6>DZF78YF^R ";Q&&I6L!?P+F*=<2/$CN/O1;0(4A&PK1
MGB ! % -3MEXXP ;#;\D<-=!"2-ZR,+S38>5)N;;G:] $??I8QW
M,UO=R'+]A(/CYL J0 8"" 4!PF;G2;6B";!E.5 CX[2CR@,V%?=(D=P$'GZ+
M?Y4$%\PAY/:$E. N;%83OA;*SFZJI!1Y:+/=,P%45>6R\#^6Y)KUR\>??OO,
M A\(!\?#%X7NN4/0. F.;17#76"?8J44+PFNKY4VQSJ4G<<8A\)[(PCJD\WF
M J3>*^]Y\1!/HRQ>K+\$0HQ5\Z,8(VFI!D8BAL'J"YM]4FY?VPK*?H5IN-)\
MG>K7Y(5O7$'7\>E #)@>+(,,?3'<%?$0TQ<4VN:-/^&5^4OR*U'WP$, #2AO
MWGOQVGUA 8KPJ^*:7")IL%2?M!.HGF(S='7H5 IO]SV#@GO 4D ^ 1^G-BO?
MB8$V/$!C>$DS:)%PW25()8CGTT'-UR@EB]5(TY;AI C?V E Y+=(;/CQPD\Y
MX[>RZ>\#V8S;JO&FAB*6T:]R0)&.VQ[S'3]5[[#9%0Y^S,+@.@\TMC;*VN])
M[G@1-+;MD6TM5BW:V.C,4K'EQIB*$H0.B?/,>)L<@N@&KE:2^QEZ(0 KVT][
M&KNE,44#MO1CV[AHR4->K#/NPH# \&X"J5J5/U'>ZCQH)3 @.APBB+NS3$49. ^9',\
M ;XQ$C D=I9EE8>(/<=P;FJ[90AF4S.;S
MP OP'DP+9#%QK5+$#&?5RH%;%66ERN++X"O NCYRIR25#]\AMI\^ K 5]44&
MZ;@OU$Q-/E>KXAC?KP2Y92@02'6[8:N[JTE^1=LZ9MK7-!TP%2X,7MMH)WJ;
MYR.[WTB=GKO5R(.%B?]*J"FQ,/>8#?U20PN'NT[5M2(L.32W4&)+Q/'.%4/9
MI"FC9HE&*'@Y!RYZVH$5O+5!Z#Y'P ^K$1[U 9T?H]$AIZBG.IUJ3!7$<9B[ ]TJ
MD>03FF&@!^+TU VZUNMU,8/3L"B^'3]N)\L\ /J:^W$H*]U
MV2",A=35+*7JV(U)E?XT!V,9&V3
ME%Z$Y?$D48I\P\-,STLYTUX5;90^O5S/I)/.+UOTWF*12*U"(TA%;Y;+H2:
M7=PQR: C2A7-Y&JIQGDALO$*U@EMG+NG%2C0ZW21Q-DU<&*B!J?K
M,TB5,>71YSUWH6[-A(@PH$+@<"H)TTF)R:4:#5.C46KX?=ZC5'4://Y7".W.PV1G^X0&'<3 *J
M&>TD7ZF&@ "!KY/>6O=G>$TY<50F)3M61#R?3*K LOFF)IXJYE+:Y/%ZC+L%
ME286 ,YM*@A#A:@[P43KQTX?J+7[+)Q!:91*=J]1=FRK:>7CAWF\^WN=[:45A6VRY$P#E$ Z2])\'BO6J]&"A5 6<^45::9MTG8-!1>SVO
M30P5,Y-:6 OCE=U5Q* 73N2Y3C4C!] F0C&>:Y
MS=:47G96))/JG:4E^-7*"Z6@$*)EVJ/F?%:M"]GF89IF4C(XX@6)!3"KX F^
MO?)K5>SWKHC]KJHH,="^, &;0[';HHSB#?E+=5@+S.OE:6 MS3M80706!Q9Y
MPX-OI5I%(JQ\J!X1CI/-)OI6.6]\YPH-WN8(G](#"+AP2L "VKC!U[(NC,R9
M[E"DMP -#D$#\ZPX7U""(K!PJ"E'08FD"+"L72)1"H$D"K$Q:L]+911Q)@%O
M^>8>>>W>#+0M,]XQC WT4JM&L3;Z4] .HS;ZY/NC?GS6>P;91ACB!D*09?DY
MWUZE/N<;MSR5DI;;M/(-5FI6<27%F^*/MRS?; K2J'97G;IF^\[R)A/(#-P7
MI]OW=6*[4T?M;PY1F3SIX2M/?G[L^1/Y^$@B? H#F8G(VSX0FSR427@0HX^M
M O38TU#(7CK!Z)2:/YC1)Y2:FVH1E',0'L3H=7?5GUCND+)T(\"@+-U,7(#3
M#SM8B;)TTSB$LHY+PX,X'4 7Z1N+#]D+9>FMX^+VW,-B7LK236,0RCDN#0]B
M=,>Q!L[6(#(8 Q*TAO\O5$@7>US8?K"=@JDGWZ!:2+X/!5)R E[G=HO'90.
M))'[03+A)$/";'N8\'BXG6V??YGEDS0GX*4;J135.(@.=YAB+# L3J'[CC
M[/3#)CN=:)LFJ/$HX.CP">V[Y7)\N:K];TW/4'X[;
M=Y[] UN<- BO?WD$ 9[\X +FN#:KA/66K[I>TOM+
MRO4A-T&TI:QW)H7?*N?.8#M*&I^>P*/I"[?.>-Y@/J3XU
MJR06=59!IEM%NDK4&8[Q>51$Q%+Q/,KPG(DM!\+FYW?X6P51'C'<$'19.!>5
M];G3F]I.LV+NW4?52KNK.L;BF #481WJ#7C^85T!U/EZBS@ :1B^J(KKJC+!
MUTFSKDXN4NY,
M% =&&:V%JK:.HMQQCI?V?^K4 2Q O0A65A3U .#:)P]MNVY2YYZBSWWJ+K7H2I/#4(5(04QR(-JXJ]+Q9
M.U^?EE/JD5+9LHR]+J/M5S2?5P&NU C%K H*YZS3TO6V;ZT(:\RBW\G(B%
MB"1V& 7?*LJR\^I\/E4)&Q0]7H*;YM\0M'??WS \1T7\F4%;5!5O#P\[T 6A
MUOD/6#T8>EW4.:[7XU1"S\LAZV;N.9A@QRG19>U^^":(?5VJO%0NOXY.
M'1;&E6[(LI407F5)D)?XCRYU%TI2>;
M!T"<:<7@^\\'Q)+^2IE5!>! 50Z^3XI-F&H7U5F RZJB SZ:V*;'#;9H%B6V
M\B>IXW[Q"->L%!ZH]"X"L%>4?7B1Z]>[/2.*E \]!-U$WMZX%KF 2-=6AZ/
M,=1U)VG<-;(RV3VR\I 9;T21PYRM3;A=B'0F# O/;;[9$PUQ/Z G&7(H(R$
MAPRJ:XC],S /<5>$=HY]?L\;!S.2!S$(& (@74,,Y\)V'E!]CATNIHONJ<^?
MR64:B\V!+A,:!8(!A-QG;;K/$;G/S>ER-OY[2=[D:FG.KHX35H#IAI\@1VXX
M0.3(C43O9QXDE^3$ ZE6+EQ2C ^-\\NF^$YBK;8D?R'^C-BHR^B]4X=#L\^!
M ..27/25 WLF4UP:88JW,&Z/8S?<"OES\N?DSS<=F OR9E31G7N/38JHR*F
M-IVI:;R0&/ULT'LOYB))+HO1O)OE]3=GT0DYH$QJ2@1%Q%7EP BXC(2O5]B
MN7,/ #GV][/PXNM(;=D-HDOJ^%6U7?.2NOVNOB?UDCK>-&R*50RB0AH.IQB$
M8I#+7H/]0>^UOZ0N5Z'7)?4:RU%<4G\ Y#4M3&% F@AXBN,3H+NGK=/9K$2P
MLT[G::LW[D'HLDB;).@.T^)UV,$ QEG,^0! !M,MO)S>#WWG![?G'E;&FBR'+.=!
MEG-&L8%K.^,7K^')R (=LAV'GY^1NN%^4^&E[%'8PP/CB)!W$/<0]QSW)HW:TCLLP\)QR2?
M5] '^8,ZR[J\JG[*]2E.\-[9YJTMP/=-5MM,9EL+ZIMI=\A^XRCQ!\C]?W@"
MEZ8[BR;5>C"ZMP?M'6# ,6+ G8?K+0?7JUT)JCQ2&C/.0I'"9Q;/U3GP4(S[QN-T!^N7UMH5+)?"#W@J0$2K)(B3HJ5>&$MP/GC#K@X&49 "
MB"")61AX<"6\%6 !3MWRX$8P%/,J1FGB=7@(\FL "#,\.XSQLNB]9-"R+$SQ
MWGD2+]4+4?0\\@0V(&][$!TFZSW7[6BRS;["#26ZMZ 7&GN?P5. B%4JEC/
MK=^SE")M7 ^M8^*;2+Q HN]!E*$%B1!L+3@ 67;*!T%CAZ[Q/B6G!5=B*FY'
M\ +=Z>>N:P]][;"5RF!OO9* @P0U/OI"
MY^W(M:B46*P?CK %2@>T:&ZA5<\=>\C 182@)%ODG(I<)DENJN">XN\'Z@]
M(*P@!N4+TH5^ H)'UU5?:H(!&Y'H &J=%[I2R=Z>RQ2:J=H+/8KA=1QU6=H'
M.$G'-=A+7J7LO?!R)7>LFK>\#TN-6<\>%9A9-6L&27)VS5'$<[QH6ER4FX@V
M$/#$J+EW&F!O$'Y.Y7 (9.OKSE?O7E?JO;'2*9)IIS)5>3CX:[P^BL/?E+*
M #Z0Z,] :[Z"6'X*P4O\XZ] 8>SO21:]^07T27SB4GY=)'%VO?@-7,.UPG7+
M;2SP?WSV\W@%AI,G6=H"2CHSV+^X[-W^*TS&$W[H % L/T]I^>H/QRW[SS[
M! 8A[\)? ((\!^]] 1#% 4Q>"1XE!9D$BNUTRN);@G%9[\G$7HVX ?
MTA@H*%,OX&#),BW?Q*^!H #1EN(B>#I\6=V#?C!+(N5VH4V0[0AU4?%JY68]
M(/$88AJI?771.N CHA%L<,\3(3I3? ' !IP% MD+
MN X4H&D27L' 91ST-.W.@PCWG6(;FBW3/9'%Q1MRVO DCU ?*5%9I? R,TT!

M1:L:\H6 EAJT$'3G-7Y$P62)"I,*RO'@:ZT1[+^@N9I\="L+IE&]TFR#-W*Y
M8/,POM4:@4#6M$3#Y7EX6"F($QNJ%+@PTK@R4IM]Q#C,#U+EM]%-1Z5 WZ*,
MZ&,]4 FQH8J@@R 2CH$3X / JGOAJUW*R9MBW]3.,KON%=1F5QH;F +()U1ZTTP=NH#-V5%<&M;J]TM@YX4'>H@VUM[%N?BX8!#?Q=>"J5>E?8WU6A9?FK
M-U\6Q1!H?O.$P-$8?& U(KGG565XG17BA/@:["N *[;>9;$(@JR@"(UWQ=A2
M&O-(H B8M!B<4>]M$3DIHX !E9#VNDNR:Q"[NE06(KD!A.06IOW*X". P:#
ML3TH@SM\^ ,^Y"]N(RA<"0S((-/4&/&J4& 3X2="?ZF=KE3.4*0J93FLU[I-
M 7Z52.@F.5.[OZ-%73=9%&AE,DO^!T@-PN$V(5KN&CDQCMM ;H@J6:
MFKV#)K6E; TQ-W4*V'$@"-VP62&KPO#P,65Y9500$[9M!"[9?M9$8YXA!
MI -J!#J7JA+B=V]4JE.*M00*$Z($8F.!I"QYJ![XY?.'=PHBN&)=#%=H&'+R
M+?"U6<$]R,$H/$CPF\$&OB&(,J$#":U#IOHU:+LJK<$\@4JK7; :<6NZ&;A<.4=?)S5\J:Q&N:XP4]X;'9&%IC[;[36TWZV$
MI**VT@*VOKC^.A!J9.9V5:4$I!A6/YG?N]F-?OP+=H$UYE=PW%(XXPX'W.E-6#ZAR^KC9^*X;DN:0
M.'$21Z1IJ#4CSE*\2=G(-J4JW$8$9HDI302M
M322Z545)M $>T314,RH]D B1-[[[:3M4/E7.!-460418*.$")*RGX5[R5UN"
MDWF& Q X#0#2:XZ&(&&"G.F;M($J+W0;9Z&?CTH7%%YB+709YWQ"+<4X60'.MXK72%06]+$M4C[\BOVP9S> 6:7
M@. &>GM$:F^K4 LQGTT!^X)W5O)@6^1Q:G%HL&;(@1"R,9^O97-><[PIIDJ
MG=[3B+#CWK2 .Y@WT-ZF ;O]J(5" N\L$L48W&)^((MA/VC+\$4Y6+Y[;JRX>2/JAKP8
M.U &2KDO*@>-,'Y&?@CT0+L6+^* $DH)U$MRL]>N#G/\XMTX4 Q' "K'TU1G
M:A6U\VM((*\Q+D-549DI"#R7^;?-!UQG''\##E=%M\U'-GI67RS+>5K0L7655@KUU^##7HV+E2-48G4/4F]1(C%'A]10K)8Q'S=IK^66R)C F
M. ?+[2-T8 9^#:FR(1@U%P091"2T$E2Y5 R"U*N"\GRD.5@+1N!E25 .%M2F
M2IOKK8+&LBP("2H/E8=NN&)@,JDM&?B^"%.- 6-4$?B==VP?ZVN0[EW(%HG;
M>QQ@.>Q[!^'FS%?S-6HR3@'MXYPWLC)Z-;CY9;;"K]WABU<%2E6"K.([/\ @
M5::=K?0H]-:AW"J(9&$,>C$3Z:U*5M5*.'B4EX+:;)]T6F]..:F$>,OO\ KL
MHTZZ5%ZFWEA..B(SY)-/=[13] AYOV?WFHN5U"-P <:"--"N4*GFRR"JZ#A=Q)F$Z^6K- =@<]2RZE/A4G5HHQ?U
MA>)ZT8?>'O'CL]XS")]"/%$/.:;\G" /5Y SO0"ZTGFY\C ?7Z%6F\0=E
M')>&! $YY>>& $'YN9FXX!HORL]-M0C*. @/XG/*S\T#@O)S,W%Q>VZ/\G-3
M+8(R#L*#^)SR< . ,#T ;Y!W41(Y%WFC*K+J\8HG(-NS!>MKN1:TY=2]SNN7
M#DH'\L?](E0^)TPVQXC/!YNYQE']*WA@'1@4SV@&-*]J%X@:&'Z:OZ3XCG>88D(\OI
M'QN2/+(7/=R%TH$U73NPIMZ:O PW97R=8']HE3 OU%2T,VBQMV'* W2]3T%
M]MV+*[L-F /WY@5[5B]14@G:^DWZB[B??'F<3^JFI@!]3UU3OL/9XDJK9W
M46, ? 9"W$>/A3 JU=CQV;4:/&4A8;BA>=0)5AO4-33NJ;V\98LTHYW1C[XS
M>GS SNBGSK='(WLZ:7OT\3L:#[WG*7E$!]U
M%9*2C=Q6V0<
MC9GSWVEA>5A GJAC?H*1MAIT#H]'8:&1/1D2$1$1783$$!&=!8Q$1(^0H#[Y$-!9)ZCO\ P,
M//WD(8GJ"6K3/%VBV@W+:+DV$'DJL #0 0#QN]DHD=68AZ18EVR$&*2BV82=VKUIH>5ZR<[,FR22M9B5)':$/UIJ-C
M"[V0P9B5)W:$0,XY3R23N#0\B$.<@=4?.L8"1 9CT#2B0466VP?K4R)6'+HL
MOJU$)(4N41ZG"Y$PSZ1=B^;4O6P?LPZ,7-*Q?-W#K%GOX.&XG6>D,:(S^-(CRC(6'918-;%BCSHO]G$RX(Z,B'?9/EJO
M,$:5 3H%V%-5]CNCH&$XL9SI89.R5-2/+(HF95N/ HB%.@8L=#]=0;ZUF1X
M[I@8J%.)*JT. 1AN-#N4 - Z,!@Z44YJV-+/M">GA/9RM\FKN.2L9@#B FS
IM]/'E1!B"R$Z.2BZ:1]-X1,I).)(B/EYA1JNF#EHU9?5[0VO@'KMVZI$=(JV=,GEBE);[=LT)
M$G%U#S,BKD. G Y<:S1LNYX"T59W9U+W)"1 3=0PP8J)SO)&8R*#UUD^=
MJYHY8 Q+P&=!&*2!N,B"46V+WY@E@>2DNH(';:'J $AD-&;A\;0Y9L=8A&K/
MF&40[2U.)A8Q&B0RF@N:RS0S07F7UQO.'YPG=F0@N*0#()'17/Q<8ONX7'E>G$6I9"N^YK-0&#NR0JDBC6P9
MOU&&1H&?'AO'L7INV]4GR$ZZ/H](^S;)0HA)+II)IE9O.#86GXLR$YI*-!.7
M]P&> 3++TB".BA21I3%<$WEP4Q*'(8B%!4B@0M9+&)VA,&I*6O[%>.2S1/A"
M+)5L[A>,8:-0E%?3*"#A06%1!=+$ZHWZQN)#]D*SKP9#0"9!>!"%C*R!.S(6
M'[(7FGAM'9=EQS0I
M:P0O'9Z4I:213.)"\2 "Z0 :/@J-K(4F8PW&Y;V8BR01.-]X(Z),6,S+]WJN
MX@1G:(T=<:%LD4:\" \B^PHDU['Z@X&Q)'!T"RCP1"021 >Q"'.R)I.'6,!
M(H.A:<;6<2ESQFNX(Y6/E3)V9(C85%0Z,!Y)WLLL/(CNQY8S/?9H,[(7LS+&
MCO#'.6>,9!*7A@=1R-ARJ72 &5"8/LG8R XW#C)MG$U[S GO9P'6+S$()Q7)
MDOEBEIHV[[CG).^+0ZH# Y?[0:+3RTS$K'EZV<-Q.\ PPK&;2(T @Z8ZS<3ESB;2
M1\T=.S+N;"HX'1C#)"=F%AY$^TYO8@U=VDUJ!!@T<]DU",@D" \B$<<96<[1
MYYR0Q70B=Z3]I$\ UN9^4B/G(FE;::?&,FF'3OS(\N$41Y1VT
M+W8\L/J#PQ8Y$>458!18W 6KW3S\AY2#R,JK .#F"+DTQ/"B/1;YFS/JU?J]
MM1?89G>US1;KO1C:[J"=CGQ="/8N7JYXM&:+./0EXTQ=B)H=(.T+F<(?C$<,
M6AJD:Y8N>,I627P3^$+")P$/C#QX0Q*'(9A.==MMD"[@>1#P5
MZJY0<"GPG>4-4KTH#'$:O;S"QW?]+CSX-8[4URDT!)X;1<&-2"1/UL7U8CZ'
MZ^!;YN-+\F^77,+C]<-L]A&?$4CF!8F7+67*(T]8ZKI"#+=Q!FV:"9:(/[,
M5XQ#TU=\O;>K(!Z^C+,H97 3#U5OX?(Y#Q)HO/*'2-%+X99E+IDOYD$DL- J
MHNL8^A'AX AU(L025P] VU$0FQ* FU6O 'LHGV]CG=4C]/)"D"P=Q10J4<
M6OR*2*'[/OOWQP^2P8]P92 7\ 5'!8;+LU#)<([*H(O("$KY.ETD<7:]8#]G
M$5R;0#.OE;R59=9 G D3'Q;A;P Z-<8-,GI6PSEBQTI1%SK>I " 7GYJA#U
MLD XLJ %RT#G(P Q OV:>:"52]H<:IL0$G1'?/"%E81BYPN:?YF4KB[&Z
M-3S:0\8K-35OH?9^$]<9OP7 ZGCD#X'6 B:I%JW=Z%R@NX9W@?]0U@6 KI)@
MB88\$Q'8!CR@,FIL>^?U'+R.VT,MJCL:[N7^!9P'P 9J'"<-T=;]+VBN$.RN
M\L/;00=277DKJ[H 9.Q=E"-+[FW",0-]I7)E?"">0! QD$RVRI
M^QE!!Y+<;27?6 !/\5*+S=: ESVIXHL"MXWX*H"< OY#)E]?
M<[YZ\^ <7W[,=>:#(NOW@?1"Y36^@K[^%,;>' XZU\8^WMQVS\#4%.XL+AM
MRPTL\']\]O- (,(<3/O/E%K 3Y %,=G[!;9S":]D?C X""#WM.SU% .&[?
M>?8/;&K>TK ^Y1&BO/HTQI-/7&C//[399^$#*RLR^K5) X74Y '^:;35/9W8
M&=WUAGIO7)9@=PKCJBQT!=03^YHQ@J5@+U%O"UUW>V\ \ 1\PX=O0@JD8/K;;59+H3207EY[W=V ATV9VNWZTT Q]3LB(>WX7^U
#F01&7T@JO=LEQ\X3(X8&'B" QFZI"%G[WM[SH!AW@M/B;#REGW'OJ(=
M J7Z^,= >7.(JC&(0EJ*<@G[8KE2WCR/RC$R@BP>V32]C95.'OH*B]U"U*BU
M=:,KB/U,",@- -\SF6KVW-: >]W[7ZZZ=B I/ 5AM2@81^ NM,U^K-[W/O@
MXMS[R&9U2=5HG&FI==RS Q:QJ^P:=(\Y/:VW3>^$VH#QO7+)$+1@R))!+.2!
M&SP*=8'+!00M50!8OEZ#%$H7(;M$.)*;T8#K\SI,@
MRM=1W'-G8,-3P+ J)UEY$I. #F,D2'D](33U\!5\^A9@)A1B?.0Z=K\(:"&A
MGJ-MOY:2>>H!8+HBN05CP0\^*#QF.5*9*S8VD,KWJ\ /Q :P>!"^N&PIY%HB
MP@P+XS<,RFHRL]2MX##"3/&6SE RUD+&) *,< -[I-!^2]:4#,09YU("SW -
MWNDZCWL'(.)QWZV)5XUWJ.#^KO2E'CO)0]ZMX!W$#Y-[^:$5 WT70QB?I &R
MP*>DV+VOK/5HHS2#]#XNE\(/M#:#32#GQ,H245-RT+?E%3M ME0T,1Q8DT'/
M&H &&^JS[4EQEN+0EZ^MLI!MS8AY!B*#],A3R9^GH5 # =#4^Y]?]PHJY2Q2
MHJ;W 5O,X*&.-1J-K=&DO\NO:(,37I:J##(4*9H\CGA$.!B(XE./@B>YOY0!
M\GZBZCPPF"?(/7?A!F*I#1,8X.WRMW/D BI?90 !#/L B\^7M'
ME>K=VGW=+K^GQIQJ>7C^1NQ,J1FZD7ITBU=#3V$N?J0)-H?($W"7 E5\@(%>Q-^OW:B$W/KDV>CA/
MA"A=&7P5W'"< 5#VYNMHMSZ0ZQX\D/N^>E9CJ/8L4JYRJ!FBFW*D6<6#^SR/
MA@9!J/.'GI,H$B56Y$?-8=\%] 5@O-2:?(^3P]%XR/CB6[GC\0/V4GF%.)/0
M#%DF<#7M4Z/;\M6;> Z:I[Q:["$3OPJ;MEGH,EH]V3H7VHYDIZN5O:@)Y)
M?-:#A LB1)PJ!E&6G -):/4YG]O6:W#*R>Q\)MH#(?&5%&^*/]XR/5L][=5+
M/6Q? OS42]>'/;L >- >GB=9@[072.,6(#W]UF"W]:W!;2]1/Q 2:!?(3!Q
MG[6ZAZ=G.P?NX3F52;4-X!<5W>UR]&?9Y:L,R" !^-$,-W+".AUMB [($^ :-*L"ZJRY"\751 ?ZL29S/(@WB[7=Z^%'=.?-QQ *^*B !']FN-RR4PRVM^^@GW9L[8),J0.^C^C'
M@(B,Z.=[Z8=2'Q.QZ]D].D?<""2>:GKNR=><7-CTW%\M3W+3])RI\B=W910>
MFOTOF=R=GC4>'DOO9"]F)9;M\<>3K%?K'")D(1>/!S$*,8HY6!"C$")D(=W&
M@QC%F5@#MV#R(4(A1CH"!"(43(OKJ-!Q!*
MN/> "2VREPNS%V(4BKD(#V*4 1-:8\IOC$#"]#U:C=FKO\]U.U>P-F>Y/KO\
M*5PG $O'QOQU%/<\))IX,D"Y;3^L++.X]DW,?BI0@
M&PCJ@6>M/AZNYQF:#,=6SVW[@)U=P/KUMX $>91 $PL2J,2"1@$]
M'%B3P;$I.K&@<99(+-@)F(@%NP#JR=J=2?T@YB*R\R@]NCI!+0PPO&AW]
M&BR%9+^*6 8Y7O)H=R.WOA)?X*ZVA7GU5PYM= "B%8OX.8F7+%T(%D2>6*5!
M'+%XKKYX%R]7/%K#WTF<72 8>^&)Y4PDU5;.OF,QM^<,+7@B [D'T!=?L@6

M$6PF1,1\X86@OCZ+$[;B$%;'\. $GL@C]8KG[L">,NAOB. UA5C"M<6#6!HS
MO7F4O6<:"BVX9(F0(KE!Z++Y// ":!V3"] .B0KG
MZ8XK6!D\G@529AQ4DF6K6"N+^"82+Y "+]?7Q4I?I5*.S2MN>0(M3:7-WM4>
M76@,O)9! X(T%$K/*N4-YNIQMXNZ^L[6ZOFSF"<^/MP/$N&E<2(MZ,WL= @;
M'X*7K)(&J\R.UD8TG:MM=F5NN(>LVH(IFYC H:)[6SC0?9@LHO:K4D'J]<
M/X #,+Z5[&6 BA1G$@"6K][<(Y:CN.*D<8Q2EHU>U-E/\6(>7 SXK/>,>2(,
M,8* 6*3\G,]>B KXQQ\@ %XH*0KZ1X4 SQEND@9MRK5\YI9V'3:&1/
MOV,AX=-$3ON"!N-"VZ=?V#2B @N'@@(-!4D *J-G;0Z&]GMV \ =(Z=*&=M>
M*5BP,P-2-L.N3ECIIVWA=V-1[<.YYRPMA BHJY"4;.2VRD9.WYX<,3=WT72%
M::,9YD8T98:G.\ILB* (.9X?PN H)>5A KB,3FV4YK]B[
M.+H121K@H.&G(ZKKDP4KGO[UFTTQ$>&MF3X7E 0%1$@!$5/4+1%]?J]<;&(D@L] B)[),/
M%5U8(OO3$R2R3S^<1XELVUOZR)69A(<.#BZ9^Q^>AI+5F)6&MLI31,!Z>;4
M)N649"&$! &*RBG[UL@YMOH7&4PG!#UTS2EB8#0-&5W2+(3R(5YR>-1E/C06(#(:F*5O'Y4NMLCY;A7"7L6,P
ME#C2&!CA003?*9#(:&@JLCN(D(40'D0K'0")C.:"YB.=OCTV%)HO^D@N?L.#
M4!T A8=Q7>-);,8.NU :2<->A ?Q?:= (J/IQO3C=\F?"L"229P/'L0C'0")
MC.:"YAS=L=TWE6#*GSH&(%5Y=-J[61\7V@50(CQRB29CI".+Q<#O3
M*,,:'KTD]I&=X>&>D SM]'.=;3#6^:2T;)P#V/$,3=VSU>X=%)T N3P]WIF2*IY\.?B32JYD1
M'9Y"-$B@$@T:@/1H;$VFQVZ7N4@:U' 4:-R%J]T< 8<43Q@IK *#FR/DTA##
MBT9'OP9+(=FOXI9]CI<\VM30 6W.6 /W'S+Y^IKSU1NUTW0!R;1(I"Y:]&N<
MBO>!],)89HGX"@WY*81K O'7OS#V]^*VZH+?YN BY4I$DN,JY,\BY*GPW\4R
ME>K0E9^X%/XGOEY"3V3Y,!;X/S[[^3^ Z& Z?,8\Z +\]%G,?WSV#K]U!J-I
M?S3^#^Z*[3D]1 WAN'WGV3^P&WDO OJ71Y!J?3SAR4<04+;,&=MZ@^]K)1Q6
MEU\%U]:N84=&JVV.K 6N ?/#.^;V>M-B[W)CR (#.C.TW<&+5ASSQP@5,Q*>
M.G3V-D@7+%T(AAWE'IB*#-0/0<1^%K,DX\D:!. ,+'45@LJC->-29DL &=XE
M4YYF:0R7R=IIME*?0P279-#A1+^"!W!U(OB2?8A$.^-2+#Q\,L21)'&9;?@SU6Q@5WJ\Y?B>?V9Y1Z?\5L)3UHN
H6]*,C;[FLM9]>^6P\-$L@PB="T,KJHW(W]F'9%9EJKO:FM8&+ EB2 K,BX>
MGRYXNA6R(+KSY-L@#$N!80]G@EW'(()(*.G"]4'"Q+= IOA2;+6TV97J^7OA
MB>5,)+K;SJCWMN]8J#%#:ZO,AI ?C\>][Y0=2\02M ?E5.O]W6[;!QBG,S'3
MU1Q2E+VK'N> LU"YD;YV(S %H+9*>X($'%&<2,97JP143IF%9: #;!0=0U3:J]
M^@J>='V=B&LP4'S=P!HVGP7?-904OCS\^6P59I*]#%Y5EH-FFC]:F>^MJ#\0
M[3^*4 70AE]=E?:./F65B)L@SB0(/%"'BGO"4E[M9;#C73*; 0YR1#-MNG#H
M@0Q 57A2.)J[3OW>E^L?Q;<5@(5/C.&NY#8 5U!Z/^67P;#9@M^@7<^$B. .
D7B!U!YKGH&'PD[D32;%'10W92W^S$ 5X?J)U1L,K(D[
S=^41TQW.!,NK=CL6@!9\A!$"N*!9I7M1ODI!RJBUVO!T0S@U3="I@R=-UPY
C[-$ <16(@EB4,HD7JK^^+E.JS>^9>[PA;XQ)PT1*0,#NV9XNU:@<7$1:'RZ
@/:HM^#EVCLK;E@D0M\C-=\575MR5 DOS'S0&;!TX![\>H4ZD"I:*0 O.$'?
"1<' "A(1.D OA\N1N-<@Q;B1U%J!?P#EP!T-8VN-&%#$8JN@ML KPGXE.^'
-WJ;K;CC/$LA
.=&HR:U>1=VD7;-(DH8"[ZC?RE[6HBQUV9TP*Q<5X"=618?+A^;.\MYHH"[[
!?>5+RL4/ME(IQ"U?;77>W8X#!N<:!UQEUQDXD"JA
T%R^2?X[^K^IJ8,[FGJ7M*>#L=4?N ^D[$&NY5 K'Q7C<1 T4)L9]]2CE6OE
;);$7#T!Q<-KV19GDH?0%.P8:G:D;P[#^%:UH*#HR >OC(77%IO<2WU.&
UFZO-\E?4FL1O*[R0.<26P\?'EN##@[Z4ZO?'U!P3<$U= (9YC[03X GZ&<"
W;D?T0Y3G#:TO&)+QUD-[6H>8S2F %(1BUGX:K2<.).@]>C&&[:N36]C0-AS;@T>H^;1]0OH[YF)-7!=R@H*.
 2>3??NK-3JP,>:$Y0;:7I'? 33@@M$1U3D>;X$B8406TRDT=O'')5L'M J4
$P!QG[6*C:.\V:6 \S JU<(WUE3(<9F$!CDN/][F-HG0N
DZ>1%!I)N7 O12,IA!%93(?0H(2$$A(SP+FZ$0F %L9:"ODMD] @OT5^RPQP
R&\9 P6-HYQ%'D C*.W(G BC#:=U9Z4G\8?) $%QKW%XD-]J YP/^2Z$:K'Q
)]R.8*SED!\S"0WR8^3'S #G<[&!R%A;(<]E3 ;?2-?IJ#%#TOHZIQ H'>2:
0XYHN10^^NT[CU4\P;$L1#]MG0 V0(]VE@9"'J[C)*',]YX3NOA+D7QR7-U
',!W\$O"O33C837L^4LP;WO4T]P#]-I&[*D&%)[\[(PS7Q+P6[WP=EJ69V%Y
59;!D2,*3W^D"2T4,/Z<(#H#R"3 >HTHXH&@U:**,SK?1Q5OG!B+X G3H :Q
Z(!%'9 SG9%Q= 0XJ0Z8,^-Q8FHZ%[P!O; -18 (B*S\#CIX!TA0DQT?H 1
)=V+XL1VVS[[E"BI$ZNSGGHPU>G;8T.A^2]=F[WEA5@T;&JJ ,E/F87'D95J
SHC6^]:D-S(6'[(7L "@5-,T1,A"S,*#&&5J#X]-%,E<+LU<8NCFN-IX;XT\.=*9EB9TF/$G"BP:Z VOFZ
I\1^^P$>VI-CITV)^R[(J1+W=0(FXKZ+ I5(\%&0'MN3M@N$$PF>?N"Z*R5:
NXR+H1612/ZGGO)&P5)$83Q@=R,*BA:ZAR)M9#(+#]H?:QHB1$P= XR(Z1Q0
)&(R"P\B)M,0(6+J&&!$3.> (A&300.JM!*XOA)XE09Q)-F-D*GP&8]\)G1A
6HZ"X&F%X1GVOJ:JY5^/MAKZ!#NS+DY=.^'K:::[:YAMW8=%@=;F5F)K8&P5
#)K)-LC0:#E7)V B#GORE]:1FQL?Z/EA&;$C/0I'@G *-)\7- D2;%S<*#5FN9A@@1
4\< (V(Z!Q2)F,S"@XC)-$2(F#H&&!'3.:!(Q/0(ZI44/@)P-JZC'@E//R0
QI>WAACE0)65.P-Y9@]&Q\]E4%NN"+(V69'4")B*Q
LRM[3-RUJZKQB*H:FPN/,2Z1F*L3,!%SG1-F1&&'U20>&3(4U0T*TV 46-P%
J]VA[Q]2+-907N4'-T?(I2&&%^VYE[\YHUZMWUM[@6UV5]MLL=Z+H>T.VNG(
E63Q .[@K\6<2<\"I6)Q[0 ^F<;>'RS.1] 7W&>!!0V7."40W(AP;3$P
9V !X(%,9K/?X7OL#X>+5EGB+;@L.[$0(?1MK?KU+EZN>+3&H77537#)0<3#
HI6"K9+ T[V## 6VS[*TZE3>D06 $?!*C3T*Z48D %I &Y8\B! ;O![!3R"
V,=N]VV7K05/9"E"$$<45RV :\KW%* &D6HNWL<$**> 0WHHIP8T\. [#ZN)
JR:L?:#HQQY@4X[)1@5B*:%Z74!U#7>GKWV>@IWP($'>RA0&3:M2EX$, 2Q!
..\#0VML(;N^QN+YP!Z.+/:\;X]=]=-SQQZ/436T/C457,$(&*6@G4&4PFME
X%7-JXQ4EJIS?/, .<3VV& 1PB/M+"MD^)3T=9!]?/=AFXV$3P'ML(/YG/H
.[JAO-%>EB ;;T@;?]$2QY?AIZ9%-J 1':]+J/FTN#F;^!"I3!M2Z=O3IE1<
N[]#*N=@+86W1">V!!/1F&ZQD]QT&$3AX+D%I030UNRIGH)4JV>PJ#,M?D7F*YX-S!7^B7J+8
54*DR:1(;E!UM>^7A0IK(=7YZUI$X(S"4%-4DS+D62J2OTN12NG>!NE"7Q2'
87RKD)8R6^J?WQR](L#D*+4>=ZL^8)\(0"01/DYSXK4YSS?
TB,\97:5IT:0D81\)<6;XH^W3*=/DUY]9>3V)3#+P/=#<=*52OVI/75/N%JI
K@9?@R7XBU %+?L<0P#=A5&14RRA'=#BL;N00$-!'(") Q;8HKT,Q ;XSD#(
UL.VOGO0ZO&&C.LPS>+0/PKF!V#Z?S'V^W G]CO(YEK])2K-=N&IK.;W[^+
J&@BANC+*$A*^G*?M0K/V!X=<5 D\5L3= -*#1.9=<@?WFMOA!BYR[-VEP-C
#93-:3KZP[]9A^^UGXYT#^\7J>"#4[
+A+Y-;(K1D-V'!@]T@^E#NA!;)DKT,(EW"XI6Q V $1QT8WKYH/K*'O=;RJ$B8.X5#1&(<)(2'
67@0D1"1F(($$8DI2'3 <1$>9N%!1$)$8@H2>XB$CEI:;3.W>B :/9Y -)8W
UW^ * #R(\(DF=G=)XC H2#Z;@[% V%[@W$5QFR9K]KTCBUUZ<0[1QBHK5.'8)Y"(#
7R3Y 1 WY38T/"2$8VLXO LZA'^NLED8>'@J1L+Q52L!K '4DP*ASD0*4OS'
SV2:K%6SYR)01UTEJKMXMD9UXD1U DG>&JW"$]<9ORW.^N"ZN #R^>;#4/X[
;UZNPG@MA 9?'0SB YZILV=N%R*J'6'B+7ATK<^7*KY%P9?'7^0GJ"CH;H,P
9%FH;P4QW"@%T8=W2?9[YE\OP70L?6).G(.;XMDZN>;!97 [="=AV%
&+"9A>KD!V&E5?]SH!)Q@T<8-<]^*?1%LB5^G$/'8OA0%RJ"6NITA1HT-8B\
,$-J8HL I)L$'AX45.&ZXBG82:0U-%VOM)7F"*CSSG)8F1>"3[#954.L6O#S
3#U+XZJ4LB:L)5\72E(/*U$ K2Z'3 FQ+'6:7+H($'!]/P$/B T7U//8/ R[
=BA5[0 B1:]P=Q.K*$Z+9R/[S> (> 94["U*:@6'(X,;Y+.J*WF+\7J@K9JI
(Y6%.I '"N
75+>C#;N4Z':2[Y;F]#M7:V2($05&>']<7:]8% $*M51A-8<2"46=R2*:G9(
KQ27@]K@R]7C#G&?ID>H=SM>H0@ UN*JDFAN(,RXDNI$3.2KIK=2KD-9LR+O
ZRCXWX)((U R1;!I\[VE9T+E6XJTR=3%4Z %SWNULP,Q7H-'ZC"G>/Q!QUG*
O>Y1!>;8BJZCJ\EDN)U,W*$^[K5P=UL9 2.=TBKQ*G5U\0ATDE5X*M5-A4]2
@OX 3A8>]C'"6K48M'T*>:149 L1M.-)WW+=2>,(6O7&$YX\6SL53A^4!AD;
 %R>],?Q%$;L5<.M9Q$R2,$16P-Y+8N@E,4*9%&QX%Z%?9D?"JN4.\XDM%N^
HH/J'NF@NO$!!]6U,,8U&MG3"1U49\Z8HSVZK'5V'8"$BG.;A(9K3T[NL @1
LH^NH'%: ND((-MVI+1Q)&; .YQ7;<+W?$[A^! U:G'8.GHZM+1UVS'RT-)3

M)RT4)1O'.P0)^;*.H4&)BVF($!HFH4&)"R4NYN)UI=?*55,* X7S4Y3&M(\,
MI3$4,W>5A0@2\F4=0X/2&-,0(31,0H/2&$ICS,7K/2X; ID'"64N[8-A>N;2
M2%.*L QR@3>.\U,]7G'<]D&QPND\2&H?CD];:F@[&Q\)' ,PN/[Z"D\S26
M#F!$'%4'[+FQ.!$UW4]-]N#84I#$308>4W-6*^J'S/FKKS)/)T4?4D;5!"S3.WAL2.79"Z=R"K/;3>=P:GF.URW&X;"9S]4Q]:T/&9C]$:3
M]B'KP-CG8VXM(#DZ=C7OH^\((M?X:*FN^[1.9F8N/Z7.V^[)K/\[PC#?7OF#\#MD=.VQY(&M/P$(0=F(\
M^(M+ON IO#&1% /W+OT>,">:81C#7LC,SPLN5>3+?'I:/ \#&A=-BS!VV7X^D4'6HT"C#NHM5NOO^#.D>]O*I^POK#SHRO% \Z3$\?VNMM
M)\9O]@%;/%EM,\76^ !AN0KCM1#L2QI[?[!/6>(MN!3L$^3]NWI5;,$Y %<^8'B?#2.)&,KU9)
M?"-\]3M>R?8)BKW4JC!QW=[;#U\^?2H .F]?,1[YC/OQ*LT?AQ>P(&)7V35(
M+V]'!J))&'@,;\$<"\P8 V-2U2W%IN&-[^+EBD?KXN'.^*UD7KQV7@V
MO^%!B%:K'BDY *';O*MEJINW01@R'LH8.NR%F2] &O" *.,A?I,(%"&\ Q\R
M#Q(0A\ 7^&[!01#S0'IPX5KP!+H%&A6!2\;+ YO#$Y(UTS".+";^Q"=" !!
M(3PUQ8>\#%ZQX:8P7P;PK?NB$&JSDZ6L0UZU!3\'RZ7P YX*T)X5:(E =F@T
M$*0"CX9GRPR:'L--">/+.(M2?.PN*6W1O26\U1>I2)9!).Q2\4 I$Y#5?"X2
MP#7OS"QXK:4)S4H729Q=+UAZ&S,9?&/0K72A;\"VKN"?V)=6KF1*GDW1@QFI
M7JEN1]@A/H=FL' "9[U.-?P2B4HL#G B7LO58B 9B--^*;N'I3<7/E-Q$Z
MU/]Z+['[J*Z. N#):[KV:J@!QG%3<#!'*ZS$#!:\742@T;ZPL^\-(@CB2.;
M'(0O/844/-09EKH1QK?ZE4I&/$B@<)+ ZS?%I+O!LA5J?M[NHHOZR^>NTG]\+@--%9$/4D# 0 T"T X.WZ[P
M-K=N(GAUX1 4AXWVV>Q*R;\8$JX +1QK73#@EF3-IZ5Q"B:SP\ML]UN5H]&N
M&#R+?1PY.:[1[+3*4LDRB401(UX>:"VJ29;D\IEQ !%$MA*1Y*C!2E)*B?05
MI>FHZ)]=ZWH?VT18N&0?+I5 O)XG ': !7 %J&F2JV?/[O=?@']M@+O!)?>
MQ-"B(Q2Y1G[?7LRJ/^,7DO?-E1J)I77*'^&0"\ (?ML'8COK[VDUWNQ$]$Z
M?(9&42HF>/V3 N=='9P/W !O<4#73 Z;OM:,&5@JOH[@;;Y6N-=;5%+H7ENY
MAJ'CR*GVSC5H\5F8*C)-XJ6Z#H.+NZYAMJYB%J55V/*:HY(JO/D62/6P0,U@
MQ;D"*G7/WRBQ67E[(I6,\U1U!OY9@IS5FV-P=#PG" EO"H$*,'3 &^-,PC/E
MJS?WH/I]F4L;PV#;"G+E,]'-N#[UAI 83UJW-%^!HL
M0:5 %;?L<[SD41=&1A][*5J =4#:' CZWN+\3N]9F^N7!CW[P&5GEU*)]"
M%%0YVP 0,K Z6%]388;14;7^[URD=!'$U!D 2.1D("C;3HYI8VVM8X]'WS\7
M=]'L]8!U?D1,9^GKCC*;>YSA69H..<=S1 @!1P21<[PLYW@I)D%.[]P1!J?7
M=F%,M0W.4PUI//DZR7R4XUP3Y7>Q7I"23RM%UVJ-2CZ/%43H'8*; P\H
M;J7:6?^,P3F/%>&TVML G'J'Q1,7O9+;&@VFQ@)(-=#,PH.(IVU[(.(AXCD+
M\)QAVQ4+B':ZXO:(=MJV!Z(=HIVS ,]QVB[C0+33B>5>ESXV"IZ#)TQ$(KE>
M,[F6J5CJ\=%5$JMM3FI;0,M3#Q0RF"I \F5FX:%#@TMF?K= +/.3M5R:M1![
MD#T0'L0>%4BCH\^@(VNY-&LA]F@U06 9'I3TQUA];!<^%P>(@?31"DI8CL8U
M%R:R&UJ(55AFDNT5OKH;EUPH,XOKZ.L==V"4"REJY8"[$'V0/A
M0>Q18X]QSUATR%K,PH/8@^R!\"#VJ$#JCX^M%476THGQQ<<]G)D.RU!=^B <
M1L^T:*%Y@]'%LK>U330:?$,\SC4J&UL0U]03#G3[T@BS0
M&+=*7&<@*,1UQ'7$=0<"/+5<9V*&%R6J,]FK$M49" I1'5$=4=VAVTRLT='G
M^UTDU6DT"C!,JWWZ0\I!9.55?G!SA%P:8GC1'IG\S1GU:OW>V@MLL[O:9HSU
M7@QM=]!.1SY&+%T(MA;JC"9?^.R]\,1R)A+6=RSF]IRA6FX,?PPL=>F[>+GB
MT9HEPHNO(VB;SYX[]HA!L\,@CM35S OVH/C"@BOE2GAI<"/"M<6"B'GP"!%)
M7*9B6 XM\"KLA"+M+)Y$B UJ5!X?I1C.="2GCMA<@'FI2NZPA=3UQJX3O[E
MYDMF:R:6JS!>B P&E 7TJ?HRC>'-@50O#*(;(=,XD7@9X\LXBU*)#17?/"%5
M*[#GOA!+Z.V'VS&)=S: !?E&42I2"(>L@QOEO$\OO7$ZC4S\"2PWP$[R?PL03P*
MC92[5%+] Z!0S'X3 >ZC0J @*K'62I3
MN!VEJ\&*5WBA9+=>Y!BK7A6?-J#<8)6<+ [^0R9?7W.^>O,^D%X8
MRRP1O\W?U03P67<=SZ"37]!# (2Z^8FO4= D5T#CIQ"D\(^ H6QOQF/Y%!;X/S[[^3] P8/IZ!G(/D*X
M/XOYC\ >X;?.8#3MC\; 0OQ[3L]1?SANWWGV#^Q5WJF F6GLD[NU=6"!G,]
MG,6A?Z#F/D!-?XU3P9R)S3Z74F*?0AX=8'ZCK3TZL:W=-?8[/C&>SP6J**L4
M@:V@B^S/##SE/ !5S^ !"?N"*AM'55PPZ#DO WA54,>[V!=H):! -0YZB3\5
M!?W=\AY\0?FM\ :5S;!) (8'(49/.5TI36;H2J4(M1D"Z]496FT3"L/XED%<
F@9> -^FBOE\ =T"MRM>I Q;27CP]ZN^@=>0=U:?ZHO[*Y[UG^MT,%Y?V:!
#-*EX\SE!\]C-205
!^Z(L2IUR7W\0&.]^0ATTD"BRR!2#EV 5BH/N>]!][G.8[U=TV?^!AZ=8Q#U
BP /*W^; P(!4YS\RX"2,3J]
NDZ$$K LN O=TB/PH.!O)/R)$OCTZ0J 9^HUA]!GY5.;G2N/&UF $99+ A)46 A"JW .9IE
]!=$.T/X.XYJ,Y;7 >EP"@%AE7\,W.ICGF ZE>/=&3-V$X^?LQ3\)L/MOJ^?PKNBUQR-/Z&@BUWD,)#@FP,CZ$)H$M5@F
7<29!+'+5V N$>Y1@S9?@R4TX%=QRS['2QZU.7Q3'Y!20U7YD-^/SWI 62(,
<5 /C*#\G \7JL Y0*0G,.$MAQWS,4,/!,M74KPI GC+]+CBJ%>OC6+,X4"3
GNVZYUNU!5S-86N86Q"]8T\'YROY!Q\S1Q6&6YA":P.&H3UQ+[M,CM.WAL/#
SG$@.S' ;QE9B?O\F?Q8"SE!Y3MB\@L^B93P($K?0NFC X]F(H,QP&",/+GW
 "G]L.7-E)R;1B&4=%P:'D3I0.F3HW,0,IA.4#IEZ0^F],,J/E.6;AJ%4-)Q
:7@0I0.E3 OF.BPR&,K26\?%[;F'O%$6;II%$))QZ7A093N#*S>Z+"MI&0P
!AA,^R4*< Z^]&*[7]7JZ7DJDI;CX3JU7SHH'<@BJ0)R]S#380)50+XGE)A.
+7=\[!3E4Y>EH!K(CQ5@/'7]ZNT!!M5 ;O> A2WA!17+,C%AHF)9Y[72GXIE
/71$=C2Q^L/#BB]9&M5"ZK ^6R[MEYN; -=RH*'%X+H%E#X&/DQ4OQE7^[
IVK Y-*J!K@]FVGA,) .(%4AT,FR %C:0F\P#K#*D]I?F^]*EFK'.(OV4S
T['*B>IXJCI>U-#0]8-D<9?P<:,R>^+]R:T7E6MA5 +D@%W)3UUQT8A3O[#
7;8?A[=229C&7K># @T%20 J#EAABZ5H!SW[P+'8 8&R]B"/$2G?H=-C,'U(
A8W=%9FPV)X9IG;""<&V\7BJT3K3Z.@LC8DHJJN0E 3EMLI/CG-4J?2+9C#,
%%8T$NKK,(8UU4,^S,P,5&
;8-C^E*CG9:8CV>[ZFC/
%J;^&:/SX #"B 5&M'C( )QZAP44E[PPJ-^WAH-C!XQH[].E+:U\%.89V9/A
>4! Y-,V8$0^'09OTK,F4R(?([@\ND:!$0^;0-&Y--A\!QK/'6-!9"XYPQ7
>9T%6%M'3^$>=0)F'(:!.C8[%8F0*9[(=O2Z^RX(HZ:YY5\L$7@>N!+-#KD<
.[1\?@QBC(*P75 .B;JH7D97,&M&8%0O8\?\M=NS1J/#B@5>XA1V^P@94YJ&
.*M3 H\XJWN8$6<=-&H]LD;]PTH\$65UP-*(L@P$A2B+,"/*>BP@1P/+G1JS
%X(HJW,G&>P; 7^R$G@[IVKK +2QL-NDFH1;8@NJ26CB?![5)+RPR76J27C/
V.\0HI)>V\N .E63T&R ^N2%(XGLB.S.$U0BNS,G.V)
[P$AAGM;>72W=4V:[Q;O[R-CF"Y
]*H*.ELE\4T@@SAB+V=ZJ+3&GOS
PGBJB[[7IJ@N^GVA'I46.[,=BDF0TSMWA*EVNL'@4.UT,T=RWV4)*N*;(PVG(T4"397^
>2R'N:"E+AT [, U+Y>\GJ4#*%*]P#:6:CXQ#5&M6F*B"P*,F.@<4"0F(B8R
&)B(@*,F.@B4"0F,FA%V%,/F#I]>VPH-#\+\")'%XQY^KDC&C)MN^[J!P2.-7U*>BI;'X\W95-H^'IV8)*%#+[J&68\.O3A)
-/'4I
B[E($N%305)CS:+UJ59R4R;A0=M<.@ 2&4T;ZW@HO223(#R(1\X')#(:XA&#
(2"3(#R(1SH $AG-!2W2-'B#/97R--PN:$Z$\"!RKX'T5,B3J,P(*H@UP564)'\"#J>.E8CC,P%J"+,I@]U$&U
.\V!B6IWFH5')V9%J(I,US"C*C*' .E:KC,VPQE2'1F3E[I0Z;.N.4 BK>YA
1J1U8-([&1!KF0O0L8.H1%:7ZOB(K+J'&9'5(4#VA\<.SQ)3F6%F;2X!;67P
UE2P=/%./]^)SE9)?!/(((Y:GOZ@P=Q.31H>4 F%8I&N@7I@B1L*5N[)K(>6
.VV[$@[%*^8N3Z+,NFN>D>CN#$$ENGND@>2>U1OTB>^,18CXSB@X.N :B> .
$%3BNT?:HSCJ$=D9"T\'%Q#[<38+!7/MDRT@KLM]%H?^4;@]=!#:C!F=;5')
DP%BJM%T8*+T^YFK@>(%AB3/C<7RN$CD 7B>:23RD('FIYX8W^E#+\@"#5["
]3T45[,>#RX1R7F8#Y'>&9H X<=/XAY2"J\BH N#E"'HWNOVB/0 [FC'HU#MG:"VRSN]IF@ 5>#&UW
T$Y'OBX$F\=A&-^"LC.%#DO$*A$2VB49AP]>''E!&/ TB",6SUD*M\B4IUD:
)VLVUR5V6<)3P7CDJY ?Q%'^\9=I937KU8E\7O.V@K@A?@Z60[%=QRS['2QYU(>3L\D(44RGK
0%"@H2)0,4!*VQQ]<*@9Q^XO %4J5S;6QD04U55(2H)R6^4GQWF\U7678G1NSQF:86Y$4V9X
NJ/,AOB*G./Y(0S.L>V2Q.0SD0DYD'ZBO&TG)ZJ)JR2]NNV[:8="!DNP=N'\!6
%S2IWP' #EQ=<]$K9 H#NW?8ALUV3.Z"+.K5"V-QH(/!6H> V*=C@!'[$/MT
" MB'W)FQ#YG QBQ#[%/A[#8QS['C)H^^?S%F8^:JA,L61!Y\5*MR1?28I%(
<8E ,6J:CZ2V/"%!PZ7'^2\ZF/?2\.A= $G6/7MRV)%>9"YD+KOHXSQ-HP.

MD(&8A0?QR4O'=H[-'\E>C*BJ0CQR<7[KHNRB W@0CX $#JM32>9B@+G0(L[3
MX)!U0?!T4>XT(/+DC@,01"JJ$@B?"&6JG9,"=H9RJ"FF^5?F^((<*F[D*FD
M1:RFN@^:52(*/JI[VJ9VL/#MK60O9"]4#IM&"!D(&;A083BC.WAL?DTVC#O;TL)+'9"X&F NM$CT]+M4JT54B5CSPU6ER7$IQ["YU
M6@]Y[K-;Y+C,PH-XOF?WCN5Y,I=+,Q?*&PT#A S$+#R(3Z9VGU9#&H%$!\R%
M^,0P0,A S,*#^$2!]+>)Z[CFHD160VLB6\<%3Q[RN'1V 'IF60YSZM18[*
M+#R(WE V[,&QV[')7JBHV1F:1 ?\UD7910?P(!X!'G%=8 &Y*'LA'C$#AP[X
MK8NRBP[@03SRTK4=VI=E!!1[>*3-Y8Z-P<1#SZ4 5XQ^2Q)COXWB A^-VGK%#SYX,6X;P(!NK.T*RL]9 >BAAG:<1&8,2
M,=@Y848,=N"FOXD9SI$8S&0[(P;K DK$8.>$&3'8@?. PV/';XG".C>H^UA#
M[OL&=?TXFX6"N?9C#R(Z?7N\%::ZW&=QZ!^%VT.6DL8I#UM>1+HGQ'@R0$PU
MFN]DIS96]E8@H6"WTM(^%"GD,!'49LAQ F#/-"9Q[=YA:?63N]/#?>D%6>*K
M%RU/^#\2UYVG]73 3Q+YG2&H1'Z/0WY#>WI800 B/R((K .^4DBOS,$EYJ
MFQ76>S&TW4$['7DOYB))A,^"R(N7 BNO"LD2,0^Q)&NZ$"P2J:K'*E255HEE
M6E.Q7,4)3];,#^!;4'8/;IJ)]%:(2-WD\219@ TPOHRS2-^E"KI*QB.?A0&?
M!6&0!G ;M)+-@XA''O08W@Q/3O'.59:L8BGT#?C,XE$9'E:%=U5-+B^VV5>X
M3-PU>\@V]XM"Y+I8S?2N87
M$BJ+TF[O]Z $DD0^Y+EKX.;7@8HD#B3<(M\]>8>;>FFSM>M6 M<.\@?G 6>
M,4^$(;I 0*/\G#M7]3EWVQZ**RF==.YAP;&%?"7%F^*/MTQ[X7&OOO]L^R37
M4S/!:&1/6U\I7U>$K \ >^ :W#:.+ Q WZK]#ZB[)(!9GV?P^&F$;)Y7;PF4F"A G RN&+35K(H Z=Q4\6F+=;
MNUJ"/(:YN^FL\7L1BME89&PT"-K!5\]X7&[3P'^'W45):4V
M&FY4&PU&O>/C^\=K=EI=#?N#]4YK>36U(Y+N06SC]947CMN'81".ZTT%\<*Q
M;3;\!LXF&+-^6R,3[Y=#J6\>R!S/T%(?-=JV8J(#QW364#0[E&#K ,*&ZUD'
M]TYC/YXQX-'H6V-U#A]>#VV:'[P>ZA3"O![:"C1Z/?0('NN3QX0>R6-=>8)W
M\Z@Y#<.LX+N^C#JEL\&,9;"QLNXMXAJ?6RM6C0-L N5TP/AL')F@.I/9^T
M2VYMI*. UQN>'[S>\'IC/QCUUYO XMFD!6)KF].8+78*RTQF)JY$4@B?Q6PK
@VP8 EY@M0L?7L&/]H.C0;^U"/(,TZXPO%<@GA\\/KP"<3Q$9Z&W ;&'%O<
M83,ZD2CP'].DM=$6K^I]M,OCPZMZ)[\8'.T =$B+YY=VN8I>?VR[O/+\T"Y\
M>/TQ" X'#RU]?S2"4>Q;;TPM\5[ )1<"97/8$6ZPTX2L32?BHR%F8ADONF4
M8WN:8FX>51V(6OK9YMW#6;WWP8 C;4M-C$$P/!RT0QKZX>9MSG%ZE=4I\>=5
M5O=PYE76.H@\"D:';1V YC66SZFVV"O^>X:UMPUCO%H;9/)!\4T'^7S+OTXA
M[*E: FV1 3$\&0;]XZ/6HM 'UGUBMJWP]SK((\SKH$?00:/]8'#B=5 KD-'V
MY.Y3>ZQMQ4MM2(HS9/JADU+\<9]MCZ!ZL=4N?/@:K@X@R3/-)O*I7HEX?O#X
\$ID2Y#DF<:G.-N FC,^ESD ^+ @-LHW4>LTAF(LQ9F"J?Z6POP B(E\>'
MU INC/@H.!CY[H*MP(5/4W8* IX?/#Z\ AD8YI47[1=QNZI5 U39BLN@)A,'^\T1D:BKGFTX ^B8.
MG0IA^B8.W<.9;^*P7F[S,!@SCS.FLM% EX
M/QAN/) J=59WDZS>;[ZS'Y%SS'/#L2AO=W0JA+M&PP%OF'0-J6MVDO"6RQUS
MRH^'P7#T4& ;-TUL'2 Z-K\M1(K7>AZI7NNU!].C?1S MNF4MM=ZVYGGCM)B
M' LV[#VV-AP>]48'C0AS,3!.X^A!&/P!=/U*!=*/ZJP 0Y+@R1#59:YJ39)@
M7>U6P^(.FBTO6XO+AUDK/X#/[;167@U.^L'@P>;*4Z<75DK1'>+!U^W-A-]'
MR3G\$\(E(ML.!O)J;PM9SJN]K5=[9/@8' 3;2Z\VGN0VG.=\[D'$!57A7)
MJP? H[;]GS:G1 YG<-AW]$CC+G#-PWD3'[J[..@-]S>SD=.$\83'-THJEDY6
M>NX,?N:*3=(X3J\5>R43ED 30O$D4J ?W &#]3"Y.1BL1*9+GD2XAO% ?M%
MP4(1Q\C:("3*OXW0H+^-.-+64RE\C.0 AHWY7(DW]L-;IJ7+4=\]<]<93VZYZMY!ROC[J*DE(;
M#3>JC0:CQZL7V!6F& 8'!^U@-Z^FVB'I'L0V7E]YX;A]& ;AN-\.#O7"L36U
M4"LY;)>&T/EIZ:T/$;4\O[M#>:/.YVYW.2 KAZ2W"!FMZ<5Q?]7CBXV\,FH#
MPKPRZC#R +3T%B'#-]GH$+)6C5!O1WBG!:FFS:.H-5'Q=4P)?XBX*SCS/;W6
M*C VK3':CJ*'GKKQNFHGY9[75=W#F==5:^DJW]"B[2A:\ZC,3O2Q6-EW=[O"\/X\KV]CT7$4^386;<:.5WM;R')>[6V]VO-M+%J.
MHDVUL5AN?K!XYGVEW/^QMA/'&VH[0=TF['G@J@'#:! P/'85L'PJV%DZF /D
MADUYQ!)PR-.YR'@.Y,QBG D1\BR[@;==\RS"WA09FPB@9QX'[RX"+Y()&<\
MB5@*3\L 1#P73"9A.A/DT\^+;)XJ06OA\WF6?I^7)P=-P[K"[)A)J+,)=7<' @&?"*;N&']E87&*[C)2)[W.9
MX0)H"9[#7X3'N>-BG9^*'Q2?)"4 N9T4N8\!(U&.?)W1 PUZ#IR-G4H/I+;PEXO PBS\0>'"KX%>)ARVHO(T 9HR/&"2$1%
MB)^4WBUN6N!]G!8:V-W#HQ'H\+T2^#242'@;C]F<@Q8!>(1\+G,>]]@==+&
M<;K8/]BO8 0@'!Z/>H,%NA@>NI>XV/PQY UZQS7D+;RWOV'DK2&2!JUNA7-/
MF:0T;,HIKD@Y "B 3XT"FXBH-ZRASJ%*6:Q[81(D#5SYI<4.2
M1MTB:JR0&=TI9.[+B \'QK"W ^/ Z/=.[$,Z3X= %PG*!D2+Q@FX'$
M+)SRY%(XERD&T+^2($38^(8N H2H0JF0B2N1%$@:D6"O/GT]>XTK'YP<'P;8
M08H#=>!MN$H%SXNYE7;T1(4/[[$+A[9@KP@UNJ?J505KC 2\@07\1PPM/1L$)T"F0SI
M14XDWGB'".D\;?Z+QX4F%(Z=P'@2 A3 2ZCH@5]RD$$+R1-]),X2%KR11 2"
M%>0#8'.69DA>WY"7X>N$A!']CM$"C#2QI=2\RV2?-'?K-P&)%!G8*W#\N%*@-I>HFDE2N&A;? 22))C!8
M0ND.:%6(!!ZG(3RUM@ZRT8%[P?:)98CK>KHM'QL7NSFT=X(?/=
MU) <>;WT;]%D#FCA8 E I9Y)M8VDD!&L,'(0%#C2'P@GC0MKCR%>M:<5(5($
MR7B0 "^2XU;4(N@(4D;U$1J+L)I(A'#,Y$9D]855CT&.RJ GF /URE 1LRU
MRT=A0FTI5W0==5\^7KK>BZ@A$1ND4 3#+7,6@A:
M&SF2D&G8"7:.UFD%*0M?"Z@Q6.@3V!)7]!78L& ,PI^SM"CM&K-;VN9! R>[
M;90/1O-IJT7OK8AS\F7@Y7D>DZE")##E9)* T?M?K;P;[1OTNQ)KD=10#[#,
MI];7(L?K9Y2?KA!#ZE4(;34P(M SFF0:W,#.[X*)+[*;ZR)D->=%R&?BPS@
M!H"Y,5C71(4P M(G)5 %1X3!UQ+6W!E452\F/D$DA)6 'AP7CCI:.C)33
M+I1UU-$ZQH-&(,J=PL$ "^HU1>$I?-59H \F P(B7)
M1K,LF*H6:CN&EES1[=^7V-*
M6X!M9[%':: //;.T!R&M[W]M5/^NGR$\#?\H),99)UDZ8VW))XUN6!^E+\)TE7K8Z'859@H 7S
M LG-BI5V/D%[,;6J4^*)-(5K%3[2REL7:#!BTCF3H'SU -ZXKU>
MT(4%F[K*2&?R?^N=] 2)#EQ.6JC;2[M,B0YE>W5U*.8 53$#>)85%EZHJLQ
M*&&?":Q7U(4:5$Z]LKS,WFRK9V15<3!+L2BHRN"OJGQS2]EL"9Q/0V\T#=VV
MP/.3G+6OT8:?]R" +0+Y;;.0-IP*/-H[5#FKDP+P +R T/5]2-1L0V,K-CR
MJ!A:*>RC+CYOK7/HHV";G=IR]$31E6UJR .^V8#MW1%-WN3 @UV5<.?H=;76
M4/"B;:.T;T3;KDNN KTDUY/%(VF;)\\:AEWP]T- ?4OA=J[Y'S^YA.=D0$+
M]KU489SB2: +>-6[. V >W/?V+LK ;*LW0VDQ174J=)= ;O!K(322B%:KB7
MR>CG%Q XC?/SEY@6< < =?Q>3G%V?X[6# \&1T>/0?1 T@:4 ?!L/1X,7?
MG#C%G T"*! UD.GOZ:Y8,-!CSG@TIT?7("M$7"\^PSJ1O;WB\!3TA2 /:,^
M#(^RE?;V13%-19J:\[P<.3UIJ$G-@=O#IMZ#A([#%'A(,JX@:'J(I$6.32M0
MC.NS5/H\/)L(/(G%DTL,FE*MX+#7[$]IQE]H8'/U5 SJE/1%+,NGQN^]&D%O 'C.@QH4(>Z[!^&/."CJ[J^#RG1A,A^FATR)A3
MKP5$REZ,9Z+''+NF8",I6K/$D[T #SS4:\^J:8@038EIX$?U>K@0[OE1-$^BWLE%$3Q,KGK/$!BI7=*8R%/#!E/W&\ 8P
MCTQ^QGUF\Q,M<>#5?)9F.:7%[@:&WCB!@M:;V=Y8^J0UPEV328^]7 EB0T!5
M'Z)E@KFK.XPC2&O$T?77#:V7/(N/:[Z/J*AV K/Z :F.8CZK$NE:!LR'?Y
M]UNO! M&AD7[V,A&X;]3A\/6JVWV9Y,6B"V?Y=B((E]O
M\/DF@NQ>D6\6 EY"M0L?7J,?!H>'#]7HGE\ZH=&]: [#&OVXM3:OU^C>Y #X
M\!J]0M)!<-)O;RC1\XOWT3>.E^'#HUC>1]]VG]!+J';APVOT87 P'+06/YY?
MO(^^<;S@M,;6VKQ>HWN?P^/#: 0*2<='/HO>"D2TW4/WG8CKM>B9X)-<9!LV
MAMO3 6+S2.F !^E;$'TT<,;G$@ .ZZ/:G\>Q&9[<]18#
M]VAJ$1H0Z%/':04"<^9[N.^>\<9#WT>]Q2/(SC;ID*IR(J8NK3/-&'QA<.B]]YT/LI!^6V0WCXT]F/
MG%YNL7?H#VA[/]#GS+K@PNVR]W42' TW[7QY-NE$:GFW=;D H]U:IMAXMM@+
MJ3;APROUHV! ?[^U^/'\TJ*<[FXK=7],N[5,X3T/CP^OU-W2K6#TX$-=GE\Z
MH=2]I X82MV?U&XM4WC/P^/#*W577 5')^V55YY?O*?>!M3XP]IM9@KO>7A\
M>*7NBBO?\KP=B&B[G[Z1P]HMUO/^O'8+D=(!/]*?U^X>SOQY[?4\GX"0
;/F)B>\B+/(TNV%AJG*%4\#C L=[RZ1F<>TD<'[0RO0AK(U;,GJS/H3E<>9#
M6(1V7UT[+',?I.A&S88/4G0/9SY(L0XB
M!\'@V%?:M!< NQZF:"M>OFB3 B%'Z'H&,)\A&*=
M208G)SY"T0I<^ A%AY"EZVS"(L-=LGF:86=]'YIH#7XZX.;ZT$3W<.9#$VN-
M?@Y.#A[:]\N')MK!:#XTL0&C(DTN62ZRV0\:%#X6L>VNK8]%N AK^[0.'X*X
M+8]Q$/3WAZW%X&9#$'YNXIHT^:.[[OCKYTDB>19 74])FZ/A&K29
M3[.TN)S6<7P?S#T!XEHJ)?\.C A?"M%UV7CAX/"RW)1+43*Y$BI/, SD?O^Q

M2"+%>*++Z5",X.Q7 #43>9$E.'\V#HL8#XHR&C#+J+O57LZ LS%74@6,9IX*
M)JY(.$UY#D\NR4;1; ;U6K<>#P=';U4U<3;-:ADU7EO"*S#'9MVR:7L-FLH!%A< [
MBB04&3 9R$Z!0V!5&DH""/&M.4B+-8GX//@#/^(D7G/L%MX>295G;MF
M,^5^\5K\8IXJ)<
M% D,($C N'Y#CN63)<9 ^Z>RBA'W%K\7:=%'(% N**GS/@W 0^-2.W!\TN@
MK34'N*7L ^GB#/1O)&:)G,B0UP,LG9<#$FV&!&X-\P(H L;(;R1;0"C\,1>)
M0N8PM.V("$U[-RP&>A2&)(!Z;H ,;D W328"QT67-\9 HOC84&9A,5,Y!W9!
M%:&*F+ABDJ4S^#,J0DW^< N 7O78WT4B,EQ; $\-I 7AUD1 L$DT
M9N7R48:3RMH= (/(-+[!-X-SS3.&;[F$A=^H7,QHB#/'?2E8\OB&;OGT]1PT
M) @0#JL8\QAWP-14B)P!LXD%JTS?K(@],Q&FEPG@%.3@]52 =$3-'2+W!0L<
M!](I5$*@M?(]5XG D>W500**%I
MWS))LZ5M=:)W*K#F&V.?L7A-Z&E5T5
M;!NEF+N6\%9QYBQ0TUTD@#O*944225X@48Q%?BV$7:W,-.F5L&DD./@R(AU'
M;"RR3+.@%=Y$D:687H*B50[F10:?Y3JM=.=J84T& *)=".['.M^J5M:+(F@D VW[,V,1K@
M ,YRASVTRUY/L5\B[+BOU7\ =OMQ"7:Z*\>]DW*:5
MWA67Z/9G:0C&*Q 7$!;1&9GD2,VE,B5C-$(N 3,4O@/R<&ZS!GR:P9^<6J(4
MF2I=A'&A@.25JC,XBOT,91<^Z4HJ)"H=1T *UC8L*42@2E@^@'=:"?U2/%?7
M@J\ PA6O3ZB*)BH%7V5%U^\ IL38!F@AE28UIHEHJ4I42T.0H(0!2P/%0B:N
MI+C&=^1T'CEG?X!!FZ/98&#U>Z&,I92)25QZ%;!WU%"PED1
M"^+%@&5%K+'!HRNI99M&%< U =^&7@'P("O*4?+P+?E0BLTUADFF4

%TE6)$"Z,2;(
MK3DA,\=J19!IE4R"268SU:M6A2N8I&%1VFT+,-!&AC43R(P!(OHF\KJGH:%@
M[2NR%"N(P'XJ=RNO;UE#"YZJ(6-\!N*''ONWT H\3#67X H*9+G2;G*>A/N<
M@ [6/AV>C-0ABRB%U?78KZE1"?J1)&#'9 O!K9<@8D#T%0N27>I@BC5):I8(
M>G3T1UKDX$*BSD#7C">7!!0=P(#[T'/4%CP\;9X"4?464D@F.?37OQ1J[Y+S
M^1LG4W&:1&>TETNPN:50[Z4*8 *=+H#!WL5I^.UO? X38W^U]W[@&0I+]45D
MYU/N7,9D]/.+C I] L' ?X+@A#\]%5,?GYQAM\.]@]/1H=' \%0:' 0']"'
MP7 T>/$W7*59Y) U+4@S
M$-.FQ#W\48'AJ28;7E,*LPT;(. "DPUO)FP*)LWF1:X^9
MD(;4LGS/G2Q@'&Z] #+.6IY4!U)04DI#$HX)*M0RV!\@%X7%9GE'VO -?0N
M?" CXBY^;>N&:FZ';4BI,RO:UB8%:R(,:X;[71@?)=MO]Q^ 7D XKOI=5F&
M;S0XRK1">2,(-N0?O3PR\JZG,IRZB]("(RN1R[MC9TWS2^6@;)*^HV)@5!(
M10[MD0%4D1S]AP&K&/T<]HH,P+1077RY(O4UH7
M J3Y7(DW]L-;9DN&W4+5YDKFISZ2-*^,MNG/S %C,L$()5M+'ZVR:'[P ZQ3"O-;I(-*\
MUFD7/KS6V30 > '6*81YK=-!I'FM\PB1SR?/06Q[Y-.6V/-<]U6ZY9#&AM,*
MWEYH* QW2I*MUQ-Y$VC05L NMSQ^-3P.AON'K<703C'*Z]:BP>L+SP9>7WA]
M\?;543\X/EBO1[YG%*\OMA'L7E^T"Q]>7[07-Z\&P;" W@ VSR>;4Q>;+*%\
MK/.?]\+18-0[:BF:WB]T*-+MU98[$%78W$XX-/78>8SHZN/2;1M.Q+8*5^U-
M'OD9MUW#63U+^^-XVU(;:[@?') TVR$.6WB&9?,8>JBC[E753HH]KZJZAS.O
MJM9OQW<\' PWC4FOKCK ;EYOM1 I7F]M$\Z\WO)Z:Y?8;9,EL[=%NJ.TP.CN
ML+WV" [A[-.9+[OV RFAD5OI+01J6N>UGD\Q&ZG%?/J
M8!0,1ILN]EUEP:R4ICO$BYNNZ/+*KE-RT2N[+42J5W9;5*GLE9U7=EW 10?D
MHE=V6XA4K^RVI\S:Z[H'Z3K?OO;YT?%>).E,)KZ!;7=UTW,W=?+&1.L1MFQ,
M>$.A>UCOACJ%,*^&M@&+7@VU"Q]>#6V:'[P:ZA3"O!K:
M!BQZ->0+>-N)K' 3TT3$^)7(^*5@:@H;5JQ0PC2MF,V+7+!$Y!4VMQ .C7TJ
MJ+)Y+C(-E*8:Y]V#B5O4'; Q5S)D/,%.)S'02?1 $>RK 5JH%Y^S&L G^[N"
ML\:S9MXH74#DP4'0/ &Y /8BJ#69;40*5YE;1/.O,I:!Y$GP='Q0ULF>HW5#D9K:]?JG=-D[QXIEOL,
M?<-V#C>=R''>F:7V9LBCC+QH3=6!-T N.-#5[YT\M%''4[<:\^9)JSLZ>PW7
M/JGH-9S7<%[#U37=&EO^28^%N>54DKQX C]KV?ZIM]T+.A&* BFOV-9WQ9+7$;WPEOF X;^(8
M]Y4'O>'^3QL!\L54L$D:Q^DU4*8M$;\6F6#B>Q@7D8C8)$MG+(?K=,4XSV6:
ML'1B8\E80+Y43ZWH!CD#.LWQ6IG@P 5^31592WZ=5K$$1O##4DN]^B!\DJ\
MN0.F#T+C\[:B'QSV%RG#)4PB69S)=[8#V^9EBO'??=(7G,*YJG39S\^.-31/GK CZ%^;F7Q#EB,
MSU#P\I &>GJ4P*H #H"3 ;#E!NL(]L%Z66\PR'.QU*81^'^"
M9^Q#@BKKO0C%; SJ:#0(VL%@SWA.<--X>)S2@!W52UU GE=,;41)J9B&&]5+
M@\H;NM.8:]@>MJ<[V:JH-DNY!;.-%H1>%7<\(R73QEHE(MZE9BW\V@ 7?!K%5
M=2Y^P'GK$;9X-YU.29+
MY]@59+V0H\]%MDVY^,3(KN'#* O!,#A*E;SS"[QC!>@7A^\/CP"L11((-@
MO^]+45J!BPXPC%<@GA\\/KP"J9!T' R&1ZW%C^>71P@T^E+&'\/+;\F54-AC
M.(/ 93+,[?EO5B1RS0I'GUMLFW+Q69)=PX=7]D?#3?=\\=S2%6[QVL/S@\>'
MUQZ^,J7="&DWUW@MXOG!X\-K$:]%VHV0%M7G7)IS5>[#\.-ZVTY(X.FF')&QA ^O-(ZJL#[.;U5@N1XO76-N',ZRVOMW:)W=HZ[SA*BW$LV+"W* KL
M(LUYO.'LQRWVQ<[AHP.)P N/MZMAT1L@;41J T%S"W\ L=MIH0SV@\/#AQZ"
M?.IIABN%J6=%K 0\4KS2VS6D>J7W*)@^/ R&^P -@'JEMT.LZ)5>"Y'BE=Y.
M(=4KO4?!],$P& P?VB]M)Y6>1H?%QC*Z-AN% DO. 63E59&\>@!<:F#XJ;;1
M"SD3BOTJKMG7=,:310J]?'6SF<-XFU9Y9++BP/
M>L-]<]SI-&'PI;R24<%C=CU-F1+9%1 C5PR>Q=()RZ>"G:6S.4]NRAS;T5O%
M(IF),$\SQ:;< L5X$M$#Z8 T.A&9FLHY?)4+;$NAX!/[D,SA#@' %]GE3< ^
M)6&/?4PS>M.-X/!$ 0N-V'L1BME89&PT"!B2%#T>/NP'[JH8O PE7,1>#@:]
M$P8@C0$U=/'+X^J+ #MCS&%A\DK$\%Y8RKS(0ER+8I,LG36O#!\SY1%+G4:^
M>9: @BK/7CT5S =ZHCOZCWN$M)*=H98(HC*D;E8N9HOOF61H5(;"(
MXDA9F;@222$T8>JO\A3W=M9(D; >(:]-"F>X%#R[00([#%@HLIPC
M.\!&923A*9IP71X3Q-2H4'*4*F&!?X3PC\S9A(Q2\S(68()'8M\RG(
M"74#3!$"3>(3QSSY!O(=>+V8(PN]'!ZXS %K"$%,R!SU> 74'KN E3AOD4D8
M%Q%*H9?#88V[+N']E @R< 4->V7%W+#]K3\^:/YN?QQ\/9U $\;.0^##<]8
MG/*D]HP+ /87^-:]E;B5H[BI;H\%;"/#7=?!=*.WL[P6>LC276,0B/!+)54S
M \M?/KW[ )7]?PQ "'!5(*#GJ43 3XPHE0E "\1M/@6<[*%@14&6QE/T&J /KU/] OTDO<,2
M4K0'=>LF#OH+FWAER$=?,(G3E(R6+CN=;D6F<%C::M:AZS8S3PN%#MTTBIU$4D=J=I]< -VLD
MNH)&LPU:C@'\7ZGR(2D@#ZR,Y#(%"":IZ@JY/ =V@^; /18(6)[C;8.W@
MZ@Q?Q+1RI EPV#-\-;QG@IP92>SH-BY(J])% #L#]8!\)*GM&QA1/2TV%[C3[G$C<&++Z
M#,!09 YG0+HQVNX'\0V
M$@R7$Y)KOP 53:L]>0U.<+S6USD'A2/ :XH5E N\[6]#2
ME=ZK1241U;F8YUI8@J <&D/[=BTR[T/?FK:3KE72\AJXVQ7K:0B.B83\K?>>8]=HH /8Q!#2/AS?"1\
M0)*G"%(%2-?2 OIZ9YA&:Y8VQ@6RV(*#QUWR:*A)5$H,*
MCG$3.$SY$3B/OC"L[3Z$1!]1?09&*EY=P<3*0RU'\YLY^%LQ7@N:'(D%'8*[
M[G7C-P!:(&T2$R#U?D\S!*;9U%5*(*N"B"@\$BV%0)# TRE*Y$%=[]OQF^T
MZ!/?I8X5T3,()*I :TPQ(A>TQA
M(R3N6"1XGI\20G,6D>E(%)63*U"*9P# Q +.TXJJSM$)X%FDV+L4 E=;\& 2F7V*4E'CH&!8"EH?Y2^T.(/ :(,E)-,-">:)07ELRA@3UA :GXU
M>%UMAWXG"Q]TEPDM:A;+Y97&.!(:+9.>,$N!&I2\3 A"20ZL+6%KYC:XK!;=
M!,,G263.LY@D$BK)&B@O^4^M<=.8\-\H=EW[H0PZ6%C'B/R7.DO8@D;
MHV5I^5\1 4KCY;&LDLK&^2K" =,JRZTXK9?PHK9G#<3C-F"3P=-U'.2CM=
MIC9*5%K1%6UFY;:!.O/46B?TL<@R\I'TO7.'#&\EV 4(K1[< TV)SY,/*I~~;*G6L:CF@*3S(;YJZ3>91'S#%0D+DO5~~
~~M4.3*-3K6=,#&14ZV'JJ'G-A/VT#5W8L["L$2A,\V+(X6AS7QJYR>?HC6QP;J~~
~~M&/=+\E3;\ AKH<2DB.'-5V:-]ITT$4*G9-$)6B,VI2$;G@-7@MD)XL*D"A")~~
~~MELC-I7@Y @2P!%2Z@>J($ED0P$NLERX)2FX)$A%R")RA!3#1"G81I[8-U@~~
~~M%@HH1H"54%FYM4M79;PQTX01,GR2OLW:2.6M#D@Q,: -#UAN"@2-N"3+"RQ>~~
~~MD2&T,!!L85N':R3&Z'*H/"LT T0Z&VM K(--D=!$7-V&WXD9.4 @&UQ7Q7%0~~
~~M7)X94 D$FH(5C<,#IQ*#TN048L0;R+0,@R?D8Z6%,A%QE] '8%B)*XTG"@5R~~
~~ME2:X&K#3PAQ)&)90Q+DB7PY<%8"#29&G U8NX1RFS'Z)\?"G4@P91Q&<4!U[I:MK"V]MTEPD0P/HQ32P%!OF=B$A)8-92%=&J178^J?E5~~
~~MU L8#QYN%5F"$35+*80%P4'(78+:FI-" B,#J:VD+ 1S17.8650FOZS8*[*4~~
~~M0.K"1>KUFSO]11EK$]5R-N4?'-+=*EXUQ1! RB#[):Q#&6.0,IEG^; FKZ~~

[illegible]

M6H@8SR+W\0V]CM@ZR>09H"V8V'D=,0A&@^,6(L:SB$\9;@H=GR[.?):P;?3O
M@TT[GXE=5];#P^#XP,=CN\4B/MFW-X+),T!,,'C.N+X(#@Z?&G,GW-(R-VY
MEI&%V@HW8.#:V.BM[-Q'P-?SMH5'3UP,KGH7$[G8U#<(&/3H;=
MD9<[Q',MR*QZ=>,5V3:BTZNS[51G!X-A,!ANK@%-I]29QH1%Q#*F-NL[=VO.
M[IV3%?0@AJQ(WM@?-@Z0LQ,#+\3RM-QA?X>FY98]V#54*G"OW$@CQB]2GO.:[E)?R["+0+.1%F<"K.NS(M[6G-03F2E<;8T"1!&E1D6D/I*0)V*WB=\U@.
MJ];+-P/Z:).HLVG-P)G'-+Q)3858W-^-+G0G>>W<$-G9PD)5[]3/-WLR-QV0
MO^SHT3&-8")I!9&&QB!:]V@FSICGZ)9R+%HU.]".#48(TOG3+A:MG;EHIZ8I
M-G=4Z#$,-)1!(U$/$9,X-%:/9ZR??EXYON5.]J^/:P&22"+>15^R%!?Q;Y[A
M/3=+8-Z&@UT:U6!IP$[#,"MXU\?]U>;$9>F5Q$$JUW:/2F17.-]/$-\\!QM!
MS\K5/#?GOZ>9&9D,'-4\21N^C-R%-MO'L9V41G?3*!18,[%>)LRT8V1.&LD,
MW%#-DE'P@)(L)GS$66-9?;:WG$ED&[OHS@\$^803F0!J5\GA8)RI@M.0)%9-/^?%-E8
MJJF>K$=G>4H*T"@LU\,U+]#LZE+4$P.E>]%TF+@N@$<-O*-1-*;-4
M!*5GK1;S=/5LH;S.&4E#@\7*B5H-F"GHOR!=
M'+B#4E6+4!Q/AT.\+)W6AL%7BZU/.--;JX^MLU@#F0T\A1/Y5L/+'?;**W8@
MEL*K;E->81TIP">K3=&\99;9K4KQBYT4MNIN=ZBM45-F!+9-\?"E8-];;91
MTP#/-$>/+6WZFJMJ3F'3B%X$QO)ML(*7@]Z-2-&N"($QIM^[Z3Z@C#K#CR@
MP6EV^/8^DK3"P>J@)&-X\5U&]:WZ;V$Z+FP9>4FH3\"H,SUMCBCO-(G,G8-J
MNI5O5BG/X2XI6W-2$!^T@OA2G9ED%0"W2)]>EIM"+BM'CU7GMX$8@5*-W&=@
ME,Z*65V!&C7=$?<5^;&(R037EX-FM.Q?&IG&L&4X=-;R:]EO]?0R$R2]%JCA
MG0IWX?1",LN;]#<.!;2#;'':*\D?^$>)A@WHA6I=/A:H>'@XE:!?0.E-FM2T
M5?E05:%$V[=LOZJ(G(%E-+^%^BR-W,G51QZ<&+P[A
MN4/,FX5\-902=1-.EOT^3\$]7&,,Y/VD7EUDOA>9O*)1E[<%(4:[)!TKD+"/
MY?#53V"-9-5Q+MLBV>BXTN@Y1-76I;-A0[D8"\P#&P
M,S#E,4-0.\"C5=O5=M[Q>2=@6;@5..V89ZW--!J0+%#,@$.P(4-PKKU6&F<
M@8P#?9FZYG-TF%)GRM=DG1ZBZ5Z>2?6-"!-O4S=F-G.DM6N<--,^@XOX4!V['4(E:,E+!)^+2"(N8P@@?WR?
MFTFP>E)Y.0U=!16#Y6=SK<=AV0*N(%17RT0H9*(+7Q#=^-D
M>3V$'>$QMO:#=P>,LF#>\I">O6E^MAY?#X**6G:GAJ-G#PTG1";\D$UW-\%Z1*).&/7-NU
MU,2D95MY];;:58?18!T%HL!&3I%B>G<&4D4F$,*K)O-'GG77PL.U!O'-9L"\
MF0N^Y-*$%4$M[[^9BJN1XU/0&["*&J33R03(EL-0UHGU5OAJ/#J.R0W!KD0.
M!'XL&E](?$-R87&XND(9*Y,"QZ0OH@G*U\O?@2V#90"EDN4I=>-Z97A>Q'-D]\%UDHP2UXBW-!0^-I
MGGA?W(45-U44L7P9A:R6]4A]IWP.$-.EG(/EP9K5@6*9ZZ-9;52KT25-HPBJ
M,!&5RLE90"9FQ,G@'5KA%]Q"?-#$$-P2=%A1Q.O8WI%>/V[!O6%)!NAJAT&..?:JYIU;A;PA=]=><)+B#>GQ;AJ^G8Y1F=%0&M\DBS.<2&-2DRH'9WD*
M'(YFHM;)L)/"I&@PXI0F5V!^&9$X]Q3?*%:#R:"61&(?^EF);IHOWX9/R5V+4,XMP2BZ^XK$KA
M@@!<4#VN\%VTTE!@&9I8-4.&(7DMIM-%/RV-QX"@2-JR1G8-Z&AQ'0V2R,1
MWQG?61VBJ8=R/L(J-X6+-#PIXQ9.V&(Y8;R-2U$=A-[[E\5A8V!GB^(ZD9@0
MJ3J4:[*2XKOA021"HU2NTR*.T#P#OA-9Z,*)*D\&'0TOH,^:KIISB69=WKI
MY-;%KN.';X7[-QGS!^!HL<""AY=P9[-VDD!956-#1
M=:;-,S#<(-%53N!J1H4VQJXB-\B%%04T*HE"E33RCT*G"\RM+D!I]G/^7-))DSFAE7RT3'WQ,305^XLDB6KNVQGZ?G[S!2#E]*L'=0\N53\"?W
M0*2X$0LPHD%J9>%4.R]H%\3:Z4:-N/K,V34IIDD:HP7[9H',@.69*%;$RL&J
M\)!*[TP)X\\OL-Y-Q#CE$D57^;>I?:2-#;N9HL<07L?G2KRQ'}XR6^/;=GMR
M-1^/-V%K'ZAOTY2^7"JYNE*R-0&[D.+QYP/-^/&5+T]OYF!(-:?5Y=!-L-@
M>+3^^CN"F5^H\&)0F@G#MY^2,GU6)#SZ05#DM?U1I&@5DQ!4VF,@U:]%GR)V
MU'GYT+GQN7+%&$5M\D:1U-Q4IQ&VGFI8&\6>B&T7QVE8&,65N@T&PZ&!?7RQHV6I5?)YZ[/$#-,!E.A1U)6DKHFA6'JW+)K3W2RV,>?H,5@>ZYY0&#O6).]3#5\B&I6PJ/#G8I1&4@
MPQ&O;%%(RBDURLQ&;=:NJOJ;BTP5G+(M-@]!8&9&,VY@F6'-U>3&Q!=)A(^9
MM^X>2,1P7Z8+\"D'@O%TM'!,F;Z3^,Q&004#@4Z\50^A^DN.L5H=ZI+(YM]-
MVLN&A0WOPG>OY)5&,UH9(JP7;L>FX-Z*-5ULSE6*3[E!G@.9';U5--1,MNZI
MGV'OH2I\2Q&4)7AW=1R/T+^?/O)J-<3=3O4P1V[*ZF;V"(HRB9**
MO"?E%52Q;PN2&2]K@X/Z%0WUP'-!2MQT7EO=LYBAQ,DM^"58##H/+Q.X7I(BV!RI(J3U[*L7A0F6.(SD+K9@'-DF]A,U)(B>7V)B3
M65'PG$]E%NF(KNA^79TK#,=88T=[+,5B"4J0'@WUXEI8SE'^-(IOM:4%A]="L![U+IPHNXDB697:,
M\H\HBZGS??5!GG1IZ]BJ-F:-[->-!ETH.
MWPB>J=7DVW.J^I9(=HH;J:*$I,&[0
M>,;)-UPY!QD1-UJCFGG-S#KA6K=23<:E+H4K7VGK7BT]+!+DZ6+U.56=61[2
M>*USB-M")!LLZDI-?72Z"G#7A4DBFE'%8]34G*%7ZY).%M'4>S]*H;A#@%W6+0(.3GJ%QUV1@
MFI+F4)NX6I1R6S5K"G!!W.0DBNA9ERGEK*L2G-0:GD@EXJ9*9X)^'2EG6T=#
M)YFI',V><:-R\]5V#1U$(LSTZ1*MB9MR;2'31^JK#=U*Y2Z0G8E;4-NAU2PXK\YU-XI&!JU2B\WCC;,>A
MY^5#;0NVDJG:J&ZF[@"*A!!%M,F#G%D.U"D"GA6"*%7@,E'9%%D55V!A)F'!
MDGL^\4R%^16A$85%39TZ6-X+=MT.-9=?QM1.>TZ0]X!%!"L$H-BP2QW)G("
MHM)-IV$1CG[FGIO5\+ZRR$O5J[QNHY@FQ#M>2DE1E0F@"RHO]!7..R]\T&VK
MJ-]=5E5W[JCD/KF28,\AA-'LH<#B@J-7!,X>J6W=/7:/XF[]O[K'-BT:O"8;
M:3$*Q*Y4>Z%6&W[/J2:3;'RJ]$6\.>?3*(-$#]%WS+D"V)ATKGLH!!YOQ0X=
MH)RD;AT#%IOFN8C/^*4Q5@'$>S8;94^/=9XP+A:$J&,'D%)NLL-I/[F$5JR#
M!!J9(%8-!0)S5.S\-8\7X-H-.7N#-+LN4-ELFAX",(SG@%?M5G
M-ZQ*ZJUUHQ9,HT*)21&7%OVJ:-0HP&%?<[D]S&9&H)T[Z:'3JI;?G@&N
MP0C>.P:9UF/-2*^!F3),+B6A6-2,%R2GL"AO15,MGFEX-*GR*I=2^J#E>#5BU.Z@):O\V&MT)>TX%OZG%H
MYPQ+1D**5Z6-J$U*JP9/D@&S8G4RD"W8/:IL^F*J?%02&?6BSZ!GQO*U>U-&
MB[\5TFW'87=UJ:9?BKR1N8TYDTG'/.38+#.%V\R*>Z
M^108DLAIOQ=@,T22+@IL+ZN(GAMIX-2^UFCSJ0;J#:39&-Z!'I+6-E5-$",E
ML2@/KBI89FZ%,7(/N(Z=U\E?7%)V&PQJ'-!<1(R9-1[2V5]#'-&YRG@"$4.@
MA)2FCB<5$:%\BF,*B-+-N-&,B!H8N8MHCJ<9>8A--X0FY.H=/A1#SA'T^UTOJ-IG-T
M!#WZ/@\D.?D21%N]NZO*\)VN-6BG#Z,=+A)6.$=YXY+-AW81N[:)-H$EW'1)\K-G)3NJ>>
MJ]/%,VT?Z\-.Q$\:F/IPWIRQ-3-G/\U"W;I+]V]:>^LIH[-4Y9\GYXG2
M6^HV#G>I;N/,-0UD'RP2=%"(VJ[,-D6<642&T/2=T0A5F?U48J]&M0*4G23
MV5I,W[QR5<0IT*$M/#^JX^LS&-G\MWQ&4^?@@+T:.J]=O,5ZG5JZZ$:+<,O(
MN44[#E6<++-R:R&Q-/2N4@HD*<[-6I!;]I&;[5A#LYH'G1\8$L"-
MZ<8A?$&M:U5^2Y[8=1<:H-]GI[%**].%=&H"D!:B9-#=?L&2=169*/MGFE\F
MG&4&VI/\[R3U@5V(JPUBPFKBHVJ$N\-12-A-K=E$4388%%L,G$$D-G0[3LJ[!W
MU5<"G$(^$9@,MKUD:.U45PI&70,B%W!5HL<<3%>V]9UI4$(XVD.;%BX3>,P3
M G[@KW8,01*@I.%[8A'T^M#ZHNQ=;)0V^@B.%)B<)^N^QY#LE!X=]T/6-'9<#
M>>U%SO:<@-FZ.'I9492,LL@>54/&)6+303>JUZ2UUI:UB,$[FF-RA2/#I)/\
M6J=692Z6VFH97QEK([3G>9-"79Q\G]GEXO@$\PB^]#;L@GK:[QU774]?#@Y[)Y4-5HM@
M'/6.&B,9:B&$439RIG-W;?QBM!"-N(M9[F""A=$'V-#E'1;JX+8!?-2)GQ3<
M/DVB3]8J-Q(#LI;[6QSO&A>=8V^8/0(6!$0WM8PPY(%5)IK:Q6P>IS="F$XZ9=8&+^BQ\U4/Q@H1KP'=T//#I(Y.G9
M&,;!XV*9#/.RRU21(+NXQ6)?SW]3M6(Q??!LKR)-"E8BF*HQ%8@[->%E-!D
M,K442A%#*O[ZM78OY,}AP?W?161$#.DQ177Z$?=8OB=[)+*J@.)E5-B>JE@R59=
MUW'5]NN*-YTXX,54!)3%O6XA6G6A,1\3:D*K$-5JH?BQ.M:S6/N()91&V.G2
M9E&+2\I\Q7$/:I@5/8ON*(D
M"4X"P\9YBW,.&:YT(83MBTGQ\3H.+7EK&,,/H->->:J-
MTY@"]?4>M';%]:)-W87-Q;FNT:7D+L\U(=6))ZJ?2')Q&&^,E]1L69U0-'\
MBO@]A\6">BWRDEA26G!1)8(M^#>9=:>0DN=.;EOO^/9"$'/RAL=A$=M78,G"\7+1\.+J:Y*H?B3",&$D*4]N&LO>1D.N9*<##0YJ'*JU^7(R
MD[OOHVO+A!8#=-'2D-(X!$]A3FIF>[[IYO2X#I-)66W19;ZVNJ&<G@O6Q#H
M%G/5%T&M?3V"I&P)7))EYR6'JRO*0['5R*"5G$[!;)0(,UV!-P%E2U1>Z^D#
M0H":5NL*^I+-TG@A@DD-E6$'A>>-.0TDLRXM^;(TJVSQ;ZN(9MT,8EI^U$Y
M3Y=D)V1F13*CELUT*-L)UD-";1(L-H)A1NK9(D#F+)F<8%^ZL3I$^F""-Y]M8T^>I*)O&VUT35-&-6R=-S>?J^#*[^F5SJ@68TVHX&GMPNMWANW.2/^>U:N,:;J5L=(J,%;%USK8H
M4S;5:%-*6U:+K<:&UNXU0:/R0*P19G?.2%-^O9QUF]3G:7&M,,TX'BJG=#H$
MU#HI5[UPYJF>5:B5MG+3^Z@RO&RVGV,T1"JT4'6LN3H1JQ57&74V)>9#6UE6
MRBY0E%K7J4J.DNE0UX0]]H'F7/+(5&;KB0HSF=MA(#J:KI](?9"2!(V=;D..
MH5:=*$;9+-LUZ.>OTR
M4F^/PG'W!%:%R:"A79T:9&!(G*T2XW,J9/EXD[VG85/.>;ZL90-
MG\D^GF-!E9OG8E:G3$7G-+J-7BL')&W,!Z'IFQG"AV/R(6ZI09FY6M4J*G/
M*;E<\G(+R9GL-7B^/I4+\+>.D@Z?D9.TEG6-FD7'-'"GX8X%[-J+#>LIEV-.

MV$]6O4X;)R+A.EJ+&[#SRS5SU4MPRY$6]>6HI;DD6.V0*=&G]N#&5\:#([R\
MNBIGIY$U>2-T$@^9T6P+BDBFY.$\$Q2"YPD)#V*CJDD.U)(;],Q-$[MJ
MR*6-3-UUPZ-31-.*#-3
MTUR?\K)'.94!V^?0I6X0&'\U$]Z5&4QD3Y-;35-$BAJ)73$GU-&$"R?T8$WF]
M56XG'IFXK;61B=*6!]1US-:.-ZM#-E+QP$0B9AQ+@^9Q-O>#Q!O7
MA"O(NFJJF"L3G,E4(-$-PR4$$ZQT5(TFIH&BR?1D!3L-O7[
MX3[YSF3EJIC$XKD,2EIJD-JK5--.Z$0^?C*#$X-="E[48$+DI8$".#['NEF<
MK($@ZGAHXV/S,"9BFWF*EIINWE$R@<,;>D+5-IQT2P<]8]268U?''NR@1Y*A
MMJ=MU>+2VHG&,5&FZY=[B>8=IPJ8WJ2'8E5+(2ZB-Z'58V:,DM@8\X0BVR1-
M<<\R+QQC!<<,EGN@LF)$4QIM-!9/G:'"L4D@=(3)WG$GK-E'+1/-P=5??\(&
M,22RGTP=-\42RF^)}1>'2$5G[;0(K'
MLVQ!D$BY.-K'Z>BFI6IU"$ZYM;?V^GJG,QI(5@O&ERWEM-E##5?M
MD"!+1,J=?*<5,+AS2QX4X@;P+HB=J.4;6A,-F=GITD6>"QT?$)E^@AY#AF;^
M>Q&-?3/7F:P^/R+?49-IXG?5J]G=U[JB,D6OKHVI-#ZB.A^H$TJI^'!4;
MVXIK8(@S;.N49HGD-?L'O^92!N!!9#I@5.QP2V^55-V3=6,\7]U60635+0T=2(/7W^6<8T-(/RIG2^59ZJEZ,-
MYRR,2*[-X-.5JDNKP"W"G9A>6,JKN+8=-GVJ\QE?$Q(GJW,N$8&9Y,N1DWO1
M:7Z=+5G,M-0S,4Y^1Q-B$:L3,4[:P/B-=TNZ"V$M/4(D0-51-/S45$F9K)>@
MQ'/]>B(/[K;\TB-[[(!6N$H'^\HAN*G/G6'-&*D,)4UZMU7'=KG+XP1QNK$.
MOL1E/R(-.0RA8)6++8DE6&JK0.JFEA34;TKL-X9GNAXJ^)34DK$-8E+GS-;W
M!H?K2KGW)A^!(/^WTV3I'UG@:*6>SF7^XV:Q[+WQ1O7'9;)G4IN59$$:L0-RL@
M7M8P2K[/]E]7UUCV&<0-OQG/?GD2IG\-);;J
ME?[XA[8N@<\;=SDKM.IYKO:9G()[8P\$B1$>6I2Q7O+7VQV:P]MH9I9GB^=
MEN&O-+V+P[E^"$WSEGYR7\X6YFZG'KVJ.ZV^.G^L-4$G#;$HGUGTGE^G15F9
M\Y&4,]-N&HHN1-L$RZ2N69=-T9-E@HO2$+-P\UK^,JB,U[Z6UG==))^7O-J[
M?U-KZY>=['0Z*PR\Z!,\^$U5V8AR1I3/3F^9$\R<$YZ;=[R7$WRS[6'SP6$7
M3[WQ<&YPGM0\S]=>?&SV.&X4\94NSDD;E'=FG&=9N>[8:MJG&
MSGY?SV;9T"+LXD'YEH]B^/PBN7DQ7UZ[6.V/F$^N+IK0SVK(7M5V7G*O-OY:
MZ-ZRWWFR&=S6^GQ7PGZWBEY,@UO+>$^EL.--$!DKU--.GN10?7:1B'8-3YA?
M[<6^KE]UEYGU]?,N-/S!WS7J>5=5JU?.OBG-6,\&
M=LL\W726IKM,-/OR[G*5698L5\.7O;/$72RDL=@2.$NB*B^OG"1+HJK,Z-JA
DFM,4OY5=!NKBL[B-XM"QZLM;&6.7Y$7W4OQFY9G/2SG#JMZ8[5G]-OOFI[#,
DAGGS-;&M9ZMFGYV52$=YAO/'H-K/I\!7+2$-].IE3>MDH-.;.OJH5TE/-8K
CXIOU+(UU4-J$3'[OXIH5Z?MX6R\4][50$K[-R=Z$'8-+/+Q-MA/=;;8-7P"
M>9FWE]U6JXY5^N+J:(U5L8IY&(B2[[-M/3-]I]4^O5G>8-7'JG;F+)?P9WV;
M)!52+3NP95+;[/"7>&#G)B\K>*K-E6,FIYX0L2#/LEJEW-F;$@651/-Z^.
M=I@$R[KGK]:-$KFN\VJAGVL'02S*\)<>6E8?GQVZ//O@+R)TGJINU@Q^J3E-
M-L>70=\K,P36GBR:^--XPP,"RN-:JG3K*DC/-M58":@EU&[17YCBZX?GL[]9
M51ZM[,(5V?R0\/KE+*Q]L<5FUE&8Q88'5UK:4-7+RHLLRK^-6-$,HEDF996H
M9Z6.2*RZ=$G-NE9'0]3"ZU8Y/\F/AVW\6*:"-R-^
MGAT=MES[O2KG-\;5+6EWO+1JU8AOZ9),:TT
M/I-"6);/KY6]F74SRZ(3U9$DLUQX\;P5F?A0]LNK1T+VGU4MRP;Z76!-L9N-XJOIV(J-G'^^H-RS\ROXQ9#=&RT18-^$PUF]D;N+4?7I5,
M9G^:78,[Z/6'6\[G-[N@6&F?G3XX[RWY95"I7>Z2?]7^U=6^FMW-]CJGBR>B
M7O:T?+-^B)O-H/"4Q-?9]/Q!F,L#&9"LGK,?HP,0^2$!J[K55-\PJ-\K-JV1FROMFS=B-;M-RI)"4;X/]7CO;?-3#:IR&P
M9^>B)YGS$V6O+^-O>^I/.RRDEW4S@B^I!0-&1!')TIALJ;YD6;V!MT)6-O-&
M5X)SK0B7HT8:AT@;"82?5'Q(4V5)-1\'

S==3A^^ST#,\J&O67MMTG?8M5B'J$>)V7H-
M8G]N>G8E',OP!FU'M?HOO3(@G+TMZR
M])21-O$0'J8>,WA8$Y"6:?1'$GR,+*"NY[Q:3F]-$,W#M-=Y>9\]9W:1BX0$
M8-0X4L"P$OQX/\(:&J;9=G",I6!:XUYXD.XA#1ZD&#!XT.-;,OK"@GRR!&$!
M:EBOGN)0(,3!DQ0#!D]ZE*;-P9]DRQ!>!*A#-EC3Z52Y?(EF1V^Q=.O]RR[
SW(^D9T6BX$KU?9'Q*+$8]8'Z+3$FX8E?OD5@J&5\0,#@1[-P;2*(-4,;6A
@"P@"$8--]$3'-I$,-B$$@\X2NU49K*4H!I"69S8G$^#]>?\##W)L-;8YZG4
8ACVB*C'#'M$&N5V.I[1M]K.,WA6$Y-CTQAZ
LK-@/4X\9/.PTL[@P,AIRZUS=5<*[]G=EFU8[]Z>S:5^6
^1'*LA("IL"*XX$.6434I-2UX>X6]&(>F3T>>H9GHK(K74)DDH$2+B>
AE#A>H=Q/:MON*[L72$PO>ZXGIXZ4B!BP@8UA-H;)#*$#2NDH4>JVGB>>G90
'+-O>-*+!F[KG&P-HAV2H-J)8G-[>@$29@>S@]FM3TJ/AH;KMJTT-;,G$U?)
FYV>.H+[:2@]N)-FJB51BEB7N2^:;/FI(+QKT2YK6?!L
[4:OP@G/V!-\.-N<3/SXX1.Z^YKG5-/XR[2(7WV>3=:^3Y/)N[]SGL9^=$ED
XHIXFEV5-W$EKN)-E(R--?;G3XG]6G[GR-B6!T7$/]U?99S[FX5WU
\;7OL#!X??;^+T'-=?IG;"PN4-S39W[S^NRR-*G5]T:.--C+-BW7M$RK>F'9
CG7V6WFI\RO]^:>-+5>VDV5/-X6-$VNX3LKMV?UY#:Q$Z[!TV3P&BWE>MD,6
9N(?DAN6WW)VDT11\EW(D3T/8-&3I,G\.,A^>;4B=[)GYV@K;99GGG^XG[HN
*L7,(\-K,U,\+#R*RM@BFF7Y?AZUJO?S>$@>:!F:]0-GFU:)GK-3U^X?*IIG=-"$\D,(G0F'9-XJI$.P@@WAF1/)==V0ZGTI)L>&^$W4RN>1X['T()N*!^V5DM<5M94G/2HZ@SE)#W
ZIIGO$5=-;Z^Q[4L9J$KDZ>RJQ[OBG*Z8M!C/1EKQ00XF3B/=2>YOF=8WH@L
/AR*("/9"9Y#5-SP''B.^N3LGM$?R,ZZA>9KMPS(L1W9F!M2"
A4FJ4#[EMUB55$-8TAL?@8H2GX[;>M]P!K)+"4$L6%M4K/$A!O#HN'.XQLB!
PM965)Q?RFB)@-+Q$G
>7Z$2,41^9@4F(YL5NL*09-2,-.0T/3L53RW#*-?=D-J+0YV2&:-2ZMA>I
$^-@4>HQ@T<]ES#TX$#D<6SPZ$DKHIN'01W[FBNZGQ0R3-'3S[E0$<8"DRT
XJ284U5B.,FD.8Z)V9.N9QKV0/;>'*6.B:$=4X-=YX#+P>5TA-J7T]GE^HYA
#=O6P>NDR^$PM,;I
7U[,BRB,:;OV,-&AY(ZG#XY.$[\N3((,9Z8=-,PTRVQP:)IHQ3WB\,,@O,MD
[9&^V8@?N9-QVR0*6#B9IN(I+U71+#MD[\'$4Q@@(51*LZ^?7JA7NW-D6<;3
5=Q+;E:O^<)-5G\J*E]=O8-"&[[YR\(F5F]\\4?RVN=J?S-JM5?[&D\GQNJM
Z-^-;TM-RN^GX=B/HGMFLGQA'KOG?KI#HB=8>D#TG-W2^R*-P[Q(F^W-OL!$
P$2YW5U$'G(L+I/)M!".P6[]-/GNI[P:UV3)35Z^H:<+A".$HP.WNX-P1(;$
[-[X-HQY^F!ZA9K@$(<0AP[=+7HQ0"0B0^.B$!>?7(=-ZR0B^B#ZJ-SN-1=/
&I:ILS;6>IUKM53V/HS#G)QIRV7>,9;+O$7#DELM
F[7;Y2?";EHRY>-R02=@?LYN-#-M15[,!J33E&?E
VD--8IZSY*;-?V7^F29+<^(/+Z=MV6RV
EI4W('Y1-E^VPV*=I,4Z=&\.->^G.J4VJH23W8;3$-5T4,:$8N9E)WL]W@O+
7-5!^;.OI]/1.4B]\A['X25)D?AQDOV".^.!GQ[,&4\1[;ZW;,$5\D'*@M4V/
L]L^Q*Y'"@-'"78I:ID4M
.FU&Y;A-OK9@0A(#6BN=P(T0-W7A*F+@B"+M,"
I-Y]\PH>/TKAB,V/$259G?ZHGZ"2GU1"36KX=;D^GS,PG8';UMV/JZT.26?O
=7.8"\Q$:X7-7-1GYEB688U.=,H*S.74X\DGSM#H/)[\S*-]O-PY&9?;/\M9
HG(+2=K\"GR?7+,G-M$@T?&GP2W3-H/V@"-82.2(.=7P"/J1"0*@0J+S'F$9
GG4D"-92P9*A+!P?KBZQ2DGM^<=D4^=)=-VL,<\8NIB/54LB6.SK0&2"-*B0
Z+A'#$UGX+6=\X-"B(-GB.S$TH+1E\-O6H-RM-EV)1\#Z=G!9AM[$=AHT#(/
B4O/[H$U-!Q7WG3ODZ,>I'7*=4*8D@IA#J:D$BV8TN.FY!G#O@=3(HB&[L+D
UH$LD!1EX2Z[UQ6SNDIR/Y(VX[--/9W#0'I6].D[YM?X=;!3H>J&E<-AU+.&
X8DA\&!DJQ,O.Z0Y-BNKL#/8F8XX86=ZVIEKV89ERRL-H)2=S4@L0/Q(2N[8
69T*[3M+J\\JL!?9BZ^^/WWU97G+@R+BGVX^\W'R-2[/J-Q07EUX$-)@5M7]
8OGO(A2-[B(./H;^=1B$><@G\6-$A-?;Z[8/=]1MG--Y-T46QGR;-84L+-\$
O/@[S/X2--&['\99GG)-\B[FZ=?[RR2=)FEU;N#O5?E:36N-7ZV5=Y\5.1<-
+2Y77$1TBDKQ)^W[$*D/[[6J#--$
P/[TG'KK\'PP<"&!P>T.[V\F>
IQ4'OFV3Y=$HF1*KOP\@?<+D8GY,B$GW7E(]Y>$>-L$ZRT-Q?EYND@8"E/-\8

MBO.0)B))Y$\S FKQXIS-PM[K&^:5#4EIF:0ASL"D<)30F&1'J);0.Z4B!7!U4$B4@"7@/O$<+>)9A
M.K*3>N$]1QV9XLR+ ;A4:56W212P<#)-DGM>CDLS@]T4:1SF13
M:9'SE-WZ:?#=3[GDN2R,U:FV/\(X+1XX#-LR#<\;D04$P=#BLX0P]LGR@%RSQ2N?R+WX;GB/>MH"F(E/K5%M?B7EU1"E*/.#JCF.8
M?:S-DF"A@&-P3B0&!-*AQ0..,G1&?9LL'^B%T(KGF2HP;I9G$W=Q1ZT^2- KVH!&E-G6-Y68](9"P7J,<-"01.0SVW+<%MGS&&E
MX/B$?L&R-B4<"D0^N)5Z6.!6G=S*,@UW1*,D/=SJ*6XE
M@"BFV3*W>&#]E/&8IU-O67:?Y7R258?R29YPDW'",55!*3"/G>..U?3$\<;
M[P;<[QM#KVV]DDZ>;4P[K![] .J3>IW.PVO8'3VHL#O-[>?[@?NIZ
MJ)0RCSBOSTSQS/"H/#)P+)DM^7X>K:KW\S@X.V=O&?7F(4M$BLB?9OS5XL4Y
MFT]=F?7T2G*[089FS]9X[\$;7X24,9\]"$/;LL-RX\+/[UGEL'V.%-P!/FX
MH[Z^6)08)*!-3P"#VQO:W2Z(5(M=9"EU2BS4TVB[ZO478S%LR,(J/59T-']-
M=\F>-Y'DG#G-,G!D9-W-Y65CVB!P4>(!NW2:IZL9'P<#?.+*P9@%-WPX-IZ.#YTHX?B'S5R>VWO7]QT^&/!?OQM'99!G/LZORUG>F)@^/D9ILV=--0>#$*MZ2
MF[QJ&^97C5/M4RY3D],;]D,WJFR=+,SR\A-+/.99FG*9R[Q$Y2,G*H\:)"I+
M&/"[9L-9O&!6\\'9K1["""D\$+0G8(ZXPEQOT.LD"EIU2-1N-1.NRH#&8S1&
M/+O-J:V'BU9-!,$H16.;>4-=4$?G:.I-Y625@KBE\M))1Z@0=1.T/B)4QVA@*$(>$01#B@:&(AB*
MT(!S,1X7DR+RD-I]?'LI"0V<(<7)#7%>>?(0NQO$*&H7LV0&Z
M1Z7(IH/81K-Q$=NH-GP>QJM9T'ONIQF1(-(0Z90[$DI.LFP;"(<^-6C\+4K:
MGH.>X$!IG8-\UN,P)Q64))-3:*USL">J6F=!HS.8;-.D2@-'4>-@(<'SX3K2
M]0#7@>OHP.XY;(<(B69E-W-;N-WK0[RI4NR6Z2@\UM%8(;-G
M-(,OP9?@2X=>CE.[=HU\+I=%)JZ>IRSE495NF-V&TTCRJC9&KE3;'S&+%(^6
MU6PT,GJK;WA>VPE/Z(76V!/^H7F\@AYH\8!-/+<-SQI2Y=,MO;1=,(-M:!ZF
MNB4#^CQ@&Y9MF'V;*A-H11'-T%,<]-,8!$*+!PQET.M3A0.Q'&*A"OO&]N/R
ME4-Q*)GR@.5\?!N+Z-EZ3W9I%^-%+*V#!^Q]R<@&AC;2\DF@4#A#LHOM#SUT
MG@?LX[EEV(Y+E4^W](}M70A3D($"/&-;KN$.X1HD4"@\ZM!3&-3C%P1"BP?\
MI-^SJ,*!6-ZQ2*7AR2-R85VE?L!9[$^X['U5--Y-D4^%?E+$(U5=L36;(+-1
MXYK)7>Y'>,9H)'O/%MW*R?+YD,FHA&&I%/Q@6.HQ@V$U7'\;6;+3->%8AU^4
M@U%U,>G!J-1G!J-JMN)G#F3O9H9/=6=DI:>*R$1#2$D92(-[T],YZ:DNM^>0
M(-99J;G-;=?28I-4UQ%G=J\KOZVK)/-!/XFB2;'G710[.#96
M-7R"P^'4LS]B#PUO('MSWK8NR=80VB$!DLF=A=7!ZK16&JQ.;ZM[[AHG3-:.
M$%G=X=N@+W-?--GR4T%XUZ)=UIKAV=J-7H43GK$-^'?V.9GX\:F>
MTG]8GEEK@8WW4UZ]/=VDG?K]N#V[-TR*W#[$N1]-#PFB:+DNQ-.>Q[&XB=)D?EQD/WR
MZI%649UR-0FNGNUYC'A]9IZQ,8^B,@J(9EF^G\>7ZOT\''.Y@YBU@M0;,XLD)!ZNKVR;LV>9K=Z"'^B\$!0R*O:/NUQQ$)7
]0:]3J*@56]![]8-8:4%T#A249+#12L@@F"4HM&@S!74-75TDP;LA#PB"(84
#=@)+1Y0!R$:L!/RB"-84G1@)S-R$%$
ZA@-#$7((X)@2-'-4-1#$1IP+L;G8E)$/C*Y2.!-[$*2!V*7##B7?IK>BX8@
*Q4$+DHT$+@0N&G-2?G$#^,R:#":"A/A^\ZWRG$Q\EJP*J4YX7
1N!T7T60T'*=)H?&=L69+I,LIZ$F>(ZR@4Q+92"T*0[0GR1I'OZ?GX=)3$-G
M"'%R0UQ7GGR$+L4!"AJ%[-D!NH]RDF7;0#AL3?8W-OA;E+1=!GW^.71'G)65W-AD3FO9M7[GZ,%Q
M'3H7J=D9?Q(X-3GGK\M'(]EFLY/8Y:BL0R)2(.K!=63K-:X#U]&!W7-KZ%#%
URW;D7T-.MR&:OO#;>-V>XB--:-*KUM>HT#0@^G(U@-,1R5@<)]'(9H]BRH]
V,\A%MO4KDPGG\MED8FKYRE+>50E$V+WX323O&:-+D*[F*75WBGP.%JM&HT,
WG(->]!V%0UZZ9A>X!-0-WG-/^J+88;INE3Y=$LO;9?#8!N:AZENR8-^#]G&
R+-MN-8)%/3E-ON-'L-#]K%B-.GUJ<*!6-ZQ+(4]8/MQ>)1,>T--XP#GJ*U(>4N9)D,#V
+-0IR$-!'G"-01];>DF-H"\6F-?T-!XPCQ6G/G9)T0!!?9,4HD-:Y,-Z2OV-
L]B?<-G;I>BG)&L.$7QU^-0TVU<60!YM2GQELJ0E'Q[-%@@&&L.G>-!/V.E2:'F710[.!16-02!P^'4LS]BN88SE+WI;EN79&L(
(9--R4156!U!*+-Z6!VLKN&BI6W8WHA&%(75$=PV"(>#PVDM,#B5\F?NBR9:?"L*[
%NVRU@&/UF[T*ISPG/W!O[/R<2/'SZENZ]Y?G6-OBRR%U]]?-KJR-B6!T7$
/]V\#V.!]&-XQX,/<>['7T-Q&Q=9QO/LJKRG*W%);Z)D-.VWGW]B[->'OR#9
]0O>%WF1\HM)DN;A-U7GO[W[>\KGG*--9A9&K\->-R5-N-W1&1N+.Q/-]]G?
O#Z[+']J];V1XPW^LDW+-2W3JEY8MF.=-5;>W?SF?OYI8V.736M/--5=3Z6\
.ENW9R-*JUYD++EA;-F83ZYY6A'\A^69YXYEL/(^#<9%FXUS'C"-UI#EE\)E
)^--8G=-?OJ1G^JW=TL
(IH*G>F#D.'T$/.#H!W%TZ$4)1\?0?&]'
'Y+M\\+1,>8-#S@ZQN@$46",3I.+NYCL-V>9=,(ABA6>+3NQ;%KXVWN7G1NDRFE8H4;
>A:=XZ'-6!;U+73+[T>!BWTG-VQG(#T#-3N+#]8E47-G\2$V!L^V'=%7-NO
-&?*IWX8S#^?7<3!IW(3ZV61EH-1IHW+M>W%KGF,[<7>=%/D.+'TMVPOGG=7
M8FK;*]JUV]2MA@;GYILL7=8M$L69OERZW"U$5BH>OM6X,;]@B?MT!#9YGMH
,-WQV[N8<>,GM<;/>%,@N,$Y"?$(OB]W&,3L7H>YIF;0A$7*EI"4/'.3@!H
:\?5,7M.PX.F=G="9Q'D$+W0.I/K)-I:,=T#X**>!7,L@X:N3KBH)KOQCS7G
17TABWJA';:KLH1'PVYP+9H1+I6LD$H1"A4G;-(
AN93EM>P#(G>]:-LU!G,?K#5T]$,![9-.#]R@,KV^X'KR'!-KJ^[*Z
.B3]S,/)=9%F?%+F[J1\S,.[*G],[IP-AJ94VQ]1BQ:/63>@RR[O.,TJ-$,M
4-0BI1H7QI>0!'G-8-,+=PS-9B6!H1<">L'*Y>FY?,G]G+/<-WO-(:DD\A4
22@Q@XR(18D''+YOMQTBOBVTAHB*N(?.0T1(HFL\8""6834\!PYZ(:-7^14>
26R%E@-KTX;2-#32P0EL1)./1X'I2=1Z5(-9>FK2-MGT[%,,1K(GG5'I48'%
3!E^I?/P%9%%9K"LML-@1/JG5Z3R4AMO1@DJWT]GM
1H;K-3L<%6Y7H[&-@7+\:P]HPW+\^Q;-GY7>?UG4-]/-Q7B<%CSX&/K7813F
(=]1;--J6K']>>-L*K8?K1I,:J5]207647/-DUE-Z"H^Z$486?J*Q0R^+T
,Q/+:=7)-$KN.1>!;5).L%8'QY)=/4-1"-(KT5AE)L-)99$?[PU8AN,Z9-EB
-[.,W*@G.P-2H&-^,!^8S[EE&^ZP[<97F(\2VX50E'\-+K.J&?Z#]!-)$G@8
FE)M?\0L6GQ0+LL:&8[5=H0)P=-:82IB(#J/,"&)KO&-AXP,UVZ[JQ-Z46*<
B)7,-,A-SI@W.@/VPY/4?68G-!OJI\E
%Y@6F,&T#F=:GH-2-73Y4%]31:E^E.I773-2%XY0O+AG.WM0Q/B1@]A'AM5'
K7ZZ@,BL=J%6/^Q.=[!'[G2W.]LU^OVV9>DZ:7+PZ@Q7TT0/1;'P\B'51CT[#[(V\$\-XI/Y@Q6I8.O#6$*G9,'[(,2
#@P5Z3."9$GA@*40-G+LUO#P,/LB.Y+J11T40AD](,M9+\N4.NUE#WK]+@6V
2G]-[T5+K-)F-^5!'<^,U0]BGJ->)#=4=84>&RD<".8W*<"YTV2IM66!ZIB
0>PBA0.QBQB0KLWO7XI-2?UQCDE^*D3@[X3A?"GOA&K%ZLF.G)GJH0R4M)AT;E(\MG,(J^(509B-DR*6
W;%#+TYVVR/.:3,J191;6WXKB\[LZ@IVO"2V=$(D-V%G]$&F]1^;FD94VS-?
QS[[.8=LR,H&-0*J-,D(!X,>V4$+@QZJE!Z9ST9-JT%[NS.@Z3#?K0,E,M)"
--2T=]>T:'NWH^5ED9:/--D1H@=()0"VT@XB)"*DAH0-)O4]*U<\G9-0+((E
^6#9&8D@".I.>)-3/[%T2$6-6-/I0NLW.8@.TI-$Q]O??)X>XB-[&!,889I7
$4H/$ETP&:4H1ZA-!4HMSBV&L5&#B&ZEKF31K:3/"$:G-J7A86,D,.Z95G6H
\]VW;W;<6I%2!RR?^3@ITHQ7AV^-:JFPHG/8.A6L-X*]-]G1FY-47'-K/,3.
Z#XHL88]>4"G!.V4R1GJ-9F$01!Q!6U':-'5A-&\!\3@/3I"@-?->V@&@/>
&+Q'1VCF'G@/;08!8-\X11$,(%(Y-.!<\AG($,46P^?@-J@@LZH--9-"PGZ
3-280"1P#MH,)(ABZ^D>W1''XXEXXI8U+VY&--4;/-[&HG#F++EAXY0'(8T2
2WMG*NN!ATQFXR*<3]Y7DY;7=(@L<@+\9D64AK9E
RU8=W9TU5##MT]4FYE@ZJPD6IA8T6)G:-*Q1WQ@-7-@7742P+QTQP;XH0(-]
J$>Q+1TRP+PK09%]J\-,,=V#!O.@"@GGIB.GH8GK\7--NS+KV%<#RWY8T(3^:6*G)#UZF-*7'NXA[U6-425].SQN0
8-9E;>3S3-]WOE[G*S@:KV/0RM)--@]UP-3-3.H3P#B-)-X!STF$-D<-[:#"-*-(%ST&,"D<-Y
:#--MALY})1D-2)P#@!!]XHFXA%1]!]PH);ZO3WL0MXXS8-U+YAV-5:="-GRG'-*(-$/G(N6MX
IDF5#P0#%Z'-0(8HNI8L]--'#FT^?*R[-L#SS-#]6+VW15,-*)BB-O&B%^G5=
BM:X3L,:VNI[%=#R<^6/7ZQ^?L73R>K=A7(JU/0!4$"3,"I:0-"S.W=ZYH-J
GH[IY9ER3H+^W,D8="T[[RT?\DU3VO=-.-.V]LG4DY!2J7NR'OVD5F3H(=4>
0+-?A383B-3[46@S@"@-!,Y!GPE$-N>@S0"B-!-X!STF$-F<@S8#B-)-X!ST
F$-D<-[:#&2(-OEVBY=NSS2?K=YNS9Q[HYR>-$6I@+I@.;2-(!/NW.NUWA(!
O=#(G$//K-.A"IEGA\^<0YF[/2G]\>-O*'-GFP+]M-^.&3E](.GXGEN&Y:(T
$0T6V-RL'-.(-D#@(N?VR''"J"E!-P9L1#D&$-6-P$;-'1.%4LG-@(THQP"B
-!#8R+GJT]"V,+*4(!MX"6T&,D31M;0[KV>[ZA4*TA2&-OJ-:=-"@KY6%<*H
XNF87M1S$O2M4'+N2$0NIFD8K67-V8?-FD.]N3T)-9'DG$W]>-\ZXE3339$R
A]QW-$&7]\#3BY--L>E%18Q&ZRXP1-$U(/"2<\

[illegible]

[illegible]

[illegible]

~~MV$Q.'!LAQ^PVE-1=F>-'DU+V&3YB+A^6)0EOZ(-#]-Y[W1QY3[%B>A"JLZGF~~
~~MR768GI:3+3?.?9TEUR6MGU)KO6;L7?-!35%X3:[RR5'YC-DTQ)3O-OE0;D':~~
~~MC/5PM'M95UYU+85G;^8:8*]V36E^N65.^U[EEFDY42PP?^?;B-DTEK]5UH+7~~
~~M5>8=5]2^LF06UI5-:>%-M.E?72YB#$?F#2\Y?(-LA(\+^+O%\2EXW11.:*IL~~
~~MUMHNKRL-)='](-RI(4F+TMGW+L:0YBV*FS#MDW-W')"DHPVQH?-WA\RW~~
~~M-=$-64=2"HO,HYG(-7#FK-WEVAFVKFV>-&-TQC=RP(*GYS?-:-J9F%TYPX6;&^6'-.V,":Y4F*["WU8QI,G:K)007)DK%<:O\+=7~~
~~M#%C6Z+FRGB'M'Z.+.5)A#-M-^T22M/WC$RL/%<;TRM90C8E>**K<(K8*,[AS3"MY99)JZ)684;!".-VSTGEXW&\015.*I>%[~~
~~MB:[!FT'[KK*IFF*I6U+DS99)2I.6=O*&9L@?O-M&$DU-WN.=%(FNP9MA>[.2~~
~~M+LEZ%=[L,E6[&3-HAU:>)*=BML.H,5,&[<-6F\"^+#A\OXA<'Y&1,N?V?QQ=D?U]-H9CW13.(D!4--JSCN&F%VK7E.I-\+/LBU5MWUO=TYF:^A!FSD#L?~~
~~MN1X+EXD'M7FRN0EOX\#^1LHWEG7E::E#GM;Q%3TG?]K8BA3N]>WB/G(=0NVM~~
~~MY:&K:?*2GH'7/NO=W\EKVN-J$7^/B#;*X]UP[:7:..94GE\(59H5M~~
~~MJ9J0RMIXE5*3G]NXX\^;+%~~
~~M47[[YPFEJ1YK66Q5R3"4K';!P7Q16@VLZX9N*AN5@+3K~~
~~M:5@)B:DXU"&*FHKF]8P?2(-VYX/[Y#K(=^Z"O3X]5?+>(HMGQGTQC16&G;SY[L-S1\~~
~~M.>3E+W=+Q@1:4HKF>/M;YXOX,0A)F7">;!K-ZO"N.*>@---)<"TFHJH4S'$9~~
~~M-74IIW&V#E/^GB7EHE&X(V^'LFIJORX4J/0"Z5GG=<:%*~~
~~MX7-7ZJ\[+G!R!]M0A=TQH9'3UXY:%$UGTG$7&OF-]*XO+0O(^56JR8+=MN2S~~
~~M^]^%ZR3!U/0/R+=1,=^69B!/1S9BX^IL92>JTM:<(VP<11;V8H,CIBJ7>0XM~~
~~MTU*S-TGM(S,+&\$\'-/?7\QR-."G<=92Z?*ARXZQ/%RN@T560VXP,;G~~
~~MK*5'*;@@J=UP@8W'64MW4G!A>570-A?8N)RU]"4%%XR.]@*;L&,M'7F0"])8~~
~~MDBIG894.EWTJREU3)/\O3-VA:3V-NY/O6T3QAFOUU^S^/G6O;U"$PJ=DREE:~~
~~M[K>\-\W3P,8W;">B4IM-=OPI'>73=ZR%!-ZP\1O;#4+WR1\V7F2KD>H^V5WGYA9+W>/;A@GY*<=+G-YI&L/-G^D1U9UIN@3~~
~~M?K8,A?])B/QJS7(<">X>@T5D^"~~
~~M%X32)+%%:#^2Q@3U.%,\MO?)&-HG=9,QV2\W^'$U)R?J.GO$*-2,]\D*BMAH~~
~~M=590:U9)%?EQ7"@BVQ,'=+W&-E1.A=EW>/G-(RE-41&79#%.AXYI2]-1:9-9#:6GF9-+RDHZ%:K%I~~
~~M/Y]JA,++,28I5VA:%Q.R3X35%53GG!G7-+A^\,/^+&X@3]^G[MA>G%33+2G~~
~~M&>-4&5O&$O[N6LHWV&=&.R,%F?R-?V,?9)7\+^6Y2M.)GZU&?'>M%MG%B"Y&~~
~~MFS#-Y'0"R[JG;YYU-'WW&6&(;"7Y+;F':8GWBH,*OZ@)5$8/4-61UR7&5G-2DRDO=X^6GQZ6HZ1$/OJTK?EI!G0UUU&T~~
~~M%U&YJH6N><+.1Z&9-586(0P6%(%3?""AXB0^URJJS(7O1G,[K"E?Z*?"21.F~~
~~MG.E#="L'YZF")NR0V#.W@!J2-8I^!Y<#].PL3@'J4-:;G=L.,J;"^8*6?9JJ~~
~~M3!1%Y?K<1G4\K2.V;DZG'/"QC6J-6F,AWF37<9S:J*:E-=^.+-YM^XG3[A%#~~
~~MQW5DDZ@FLO6$4^'$5@VGH9S72A601#/:K1W'[F15ET0GYZT?GH/28X0PQ?%S~~
~~M>-@G$X&.7V%FY[;<%6=Z'9?']T"#E:T;YK*#D\GFSG#?LMER9?,T6VC#)QV>~~
~~MQ(=WJO3N*WG%+"2.M+#^"OW>?@@;2XZA5+ZIA)M+D:~~
~~M1179&%6RG;2L/)",1SN!>0=/)V.MRMYD1QYGOBZ?79FUG(9;[V"M/)[H#%E;~~
~~MB4+&W,W9^*K\/=A&L39-];%L,.1O11I[5Z^'G@F5^:F-S0GOZK6>;#%&O\YP^<%!2EUHY==+>79M-R5\D^0.#X%/]]7/%P$/'J4VS]N[:^&OR~~
~~M1=:/B8&55="^=>6O4DI'6N[BJX[Y*ID,^NW2?LO2!.EAGCB&[+RNV'W/H7J5T?F?=K.-F*VR#T@/GB()W~~
~~MVP.EB-O-8&-W%Y1-D5+I!,QF03)UK%4)0K(ED1O^'KJ*V*L0*,(%!L,[B:'R]\#]Q/XA~~
~~M=!1=^8PJO5Z>^;L5P+\+DMEY,;8DD6MO,;7VS43)J!U3BE5>7X&H?MEXR!G>~~
~~M*-LE;%3-DV/G-6^YUIG)K8J7GMG8.'ZQ?-U*<^2#+*5#0>L*\F2G(+=-2/?L~~
~~MJNV]E[!+V9KE>33L.G-%LEK[RQHV^789H-2OW~~
~~M!EOV/-\H+E^VZZA-NGMC[TT,T]IRM2JLG=R(NRE~~
~~M*#DYO'OWJ])}[-59W&$/@+T4P?S#N[-%'3X.]%*4=AW?O?LNVA[VBR>*H~~
~~M/@#V4C0:.+Q[*[-7%EE$FCA@[-(J\M\!&O'@N?%+D<$4;0/8^PZ*KK-X*M%3~~
~~MW"N+*1H0L/VDH*UO]0O3'*"N>09DT/4%L-P1IL<~~
~~M+#U&9;]XM].QJY9X*X:>%]@6H6[G0HBJ]J.\G:&9'+[)~~
~~M2$PF?O,T"&>DD6WRBG2WT'9V+\I9+.2"T)'3O[&A.(WTTS^N5K&%K#'R%MJS~~
~~M5&O>>/!E6\5F!\KL:-:I]XG7("O#V.JR1#,0OJ;%~~
~~MJ#E'L#,N]*\?ZP[WK.KY'-;!9-6-L=$@@?;>NIG]F,>@O:FBE?L"FG)'&&QR~~
~~MHRL,LO8^.V$P6CN75H9![TH=;?&G?VM@M'=JK3MG]^G,P>JU5>J[C-8.R=4+~~
~~M[B9GM5M\NJH2JVB[*N'7VL&\066J)(TE%LE6K/G6GU-0"NL,T0Q'$%WXO]["(0HN]^2]~~
~~M#GN/KJ:7,AAA=K]<33]:]N.E&]F6]Q>R-AGK&A.RZ+BV'%Y!R3YMR;X.Z-]B~~
~~M]'K(Q=6TZ4L-6]D[/\UFR''Q9O=>XD-D(Q)QVXU!C5E;3#%8UVELL+\'KC!2~~
~~MX23]!+\T^3G'.+/&L"PJ1F])>Y]T](L%/3[#!5$@W./G)3G@E1.1)@O5DN5X2~~
~~MP9X&H1!9^(>%[^"O8%4J$'(M-^7--,/$&OG72/AX>WTM/+N>)V#\-L%-V2]8~~
~~M/OX-@@OY30*,@)]/'G-E.U]PK!?R7HOW/-X-X;'POK;>/7IP?=(HGWG\-UKX~~
~~M">&+((T$3((^$M!-R1/G('F0AY':DX>\>M5X+^,>[W@+"?+D'-A:(.8(?G9\=+?#2-V)=!&L6+/R8/'87A^X#~~
~~M-G5^@>/B)\9!&-DS-$8'Q7@KN#X:,S![^5W%X%XUR]3Z@)R%';MX)RO&\6J:~~
~~M6@DL?!=X4-B.%!;4A5EGSG-3=;%!#JXU'-EOB1&,-$3VSA5?%O>1';J)]U+(~~
~~M[#%KS(!FX5@+PBE~~
~~M5],I6G>7^X!6*.992Q$#8&#EEE^)!+Q8K'GQPI"S--SW[NO4,F$5'S^&P>+A~~
~~M48B?-R%ROPO81,2/Z1>(WI\GI$0GX?G1Q9"5O6G]93VR@-FZHT$J1~~
~~M8G?B,6N,J*8!FKJQ+*,33RM9G@<*HV8V=;AOE@:U590($0D?'P(HGBJ^D5MM,6R6?]3$ZVT;GOK'*KHAK7Z!O=Y71U<])AG<3%~~
~~MZIRA.+@QY$Q)-[02GFA:#XRA.&(Q9$Q)W[,2QDAZ#XRA."51,>86FZ3PHX-"~~
~~MAY?;EPA-DO#F.@S(B?L6GZ&;"I2L],$=BH,.:^[4$BJ]D$#5#7+UXB$[[\GK!]MGS,EG-GYOIN%!-/[PFQD2133;HF~~
~~M=\V:AGYO5=;4$B9#EKK7OK+8T/.MRIIZ9P+=[-[MB<7:ET4*?Y!<(;K.-]->U3:WG2/IO\+*GMZ7~~
~~MDQV^2YRI395G.U>X2F*7G,Z5K[\.K@2,"E%6#'%5]NRG"~~
~~M0>-;EF%0VB7)TU&DW:EG*>VJBA'T2Y/NHPF[4J5!3F-8G>>#&4O~~
~~M<82ZW<\F\[SDN*!%?MKM?L'%/Q"-B/!3&O\O:KG)LB3,*OG$V]5HCEAM<4R>M-]O6G@YI-KZ#O^Y@HDK9>U6V-4*X~~
~~M)Q6!>4&;T4AO0%WH[)&RKW*E">U3O3=2=%4J-G&LMDWJ1%?F+=870\J@)8>Q~~
~~MGN(7-$2D@W$BH"G5]V~~
~~MNW0L!!,!ZIJ^IP;TEE-%Z-<%@JF>IL8S.,>HD$5P!H$]G2D-W4JH@I-%)UKQ~~
~~M?G"O?>9XG@*Z[1V/3QG"L:(,?RAN7*7&DWAS@9,Y:MJB?"PS<-GK>.[V27GT<&!LLTL"7$KTVOFK-IN'*1SLGA9O(U-%%MZ5=Q~~
~~M-HM!NM#ZX-%GTW]G"=6)HPR^!@&,!!,Z-?1(L[->0-#T--.:DS-D#@3[.]@]~~
~~MFWJM&%,^N52Q[.-@]FQF'6=/6!P8Z#N/GR@B^52;I\D%(K(%FD9Q$I<'/T7E$(EAK@J<~~
~~MK1L/LP#'MA.XLP#*FU-GYGG)F&!V?]7%W2O^D?B!-\S^E>(?B3GZ#?R4\7?[~~
~~M9\2N/P%KVDI=&)Q-Q5#W";D?N&!'.".-PGTGQ>4NPEP^+=R2I$:\--V.!?=S~~
~~MG.*,DK^5M\K+1W=SYP9KKTJ%M!UXGAGF04GW!WRP(JJP<90GUM03[.QC-9?>~~
~~M1.FYJ.^*#XK-P+-@=+ZA)*I:Z3XP)@?"K";&GGY$W;EE^F*:$!/]D*H9"?&$~~
~~MZ\M9GN!,=[JJ&8G^Q&>)P#TMU=QF,;,'.=W3Y&"-4#G:!$$%=-FH'^9(L"<\~~
~~M!-)'<(+0-Q,^O(1U8EPTP&DOO.D*3GM;L71!TEX2T[:/#4EWL4K;$IR@5"!1~~
~~MLN&+^?^L\H(>P#'-!JM(RBVD/#%@;>'TPI/>P.J=(F:G!$]Z@ZMO76AZ@G8I~~
~~M@Z],)%K%Z5-U7(S3!BKI7:T^5+%YVFM=,NG-(KU#U8?%"T8GKWUAD=YMZK6V~~
~~MF0(611~~
~~M!G&V)R1"%^&8MCR&]D;XYL7FSG@KN\8D%,>=6MT;\GUR2-L]$@,(*=QUO.X3~~
~~M'#FAMVDW.,\OPRQ;/^*,YF(S--8K&XX-X37YI-RN#D^KX!GN%^[>Q@P07AP>1;L^[LG%Y1%"37.5-/7)MK~~
~~M<(Q*OEF-,B^Q0FN"QNZ,5'YY^R75N3-/R)I<~~
~~MYB-JH\89V#(#S^69NOHN?PRLGW@HG3===K$J%0OD>$/,O7FB0%D:)M6-O^H6~~
~~M\,>[^Z%ZP$/713=5R\;!R(#FIEH<-GT)LR0TGL,AARQ,HT6I%#"/-WFW%*+T)N3D1%:Q:Z'EG>%]H?:&ZV0V5K~~
~~M%H$-LW+;?D(O;&XF0Q%K%N/7\$4[ED1[-<]-'!Z7F]?-TF0V/R.WJI=N$638~~
~~ME.M+1&HUG-S1>I>4BDW'S90KY8$RBQ@;O<3I-#).$LJF5Q6XK5$>+09R].B^.L.L-.M,>PEG[U1I'W+9/K6F(@.Q]~~
~~MA@(.#U?V:0Q%H7FVGUY%A\XX8L93&8I"6MMG].7P4&P?82BJ4"WQZF>[,+3)~~
~~MMF(5(YV6,L@PU)*UOP8A(:76389<6YM%5U5(M6"05*'9G*EKXI&6&0RJ?^(4~~
~~M52ERJN3)[<6Z*E[ED)-;KU3-MED7>^&2>'/S$3N0^J)AAX<8>S]=34)DIPR1~~
~~M.426QG=VGM6[[!(2JJ.^/)E#RN/E.U2>ZGQ;XO0>%45"V;I8(:60%O656/+,~~
~~MWKKGW8W)MO7U+LPT;X/8M4OMTE1!O-2'#SPQ%'GM)#1(]RUZKMGRF-KK=H<$U-~~
~~MT/,VBV#DT$E*\)&?%Y9QY%QI]%9M#]^MBG@;9W&+(-XE>^.T9EUY?XGFI;&L~~
~~MJ\X@#;#H+F[+32I(N!>H8U.-WMX2APEA&$EG;WG005[9@D(7%32#,TAEM6((VL-7,BDIGTU9)\@:.;#Y":&Q<(>BQ1$W&5[&38FA[34H]RO(FO']I:$H-1QBNI'/X01K6G]~~
~~M+5V1S+]P"?\NUI?X^3FFP?4'A+:!$PN'8]^B^OL-VZ'RUG(TG>V.$,JS#U?Q~~
~~MFTS=D.U5IH:V9/'OO8T<&QFZU!G^:*I1E'@$U.G8GG8UMM@8[[9U\;Z@Q@#B~~

[illegible]

M-Y*&:(/4MW>-GL'R+OPVF$/MEY2+'@)-MW<>06&E8[YM@W:W%XWT!9#O8V%$
MY?K0[1N,;^*":=_>F?'$X60(;U)21I/5-+;LP.@XHXD9"&Y[8UVAQ'-.I21
M7F$KFM"00LN+5]F?8<"XBZI&!D/VG%#7R,#(&BHH4>M>0\.[,W33GY&.7L&+
M<>I67$001"&:XT7MI;A*O
MA>3G'!^R08+6,*O-'&*')#7/*N<8884G"JRVV%4#5AVB5^U0A]M#J0@6#)[N
M&!;*RLHH5OM&[5,<"WP98%V[MJ^U81GMILZL,E(0QI:Z%\R(0!?(+:J7-X9P
MIMU-):LC4*-^-Y)P8-]L:%/.1Q(>[($3K0;72(*%/;!BVVXV(5JHZ9TM#)\-
M6+"B+'QF="F69/ALW#'!NO"9T3%!6=,-YNT63!A5U$B(H+RG658:IJ5!4-.;
M(XC[M)*BVHV[MBG.;;OQJ437EP?BDQ-\>4K+R"\9.!?;?-8-"(>9J.X5A;TX
ME)H@(*L@,MT]ZG.*K'RH-EAY9&#M7)6G1L,G(I]J#X&GP5D[!%D#$X7UQD*@
M*2:(=Y<,HZK>2("\-&/.@BJ@W-6:[K>I14$JRD-?EB!(^?[;P&EX:[H(V88
M4K-7HP'(H5W6H5V6NF"&.>VR=G-0T6N[K-:),;)X1[OP;"-YK-&,/BDWA.YV
M-PGTV:?MVI8)88FA90!$G1[16&J$K0%YTAG'4JOC@R%<:!<4*%N:-CHG3)A.
MK8GB)B^2$?$:-60#-'DGB>QTT+ZWG*LB.@".3JN-#B3#.\($>'GN.&ZZ]JV?
MS-GB?Y'R-V.A#NKA!R.KUJ#-!]IA+%;Q#5-$ZM56BH+R1GIA2).Y
M8'PFEI"&X49333YO+1U,'U@V:O"$[-JX8Y"/*KX/Z)-$GL-S&K:-4]UG)9O/
M]D2GPP
M<<.-23-VQ-7I="+-)N9-%Z90*8)NQ[G5H-GH-8MW=ORN/I"ZL#CY!!8DOCQO>L'NP9(G25^
M]J@P.\/.9[.-S)@QFNG3^:*GN@:-K5@MJ$#JD2PMAA'Q5D*;
M3*Z]E20+Y6V^N3G^A1V+4/P61H?H>6%53UTJ.]0\<678BHXIOP.*3FD9M*9#
M6KKGO-U$M+KU(\+$913R*9#$F03)-$AF\:P-N^E/94YGUQ6'9LPFELE(9F;R
MN3.-9X:TK*1?G$%,X=GXKG2)D8,.E:$@D4V86Y42^8.;GRI/RR"^%;GTA@;$
MMD*)-*4Z")H0-^Z'2V*GK24./J>G%HB&U"2U!*A'/Y^GDJ.-346J-8#,2O6(
MY:>>>>Y2"*+P[NX2F9O:!$)U!E!B7!/R&%'[KTGB-<=?P-8@JQM5)(O=^@YY
M99HB39Z@($G?);E<5!A$#;=G*-(&)PQ[G6'P5/<;H8L%T^?Y!9#H,K+]L>IK
GW"'^T.IGP0@-BG5---E\G>61G?+:-&$>P*^9@(M--;W@26(
MHVQD!",JDL1/!VGQ-[KX:GEA""?:!0+2'T1![GB!N]'=G=":0*-+54RD'E5;
MHQYT@'5'MQ&3N6'RL-G7OV9#-<13!,&F#T;I3J\AU+;?[?8H5-6YFZ$^0:O1
MK:#0]I#V*W2QIFGJ5GL-NE*KDV:VF[!2,&
M=,(H9D1]KC5!].E.W!%HZGM!]NC4GW+R&^L1"L+/=N:0=RL@*1GR82=T3>G"
M(,&'G1$$;7QH*?0J./)Q#-6HJEJ^@B&?G9Y%K(LA>>HH-?OK2"'XM1,O1O[[
MH@&)(!-=%G-F$XX4D0/7<&;J^B$YLQ,73K4'28)*,9L5&S.9L@%#+G&EL!HQFQ$;$Y
M$6G?J&^G5*5?#,7:&F1&Q$XQY&PP)JZA,"+6W0>49VZN[GT^+!,'$MJ'
M1G-"PW4.O2Q?G?N-+"W7D6V6J!3?$1T-WH[?9-Q:#7=O"P1&Q+;U-6=0B/MB
M#2G]ZO%1W1$-V,1N-?='TG6D4-Q$4MJZYGB2,M9>TM,5V-*"
M>3N56:#('!7<&O"],#=OI=D%(DH5QR9YM1VU!D>;X-Y.99-I\-<6-#H[O-JX
M((/@W.%)D(]\"2[NQ%,Q4)BVX.*'PYN!3"0OK#L\&-BLED.G@:ZI5H*#AT>D
M*>-/\&FGGHGMG.ZG3P<)CNO9-1;;0V;"3Z8Y:4+[+E*]K\/(7&61<;Z'9!I[
M=^Z4*$B/[XB"P3GGLI2IG-7D.-UP#I$[]V4;O=^).YLGU,Y?2&#-B,-0$\OI
MLZ(,@?V+%7J*;-<\LU+$,2,GOIO52K$2&&&G
&5!@1Y*3<\A\V=7,EW85H'QH.Z3!2"VDF-T--6?;1.E'KRK!U9TG(T5U90Z-
U)[NTV")+K?K,&4"D%T&NE8>?:28G&N^1$]W-*56"58-V#0-="]DE%-85ZIU
:I&/9W03,5DGA"(L*<$*H[MF]<"*1ML8E>-Z:G9LNG8$[49G[775V-2G@)B=
Y=J5?]W\I"*EG9!X0^']-DHL-O>DGY1XL*M^/)E>D>>()ZT,8OYWJ2!#-^L.
&EGHD1RU9NX=]6>\/QA?N\-*8\-6-%-]2#8+OY186?Q![(+$2&D47.6E?$&P
P\N+,-R;?(X)R3Z$M!XR50,=%P(
!D\;414H,%N/-9MK><6\M$LKL=+D0D+=U](=)NJ-.Q2[[;L?(4)=)]I\\PV+
-36-6FP0>[5$KC\J1@1^0([];K0:0FF[:ZWU&;-2HX)0:T>R:63)X6CV6A'
93,!NU=4&IT-CKFW#;0:'3I!?60;MFB@L=D#Z-%K\)+4J4:PZM7AC!!2-"
YDUJ!-0Y545^BZ]0!+0&#(-#$@?4,,$0%@#BP1BW*^W@%1?\,#M-0)(?N&B(
9(;9R0(*;->:()B([H+U'?W1W8JH9,$%\7Z&V1?.A*<!Q$'-F)4(E-ZBO?WB
M85GTMR?R5/L>--?%EMP74DKNP+D?*P'H%D0!*.^R'A6#<)Y;2-XA--[I*-/33G58?-+02PGL#TH(3J#$ULXY"+G-A#!Q)H/%:-YZT4-["6>'SK(*BODDU&Z/)2[T<2
O+@V>XG9TUWQ8G\Q*L+J'^&O3Y-K:A-GN\-F';6DFTM+U(U6@]-E/XN^!R6U
KD)59;-PG?K!FN8J'--MON@(V-,M8MG/PH.%GWOE6Y4WJ-L1VJ.-X<
P<-67<=)$PW5YGMZZG/T9DQ1#[\$-$0Y?1K!*"8!Q=-SVXX7L<=30*-(DLD(
%GWKO9-U3&(*>XMEH.-*TVZYD+&*Y>Q++JD(:8G9?/W6#Q>&*',N0-&9
ZIKG?!R,1%GYYJ>:3N;6)!MN.^/#+2!P0Y%TL>)88",J('-FR8^LXU/^G5G+
Q;Y6-(DQ4@$4V15T1THZ6MJ@#QCA7>V=W$HM/23^02E2Z-3AD;@#!WIM,N/%A%HK
65[
6FQ0QVU7&@:RU"7]N-5PE+?-KQ2W[,\>2>2$6ZL#@\G]9-+O#:.#X03WM^90
OAAI)V<=).6>^<4R9LII!]=>+0C%J/]&YJ[MR4QQVOP2YZQ-WI$Y]9G;Q3*@
+UFT--Z8W.,3U7PG9PG.F8L&JYB]7RU[SI[=8&V$XGG-".;@!#XX@?-8?K2W
&2P-6:<-YE#[U@+(.]0-3V'6H]#
=12&,=*AVOG.FI#LJ\;GB-::1M*!2-(4;&JV(^G%)4EMK>4QD@9=+[\Q-(/^D.LJG9*+-W(\I(EPSO"UESK@E4Q6VY3X*-G
.7M;4GG;]79YBJ$;!F-\3L*#KVH??57E6\UE%[-$'=Q4#>-T2D2GPUGG9GBZ
O5(@JBK]40T[L?N=$#G6]X+942-@\&]4.,T327]#V;[W+#2-J;:G"3/#TM\
;-KL2-KE8OG38-R(=KA@BM4:WE\H-7ZXGL?.[N;,5F9FYMV@D[+8R33-92D+
O(^5!G7%.Q&@5H7+5[LG[#@Q[.R-'[HKDOXO1HEK@Z18%\V7ET$9F\9QZ1'+
3VM-KU-Y6Q?>W5WB4G8:0>"P^)-
TNG<8.X^&9K51Y,";L]X#,HV&=)"[8;-&XD)"7\'*/GI&HD]B2:]49,82?8&
2.0);6TDUG&*JGJU6:(/U)!VWV.\6%G!:G*M^)D"XP^QG,$6[(0*Y6VVW8G<
N2]D$[-?B3N;\W%.+R2P9B0]IA=D2@/RG;'H@?GDA^5-@FO.KO*G#=&V>EU6
?2?R&EQ#9&U.&Z3A""FYVV1#M6+0AR,877/3#DO]U-"'\(&,$G'I[6^5YP6\
$(\N^313>^Y3G\Y6#-Q>2^#>"DIUK#.([H@P0/QDE,;GMVE!!F-8!23,.&J
Q(2WVW#2-F-^LY,Q$D]%&Z3A+KO('50,+>UVOZM!#T?J6IP$/Q,##E:;JZD!
JP[>IW:HP^VAE(*!D-[7-H,E96>K/:-VJ>"'O!EH)+7V@A?$'0\-EH(PKA2
+=-'XBJ2?08I-"$?B?^H!TXT*F8GJ?GI@0VM:O9(RH)Z8,6VM322VB#9E[G=
MA5)*&,5![(,J/5=G*1GD@*6K-<#?=JG*R'AH,QY=0Q-3-6Z\F]]A&PG&GB\
22B>?-Z[E*L>#&Y05WP[EJI]8L^1F+J4G'YX7-;GZZQGG'
H#-5F[K\,DVFEP%Q7)1!?/T[U4A2?-9$@H4TLI7?:^!LF*]V&0:
.,W/IPR'T^\T(OF-^K8$;VL@:$1H#-?L-T-GF"FJ%J)?"[G]02YX(&-?WA^K-+:VG9G-5,!8YQ
APT%5GEQH/M(WD-\X&/K4URJ[G?N8/'-2AX/:OG(F1UU7^-P>(R?F2+J^OQ<
Y:!P>#1!0.)"?*8!2V)1^:WJ*&#R?-ZPT^IQB8,.+U5]KV'4O-JT-2.-G7!5
?:W^/79X5V4FO9-9/9U,ITR,.UQ:W-U>3![PT@8(4'46NQ5*2LO-+U47[)=,
'?P9W-Y:P\7L&V6M"&.OY/:WR->"G]Q+G"\\2D&<1SY-,9NQB'HY6N'TA5?B
9;[H"[MU:+WB>-XKGN>RVE%$[JT5/R)8Q6GKO]S*'92R/G2RE>^X=EF;PA[H
>@!X/I2]&GA65'VMU6*12-NIAZ$5>:Q$K?H:;9$\$)O&-<\Y?T9N>,W'.-SD
ET>MW9-+)O57ZN%>7ML!@:[;OA
DM'::*$MK-[]*LJF-TK;+H]AY9-D+L5>5$UGH-1H(%3(Y?'DR76GU1!*VX/Y
+2\9K=<.1I+8!R.P1OLR(5>M;RE4I><:T0((="T;=/Q:&BO344\&'&K:?FI;
[3#:;"8*,HWNJ@PEL\$H%VET1@\LQ6QH-XU&UVA#::QP,4ETY#*90JA/3Y"]
$]((ZFX59.^&=&KU@4MT>G->G]B.0!0YF68,#&^R9&I#+S4$;ELPQT/.-P>I
2G(T&D)A^^UL"/>5^-ALA$U%WK#1Z@*,.&!,6]-\G/K0M-2I2DD0=!KA7&B2
/PWY&+5$5LB@(0>4@V20/)V&4-GH2]N4#T2;\JL*-D^,K@-"$=BOQB;(-+K@
#VZ]5&<.%F2^-]KA!WM9MG(S"^H^G
-=-766"5TWDV9*14R3[>K56-%72>[HP-JJ;OH]%ZK-1GTE0GFM/^->XG&ZIN
^=[BUVY.(M>VY(9-R,$VM**Y$N5#>;/9E6,]-1TG[-):WDWL.^'U=$KLR'TA
GS^LI1GZ('"'0I2=+@0Z%*L<,D8/&:.'G%'9&*LAV:(*PX^&)TXJB=-9GDO9
+>1J>-]#&'$@WL%.8>*!)-)G>AF',1[)>TG#"3EEOA:98(WT@2VO%
+T0XF>:.RO(0ULFSY\[2-JX8RE!@E?L@TO'*G-'SGTR4/]%)KZ%#'1>ZX.)7@HT*

[illegible]

```
M, C%C$2,BLU0YO@/$# V@%Y:7BR@)@]V.&<+*;RI%C\T9+#U4#!S&(<&:ZG-
MS" N4FI.[B&<$L U?,9
M74/RP-C8 )W+X,5P6U*"'1<3E)C&L+<-*4 JQ6-K [P2MO^#P8S=G]EAK] :
M.A?<0.*9ZQ R)"O%I'W+8X^VFPR1,#?X?FI^3%?P T^4(>C$WW#6IX$+UM28
MF45\Y%O+?5[ "_A8&J[2^[YM; =J0KZF779@07F!-6$6?!D^@@$>5Y$9YC''

M65P\/.=X 1\Q:]6LZ?E(TJ?F)KL8H,%86 +,>;AQ8B8%&3J*XJW)9<#
M;*0@ %>2O(DFPMACCB?I?<+\=$VFO2TTWQ&,$)DV1W7IS3%+I8QG##M$/7Q4
M,Y5:;Y/F*G/+&" P=<;ROU?L3%H16,,X'NJI:YH5: 2BC[!<;KQ-84KJ/N8Q
M!:.PDUD&2WI$<4)SVI EZ$]LO4 86BXNBD7)=X%\^W>.MUN;AC,T$/&RJ3<.)$);'I&+ [[A-5P\R% )/1Y6LQUML'YEF&Z
M>"S*/%GI[T&T:)EO133(^MF1R)QL:JB09SJE->]P&Q(3S+"I$B/&A^NCQH5P
M!"(#K<$3 "*Y E<7(0?9?9+Y QF%CF,7M*K>*^
MX4>@P:XIJI3GP-H6A/B:,KA"R9.NN76^9*RMUO?=&UQ%'E#ZH2Q.K5CU4U,>NX&
MR1$5.[3C P"2 (K 1VNL-?MU:JQU*'NV7N^QZR&5.[#L
MASRAKZ?O#]M'C'2MN?,E8TVVON >:@5YP.F'LE.U9C&O!F+0(M)1H+-7>7?P
MB::D)5GY,=EJ+VG5W[5\D]%]0+,<- 8 WUC*^@CY=[9!*?6BC#T#G(4"*RCIYF:S1R\1RQC70\_;?$+YO?V5,@22(^ LPTXM
M8^!@;:7%" 0ZP@#\IPX&[LH8<(>[@RSOA2S]RJ34WX,.T[ M:J DYZ^V@0@Y
M%3 &08N<3","]956(08("OU.[/XGS#:9V62'ZY2I)F; /!E2 UVZ'@S[HH/
MX(S"&G6?ZO&H:F)2,S+2L#.[9>3/R3KH">>&Y68Z7[549HN* XME7(!D$]9>
MU2K'(TJ)1[W(0+/.[/1V_XG2U17"B59B4<\7+978H.'-0CD/P)B$M4^5JO&@
M.F)1*]+6J+N5+L]2+?'J5Y:J6BSW):OJ2=8 VL@Q@V4V*TZ*!>8#1P&7"235(\,E;[XNU3DNRHIWSW%41E(7_#
MDD8;+B-^S0NGT'NCY>9*UJF]Q45JFCIJ1L\((!/23F&J&(+E!E0L@>0YD*(X
MAPM9(8AMU-F;C.S8!!]H6K25L8EO3C,K1L1]%*ZMZ!?&(0YC:>M:918-=42G
MUR/''[%&I7SL]1TE1+#-"@R;E'8I@Y]VTKAQX0\7 A&8]\#2L?C.HE*
MP4BE6 +9S&3">/L!>9E2J:,VUR\\6=B?(#;1[V[0&U2=KH?INK!TFN&H.(8
M@=EK H4-51 U^=%NE=/X]K3IM2+D=8%.N0#&)HY5
M^K'R58C'Z(:VU1\%X6 ?1
M*!,U]6CW['2J<D1@@G8[M/REV &:^7\-;[I]ZC^R8*5J8E-UVYZE
MLF>V:UI>V6@YS3YOMSPC7 5@I(1JT!5P4X%8--K RD+#>HJC]4$3T4[9\CB%
M1D?R4E9@T>C3P+C-,T&M5GB?-2OF?X0FM5;UZ-C%T &2'M99@ENS"\(?1%FQ
M!"'\B38!+, &YV"-]X E9H] (K]#/O-O[] \Z=OWK K)O WYW3=D]J. O2#$
MZ*8.?//^#>VA^!W[0/>WW[XA7(L=9!THT>&/0:=,'8/ )BA%"C[JX%YS K1*
MDN!E&4;FZ>AQM,OM:><1]2":.TA N '!K@E(#QA>(N)U]D)8X?Q K, D K:
M9V7T31+N+4123V'0[:12OWA("9'H$K75>*!A8A:+;/?&6F3K9?D,\]86P\10
MMQ L,:Q$5G J)V[LFA MGMLH5:;2]>%N7UOAEW+V[,/
MKMG,-+GB'X7Q) IC0%TVL&+/ADM"*IJ3PG%:FKFS('@#AXP6))Y
M60H B 2@$@'PNNSSK7^Y<+=$B:R Z; VZ8Y>-EJZHYK.)-!4)'TL=05*K-:M
M9!6-HPWBHW"J?J5%BD7761@G7N!6\IK-*:[2+"WA3?H"U]=929235EV7#=UB
MC)(5&,-$?1QN2"9BO1O<*S0!PF8ZBQ8,X1N<%6"\0 ,4L7Z>RSM^P'C]*45:
METYB.%XKZ11Z \-*ZW\#UW56=8S6O=.$7NG./0PWK&
M9^X]6^.8M,S:JI8SE3SFC3G:GX.
M.>F@S-?)8W@K[:CSZ*AQ\AFCA\/%6>SL)DT>4Y26*:3=:ECBN6CW1+HC(5GMER@5'-,VA"L 8D:E]QEQKL6 T*?PB4)"Q3JVZ30R-KR&B-
MTT A4DI9FYC'3,(=9Q1#-E\/!(H\/I5VHE,WZFA:\)AX/7M!JT73)G\ISJ38
M$;1P;#5>:(HH#S\W5_C,]W#=7DVQ
M/6KC5X;15(>@K;>/T 82:RE;5?)78\D1. (;H(BM !H[8J@-5G>ISL]=;OKQ
M\N)>%^+U]1U\@=G>9G721\$*#C4Q#S.(?'2>ARJ?T0O&$!9 \ &4R
M:T;\/22*@NO&X$R"DNK;=I5*G@CYRE=EUU1O'Y/5KV1BR' )]::UV:K$]..!
MQ]45E>Z%?0OR@Z:MZ8TL MT2!!^><[Q >A8E3K.G.ESY7A+Q\+@C,KPMN1!@
M(Z4PC=#B'3%J#I:R!X( J 1H3!%!5E;')^K3[E><'>S[?MD3R1''@/X'+U.<
M7J+XOCP)<29AE]PT0,3%SMACDM/QX82HP!#1M#R.4?\QA9-$*,]X]!U6]"=$
MV>SUK[,5WLYC2 +$0M^4XAB,^NB"\YH[/:UG]VD7H#2(N=PB^S2R E.,^ *7
M/H;CYQE. ME,>(V>:LSL2 1XX@'FVYLT@\L-KW9BM&!5?M]N&:4@Y2.-+H/,
M%QC]H"O5(=5C';U$IF:Y7B4, .4 F*Z7&U%$Q\U1E\\ VCVKQY'[ZG=
MS %%'*M(*Z,B6)S
MIX%']QW8@)JBU#UJJKUY&CGSU"XW P )YX84/^2XL/0"38*3#J8&:7L\Z*&O
M9R-Q$3/<% >&&GJ,':/N^15]+MQT)<9T]LVW7>KL] 19]VFP1]="D=C^2%ZK
MF^Q57SFJATAZQ:4DKQ]#TVW.BC[:5%7,6 ;W
MJLD. .$CV=^!K]\'K8NM Q0V4%^7K] ^6^B@D#0A]!F10.\E F8J3! !(4 VFTE67,7
M$ M7?MVVXG>7DI=B5F+'5X3N,SJD>*RAEKB4C+KZY7U#YVL61)>%.+,SXN/O
M6J^ FV3\[$5PQFWW#?BW=U^^> ?N/=@E.7BA#%D, IOR;Y\QGGZ&UR 5^
M(1^A Y M7=Z [-=] ^&13/24X?I [T 3IN ?,WD!8%?2/)WK'NRZ(D/Y!)
M^PUX ^[]FZ \C7 WK=OOO[V>SL.H?=02OO!8P!'9"NH929SN^!BO4[IQ4N"
M;I-T?9V)K!833^PE8?>,6$W-PU/OBA&@U0??IAE8<5Y!GW>/X($U-16?[M&1
MVBD3LJT YVJU^RJ"L- N45)" C:=N-TNA\\P*T@TX[F0- 3LFMZ2/B2?G?S
ME+3M,WL3+EY*)$@!9%NZ!"R18(8PGZOATT$3'0/*+R19WF1E\PVY5
M^&T]$6&FT[HR23.XODSRC*Q6BH:H%W"3KLP2''6H69[6C!'VZWYKSB3L.9LV
M4MA<<5&C4IV8<79 \@--B"[4$,UT.C;M5,S9.8RO"\JB]RPLKJ,PO2,PIT=?
OH^\9C'H#VE&]L3E01X]FYCS\7>M--LEXSZ@?XSP]J17\7A,,Q$I61BO)%Y=
M8 2*Q60YA?;T[$6D.BY*7DMNJ,3=M/AMQ]%1 +)A[FN>B'%.F&0.@ .(O>9/
M'OJ!*YI**)EJ#)IB#11QC**,NDD@&*?EI0KW#%EH;W0JCYY497651^LI.F(,
MA1=J5%"?Q;=^2O*46DR50Y&53*BSPSE*BB(E&S3V)&&Y87\Y+#ZG1KER=O2M
M\+-AY7[%*J5HI(0(.<#9-;0EH:=&7):0;CC)!+ + 9\8W&@*TN 7*L@\J1!=
M12A5=KC VR3-C*Z7C>C:72<:L/!P+7T$7@ 886]X;>#%4W1\(E B4Q3!+YS]
M/&ZI5L!MGFZ3 ' &,W8J2G[\P'(,)L^V Y3=!=Y>)G/.L-'-HN.@CLV?(WH]
M&0"'Y\P#$-Q!@SWXA0LP4 \4A/"GA,!\A?,+O'\L-WLD6U['AX=I-L@<;G(.U$ D0H*@%]Y6L.))JCT5"%$7/=IW7O(&5;^7FONL
MY?G:F9VW2;[,[TMZ;B@T34/N+>$X#?U,F3\>0"GX+7
MFQX\K,?H@4)=G'@&(V$*ECG@;'D^(R", >,%:"<%LCK"LWTQ,]886*6=(-*C.YQ>-ER2Q.8<*
ML!$/.5)AO. ,^\JR'Y89'.8F =<^7;.#2/X'2 "<^#AQB*8#E/K)>SA!>'K*
MX1-9#@-4 DYCLD
M:#^SC.*$P 0P]8M%#V<#LXKC$:?^1[.RU0!KR!#=[>O^ #/B$ FX^WV?,VM]_+6R=
MU@* @T69IRNRT#I/BF<=RU9]RTAMQP3<*&F-5WM:/)!MONB+2\D"K B/+T,8
MZH"&<;\BOC)"L-432BLE6?4M8P3;!+P@V.FE%0S!'@WC?D78)3[0YA(>$K'Y
M PG6ND*9@1+(7=ME(EN^&I&4Z$C
M,63M)"8,P7U1Z2-K'2@J/4<+3),5WM%77;17]--D,H8Z]5UM][>P-->XTFN[
M2A=M'3WX5&:>,J!QVK +:J:CMI[SU
MG!KN-:6S.# '1;G\
MJA>K]G]4:LRNF+8A:+;%&T 4
MN&J2>!'.J"QOG*F;">-GE+T)Z-
M) U3H)@(1C^@/&:%E U6M0HOV^W5XO5^5
MH*!B!%V2#$&"=?O5F?KEZI RD,8-& M:+7>F,KE\:K-9!TVXK@#/-(
MJXI%CX/%CI=%SDP9% 7K%W?Y>4>V G;+\7X:EA?U:G(^URA0\ JZ4A % NLJ
M*4*]"^-F3-B66[(9V69'>1;63KWA!V$CAU\G,[8&4/201,Z&]+']T?*0XGG=
M.T1O 6NY87,S+7L'\Y=T!0NR9C),<^RG8NT\:H+^+*Z(?J&H 1;6UV&4P'3<
MA2\:68E$P0I07O/LE" KGTF8?TGR7R%U5!%DG?9+ U3LENV]!#WLG=@*GOK
M5O(*NE$:1P3K*RI*[H7/] %0H*("(OU
M-LU2NM:FRS4+SQ@E987'"%7WWB$8,N=(6BQ#^HCP'GO<>OVS%:7=@WOS[M?K>FY-Z(6;=':D/2D'$6Q[V[0ONJ" :N;N+2
M]-&5>:/'YBS&+&L2<[["CS[BK(I:AA?E>O2L0- A/1&5[SDJ&2O+LQ8>4)5M
M%O&[]TW-7"Y@A!FV46"L^+2]I@)&.(U@"9H\9[MZ R%)LX*Z+2R6V>5GRGN?
M%L\\8=+TX8$&,;L=V1A=' [#9A"RV(1)C@[$B9I2PL2:C1*FS
M
```

~~MX'R=9DE^N*,7M--;A'H5PW(1X4TB3WNG1R8/3=*@:Y"22A1V<>G?LO",>+U.~~
~~M*ZI6L-5N#U!)02TJJ&4$7$BYS&7B@I:\@-DQ@/$([--].!SY;H^&XM-YVV<(DVK#=Z96NZ<2QYBP,GWT:W[+~~
~~MLN*M).!^&B-;9(-4!TYSFJU"K;A-]%&H4-@G)ZL\L=,0GJ9G$OW3;^MTQ:9G~~
~~MZ7=5R^.>S-G8Q$L;-4FS27:)A[LN:W1G?ATZ:YL$51:;TS4[BO-+G%K&WL--~~
~~M$N&()'8W&YTO6CEIDX:-4'=DQJM&[4/1DCID.%1C@-?U%(N^&TXP]VU&NR[\~~
~~M1?J2KF&V[KY\O-[N#!^GF-%U4-)^F(6/--']!@@]<@[5@S'TB>X%YR7(#=NW&~~
~~M'Q&XB!7606T*=!0>.Z[#[0HJUL?O<3GW^2>7Q4N2(CYU-PJK"MLZ2XIT93W]~~
~~MZ)">'G#'N?B=8\1[D\MUX-G!??^AFF3\$~~
~~MV8(LL)(G^'%/FWXO-TRD1ICO"2YGR\$*0SMF[AU4RD'+0?T5?@%Y/^UJ23A@IM]XL(DQKZR2E:M~~
~~MRH3\JGIHE0J'%M$-1G$-P$FCWTIP49:D9!L-&B1(H*/7:%PJ(,4"4J[9"^3U~~
~~M:/#'G(B#:-,LFJM&I5]F%T3F%-;^JUCD:4$B],4^)-^7CT7JVT78F,+-J2'9~~
~~M"^(^K-2R\)F&S"KK6A26(4U3.QMWXJRV+QD9.$!6;V(-Z6O6%60S[G?OWP!J~~
~~M8#&&)-?6IQ&BIH+[JBQM/(0U[(^*R$/:,@,-*8$0$W-Y992KKU[PI<\=7*&D~~
~~M*-)-NF*)/HOU/-=%24]D:2[08GE^W5*[RZ-VB;WSZ=%2$@-U]"$QH[3GWJ,3~~
~~MW&AW%?R4,=LC'\4TKYT=*L08O%R8F>8";Q*(K\ND-)=@71E!+23/'ER-)3@'~~
~~MU]W--G,(4VC8)A0-DK%MQM='T?VU2QO&T.E2.IA@-TW&J7^D4KWP(&TG4#;K~~
~~M>(#;',.VG=48@#(Y-!)~~
~~M+0A=-F?D/ZJDKV-]/";-GJ=IWJS18Y>L*F--UR#U:!F;H-Y9+T:W.+(Q95YA~~
~~M,!L&P@Z;*M/,CNI\[,T&KDAH=FE8EL2-+7/4Z6~~
~~M-3P9-S.+9;D.O/EW\WSA.EO05RQ9B?="UK51;7+&5JE)V8\=EF032I9$!=TI~~
~~MT#.UEP3M(;OFRE*]>,]ZL.8''SM^\)%6DHE;T2^#F:0IR-A"Y=9FMRBZ!/GO~~
~~M+4RNG]04<^NGZL74[IL&E10-*ZHZQ/,-QF!,H]-=&]*P,DW;<],46IEGN:2+~~
~~M09D-V\X"-8FZJZX]F5*U:.]MP!I3^^]V\G'?--0E'P?L#FX%,+;7LR<#-)M$~~
~~MCUH+RB&"4QM/]M/VUVZRE0O,F<;7~~
~~M8E(#175CR3&-SF6(G#<]-\09^6>Q^)P:O80;(33-\%0T/13!KZQ.6%G-,-HK~~
~~M&X1(95W]:HL5CB/-/T*"N#[A-D]V3F><%WB;I)F)4-00L$L:5]%R[P1=A0=-~~
~~MVA-4/];236R81FHU@U\XDC'#5BZ"QYYZ?V-I1[IK7UUJQDM>/<)>5KIWHZ-R~~
~~M@ZUN#<'#YKJ,&JAV^PWG<@-1C@GI#@;\PMG.,YFU]&KZ(6'X^PX>"/NRILYK~~
~~MX'@>;A][]+AB(M,S4JIX7H-NO%4UMV;%EVT30MIT?+2MJY-$!D[-Z=$W'M5'~~
~~M3+I%QVJ=UW-7Z6[14G0;9*NK[/S9)>6"3(WXA%"=GTYAFAZ:)=2L0.4W]OK~~
~~M#-B.0?ND:"&$G;06*QI("02H@9G9.59DX;Y'M$Q+7[*KA:/H$[6#29>^!P>J~~
~~M60-5]FU?D;;97,D83VRMUU/-#NG!)O)N9G6].U@F:0;7LF2-N9-U4;#L-Z@B~~
~~MYMD+#+N-F78&M9GJ"-M934'0:KW;%G-6HZE!,NPE.IOV>W&6N0<&-$~~
~~MO/%6\&+I]\D.%W\3!^A!-[\JG>,AQ42B7[G)983GM=.IY[AZ=.Q*1\UZ)*A9~~
~~MWWM.>]8]IM576*0XH$$(=!U"G7P(\QO6E[VI&&8W%KK4S%,0M0G[R4]DK,%E~~
~~ME!DYAO!A(QL2TA^--\>-H/TQTWO\-!E+^^FEZ-/'~~
~~M+UAMKAP@8*C!,6A3]?\"+K3GW9\RB0S@#F7<9VG@Z>)WE^~~
~~M(&N(Q1;OL[)=R)ZOLDW6MA;$K19;QGGRG#%^<%>XG:6*C?PQ7Y9)F*VBYU:17#1&ZGC"TS~~
~~MG1W*X",G0XI-'Z!&E&?DQVBP5V!>BX'(2,%6V5RT3ATV)AUH&,]RT]IGUQ+*~~
~~M4B\-(4,&'1[]FGK],4N=1)5>RBZMHH?)S'$AGKG8#N3Q*#"HYY,!--R/Q6*@~~
~~M[-F"N9>NAU2D2A:VGJTGJ'\J?GY\-V8N/W-]"GH,+TG6E-;Q3HAD!&VJ-JSDG#BCWE(#4G27Y!X0,~~
~~MH!(B-(3IRU,'J;L/O*%]]33FGZF>.ZKKDP)6>VH-Z;QWL"GS=%4VJ[@U[^!D~~
~~M;?2?T-*97D73A'\3][6G;-GVP9R5GZ;DS05Q7LDD-'E/#QE;K88^-<0)^VIE~~
~~M@B5@%G"<"NK=]S-5Q-R1Q8S0#O.5G\2#G\%U.,H5JF8WDE,9XTB>;G.T)-83$<"YYH/$.%K*!,!POFXEZ'@X'"27~~
~~MQ>,"=F-I+18GM&(YO9&CUJ#I>H?+P-+B[.">\+6V;"Q->QK>[Q^+=)U6(4TN~~
~~M^DT61U.X.'Q=K,/02UH=?ZG-3KGHHJ77QME+NGRTV&?0HQ('%G/ZNEF?J).T~~
~~M#A$<^EZF5VW=64O16A0YITMA9@D0'](,Y^GU#9=.MIJGLEVD16W9?4]P-L'?~~
~~M\)B$"W<\K9+IS".-D)B-](W;=D^5#6$">!]E+Z"7@<7+91<-5[3]YA0TG9;L6*F/9W#%&DUI+@'89V0'~~
~~M\HD-6,(,[/;/*%V1KQ'7)]]6F0>I)+G"@;>[9O!K^G@'BMBAUO59PI;-.8)W~~
~~M+RY=\XBB^ZG.TW7.:)*"#,U!-[G7HZ]Z@7[<6<5>=F9O-0A+?K%&NP.TRT"-~~
~~M=HX?:Q<1%$9'G#;!L,#;;G90#<\-.03A-Z%&-NKBUII(<~~
~~M%78;MX59OD"?KLSK,(Y1LD)SF*@-7PWIAIJ08#,M1:O^=H:'TE?411#GGA*]~~
~~M3H1G37-S3WHQENZW!EEO>IMS4HM@*@LY?-V8Y3!!Z6]P-4.29E2\979!UM9O~~
~~M29F^F.TT1TB903="U;WGU0P!Y<@A6V:@P32D[^D"A@U5&"\X:!(N<9A>VGZL-*L$O5GRGB8BII"$+77P,]6UM'~~
~~MGI6-G*MN<'3:M4-HFQ3/=.K26ULIOF3<^Z/U?2\-6-0'P%D$&[2BUB[NU<)7~~
~~M1MG).7&9W;#DR30GMD-F!UT8^[]OG&8?*2-@5HF6.-.(Y6=N)+]@2(]B@744~~
~~M98:-,"#ZBNG#BD-UY($,R];J/$&A9L9XVUR8,N7*YS3QH^06^LZF"W:(8VM-6YHASE>0;@NZ).-'-*$L%IDM)=.25^[GI/-4UKR/A%W~~
~~M<)7LRGVN]5G3EK*Y11HS\6.60@6^*/.)"<+>3154%#;&KK@P,E\EE-*$LTM[~~
~~MY/$TY=M;*+/^!=D-E&?)ZE>X-HA+-6V8!J%)]J>D.8.Y\="74,9O'QEGD%'6~~
~~M45G6,&(*OQK0HNER;\>#IPB:MF8S3L=B03=,TM,*3G"MI\N(;$8;+6RB0GM(~~
~~MXW*'8$YW4AP*MD=HAZ7H-PG6<"NBEJ]M0F7FQ7+G=M-J2M<^R&FR\!OTV(U-~~
~~M]"9I#7Y91\E9[U9'*/O=IY(M:,*YT\();U65~~
~~M$X+O3'61Q!9ZM9^!K[.T3!-TRQ+^ER+?GVTGY#-8+8Z\?"J>;:9G"R:3YF9G~~
~~M?G-,U"F7J?NT0NY4JW-SB]4=06"GKS2(<%%,W?9VHIC'+?$QLW)&0G640[;/~~
~~M1)@=S,L#^9%F?>PH:G&Q-Q*.B]6*IK,0-@>:]4$^1'Z3[^%:G(YKG-]>13#V~~
~~M$(-2>/&?4";TS;Q3D-"JJT-%''M4ID>V3'A@;>Z)S&;&XGY-2K%W7L-KF;OZ,#GL%~~
~~MULRUNJ4^VO4]=/UDG(JQT0\3]&+!G3HJ-#6GDZX6S!0U0<+ZNG,U$DZ@O>#*~~
~~M(5UXZIO($-T+-^DGY\D\A"ET%]^<9T#;T,-&ZRJMURY+90K-P~~
~~M98$IQME-Q]!BVFFVT-6Q4-YM4X7'F$:'.8!9L,S-EVW[A[(]"G:-WLS0VD8TK~~
~~M71*MSPX-%G2KNB3;6.)'V=-B59+%$JT41<],TVQ/3^3Y'\F2W&9^IO]@#5-P2;2^>$--2F4~~
~~M(U'<6T?SG52);=(AEY/=[5"S88=FY&?V0&-G?>7Q-/ZP+]@Q]1\!GBV2>K7"~~
~~MOD-V3B%^91:'GHV-U?>1QM8MGT#^:!:;)T5A3R-H6D%8O+!!G'X\,J*V>#=*~~
~~M\;S,%!>0;-E7*9M%Z;7,EGY9-\VX%^(@&2LO&J#HHUIVS8Q?[S785:4+F[^D~~
~~M-U[+W0O/(P\9:G5@Q-;*G1,RI$"+[BJ;G&;Q&A80:7GA*YQ?X/UGN=DG><=I~~
~~MXG;#=*Q-&"+IWG'.DG5Q@\=2WH.']-$M4+")IB(%0+A!Q8@UV)6L@.1EW4'/~~
~~MYXOG=O./[G-GFO#Y]BGA,\J!H,X8EAFXX2UU)HKM]\6Q:G%$'GV)9\91RMQ9~~
~~M'+'.BN)U]]E:;#\QGZ62-6>:K6T*ZJF^,1=>G@GYLPR9;A%%=.]7/Q[73E2J~~
~~MEO%;5$"A#.8M1>>@][G3-N:!>YG'8-X&-^XV[;B\]994#;#ZBFS~~
~~M\/O?->7K]U--;?#1RDD,NHU?/=IKN,4~~
~~M3526LGT--J%J6ZY8DX&'+DK/1#S:;B]K'AG39YD\-1*ER6.*PA\?6T"+[35\~~
~~M$G!6NP[1O[-JY-DZD)4EU?I/8V-R1;D5O8,KF+[0'-5I3JBBYPBW8](^9@W)~~
~~MA5[P"#9Q>=@-8H.^U:>^6-'1*<*J[M>K&9RH^OL!6;$3PP;!HX0<@1-@Z8/~~
~~MGVF0G\M35*-,NLB1HJ(#0,,I!N"8R1E$8K),6A9G08MLO2R?(:\N,=%+]#@X~~
~~M0D^'F0^-$GS9@@]35F(%&)>3&8$]Z'WZ>GX=8#7\5<)(8J'@6Z6AQ4QQZL/0==#]D-GA6E<3MB'D=:"L*6SF/'06@K>JO&9SUGH~~
~~MT\";>G\NPTFU]VO\;;(O&?%R!ZT'6R^>V'K6W9@?&\]:G+G?]]G%3?)"3-!TDB-3]Q,GTB)@G>#MT?>1RB:5.&GG$~~
~~MY:Q]&-UZHU)G,>,QY$\5/G=J?")\[&/B25,Y!7G8X<@'<9D@F4!@GJE^ND]^~~
~~M5#[L-I"3M014&X&#ISTAXP,](BIF?0QHS-&EE1@R]Y$2*-2(Y0F+8[L8GQ!6~~
~~M$)R\#>A$G-HV-#X&G+M-@OIX5M4^H;>2V1O1.H'M5IN]%$Y@^-V<.#%NFM),~~
~~M>=-R&(P[X.R!X$-?)IU!GHMR-$Q/^9^=:IJRY-DM46;9K'MF,@V84+5,8M1E~~
~~MX,6.R=>?$WJ0POK\J6KMA4TJ-<84VZLV;OQZ')%V[1-U<25GP%GS>@X]*,[G~~
~~M@F?[(LT@?2G'2G-2N4/\1:L"E1U=-S-.L/"3>4)H%RF?'XDO/E;LJ^=M;,,F~~
~~M:B-K9XY@7JD#\Y!?GNHZ=DG'?;/FS5[QRB)2BQXX(]Q$&;=Y"K)@]GG((LY5~~
~~MR/\[WGV=[N;)-;8IV&8IQDU2R(A0I8O/=JQBS-&EE1@R=W^L4J?GQWVL8FL7~~
~~MXQ'""H*3MP&=B%';Q@S'*H&-#9]0;\#X)NG%H-G-FS4&3'E#[@-;//&1&#O~~
~~M:840T(R~~
~~M#@[6UUF40"G=1#*B[G"AP,"+)S2[0IG:--%WK93=)>/G[62GP6%H-^-5.1X3~~
~~M2@&Z[3[3K)JHS6FVMZT12<]A9<1M3N&49":=T"@H>KRTD58--G#L-EL'%\6Q~~
~~M6:^V(L.@YU!,6'X=P1DO!TLWGQU@^]<"??U?XQZ/->BI-$-%J#:W~~
~~MU>=7?6$R[%9GW!)&]Q\G6)P.ZJ,[E8'B^@XFG/G*GO2;]U"A.-=%5L(,5XFK~~
~~M;9D5T^EFGJ[/X].I9V3#=+E6;LRB*J#3M/@/:8;SM#S<-WK#V$ZX:EJ38ZV*~~

MK(<2.;2/7M6OD!?K((&41:"IK0MCF6('P>Z94-NU'&&PRN@JV8$FOYF3F":[
MVPBEB5DM'A!1G@*M5I>\;;6##J$Q'+R,0*Q,67+M8C[A[$]+TG(OW36921M[
MMZ;9R)JG2Q036XMF8..Y8X0M:/"=MQ9IZT2*;E26.Q8(+C_#?)46AHF&-!EG#BIC&<9*H(AJ#@ZV(A>
M9R0")>AV3[8&*]FEE24,M8NVLG+8--'#^QD38PCLF$15[]OJ3*G=#/=T-:-^
M;Q&#Y\(-*8#,G:C^&20"LL@&%6KV.^0;G#T]P'PK"D*R?6=C?VE[O3Q*=O+-
MZ-@'SY=W*U$-DY](U$/EAFJ^>5[Q8'GMIG-)D!L]4I&.G2!4-W4QQE=NZ@.%D\4)
M"DQG9$F-U]VH:.+Q0U2LT.PGZ,=34QFER<09>K;4@-3K:RI*]0M'X4["^("G
M>7)"IVEWD-B."7=?)GEY4\O\!CS"I&3+V-WI!O-/12309;9N20MIF<4^.?WT
M0-KO=@C234."J-Q7"'^Z&C8XW-+^E19OS[1)VK7IT+/NH6U2@S%8I\4*X6*?
M\Z-(MG[8$$E(6*I$"=I'R1!6;*C@^"$$"O18.*-<08/M-'U"^/4"/1HSVP,W
MOV>YKZI)>,@:8(MI>N!'J-:D/;TPC1''UIH-!73E
M%E&-UZ@H0,"K]X:,\-0GP>R61%5@C'"3]8::18[((ASMUW3?W*D"3QN.\TK-
MHL6!E[2P@2)LS+C5):[HYHU)33=O2:?8/^\WWZD[-EJUB9J*["QM1@VMJC75
MJG(%I,"JJOR\%/Q0Y.4T10HRK=2D!-RQE?\A)R>JW+LJ(:GG,Q[J7'?2IK@.
M/&5.G:[*D,SDX7;1UMH#!FWF5>X+M\):QM(/S;DJ6>:W9)LO-M'(3?HI07NX
MW/!.+K+DTWN+%8HI@RGSF1DO]-[S$WQ.5XBV>!-\P#Y;P[Q]^QO#RL02]>-5
MBHW&3PWA&NIEF0,J-Y#-,B;T,3'H),0%J6JEO9-%I5G[B/OT*4LW%2K)I)HD
M\BOKDE5#3>3^0-H",R//GL;''"OXI+/TUL]^)4J3T55G-%>",!X-Z
RU.61@&I^DZL-[NY0M0<0#WJRE(4D5$1JRU'&A)0[@\E@NBR[(-H*NDN@U
M6[9>9KY?@W)^9"O.&5+[OH>T7R.X8-O-R^9+4)J<;:O>FV-@J#4FR0LL,T>O
M&V4ODG86(>^9YQZ:92LMDN+-#@O)GG"7I&@'!YCDT0ZD@D*HO9OGR'G-,W7F
M3TF6-L:=R(XXK$L1*7;$,,90S.T<,[4*H"]YN
M8VE#(M-22>&<:Z%H!*W$-K5<(^=&L\VR3@T)>P'MJXA]Z:(Z[WV-C\LS9%B?
MP3WO^3U,(8:'B:,AXD6$XG,*UG.-7*B5@8LY6"RQ./\D*
MXI9(OJ)M'BUFYB$J5ICW$W1]''G8-,DGDCE1-Q>LKR[/LU=C0W^Y0
M2U,B,V+NAUH*FT@[2,8R#[N7HN.T;,&G->-%$65UL,$&&O,<8Q7\K4+L,!U7
MQN0QP$IN@<\@M/-8MA\7,=6-[@<]63^@YON,F?;[KX5AT\OHX-1G2^LV(&+D
M9FVZ;G2]QJO]5A[&?-$?]ZKD\?KIQ)XD45]!JW1\HQO6&%CR+?QBZR,R]A^CMXFZ&
D]-@9EM.<9DNZ&)[O>WE(]E=Z*.&G;7HD>:?1*\7$G8<97;=T.$OPNVT^Z:M8
LUJ749JBYL[%7*DC@IU.--D9^7-->/TI18A(=$U6=-D3[=;"GZ!,.T\R)&P%
IQ$/IWA*G@S)FK=\O!/=090=G'B2JGU/(5H264TBII3]V:['B:2RX$1EP;WK
Z:@,=G!*L5'PR2!I'H8FGJ*)%Q7B(3MAQ]XPG>-GG"X=&3OCPS0GFL8;;A/R
7@Y&A-"RC-+G-,R>?JVX$+Q=8Q'LA,0*5&RK7<-G@7P+Q%X-B5K+Z6]P+025
$KI8VTQF915G)G+U\-"*O[=J2"/?7K&0Q!\ZQKHHB9UP'GNMG>95"UL5)D%5RU2-9V-Y.?11=]PUB
?.HB.X13)%%%!QQLH#+/TV:WU!*O3'.3)H\I8M70I,Q-'KJ.7]-G-.7I$Q?X'5&7&O/:G%DZW--
]5.K.\?4J#F!C25ZUAP=(RGE--U!V!OI1&DV'(DP4$^W#^P0%>\AWU@^RWEA
"I^Y',+C#%-+$WB"<8#W-/MV,U6%QG9RM)MX;\2:'=XF1?'PG./]TW/=]G!"
%K8A4>/G5"/Z7JZ.>(-('1$!E%R&1N?/&))K[7#%UOJ=*1-M?O-X3[@J'--R
7[PD*:);Z2NYGTQ-1@M8,T(&HUK6O3]]"GX/H2+/*<-LQFVX>0,[,Y
=MA:AZ>-DXF7G7V623/=RX/-DKG[32LDVD2'U)"QE/47>,9H
3:R(N--'7,*)7F5-U*Y@I2Y]#X^%&ZQ-G^QP\3?-)0A:6]081&RMG%,-#!UG
)5-"E&-8B]B*-^T+LZ596&&G>0=14HI$WWO:N>0Q*>#Z-GE8]W68RLGNAF(2
4[=W%#7*K.E-+0P0THAL\UH>(-6*9-GFR%BP6WQ\W\WJBGG6%-'N>G8J*[\^
HN;J:5)[R[DU-.0D3'-$"FQL?TGOIXNX55@$9YVX./=\V120]54M4UZ>%I47?$G-**YG.8-8W
Z>37Y/8\[*Y]+=GY.-RH[)A600AZGGL59^Q*P2>(J;G*YT(T'A&TY0!2D*#;
-78-6U27Z39332\)*^QZJ+F-E"X:>11Q3!9G6&!-+?EN.M?*O"B6FQM8%#B?
&/9-J-KU-]-FX*$%7&5I=--%9GMB?+Q=^?F^*/&6OOE^RF'X6T(+:+&]AD\"
1M1%4-:/#>"<@X;OZVQ%G.,<7G.U0QI,T[3F-;TED%=)-*?LG
78]AOVG-2=>-HG?5P9G!1K4G@Z%Q-)D]GR-),R))<0MG-N=@E=G72\,NQZ^'
G-ML/\$$$"[BMB6.V#*"-;5E.>(WF5N%,P'B#BQ'8\AF;YLNL%%PX)B,IO!
D#NBI1@U/^"VXG1"#57R<8:/OW3<)N]63-#G$DD@'\4#ZRK*<^#N,K?+Y.\GXL1T
?"8U=@TH)JL9GL@?5E*,BN]WVHG/UL^2(BV6FULBE'RGO;
YR1"8Y2NV=]NR4^K--^-QF5@W/-R?C[M@JV7I-"-:0]O0,(K@M(KWAUG#G8X
!X]4>/KG74-\=GRXJP9--[QJ#B'8-WJGUH1=PW?"EM,;O&?2)&Z[)G';,HF6
;):%.^+1-&H.?MD9-*(]^&5G\(!+)/\G-6;>P15*BB+=I"M>%6525-2E9FR]
>H2]1+8GUD+UP0*3(6387(-1P]/>.G?X6H:&.>5'/:+;.[:;/<"/!5QN+HLR
W9*M;6&R\.]^TVK1V2;BWE0(?3J15!Q"KO![5(V'M1&-6E&MT>6-1OWL5.$3
C]G-0-]!'[R\)HGOQ">ZD2=-N(4*'MH=<%L(O:,J*$4;82E^QXX%J
*'A""OVAP=3==J@H\W1%W]D2#M:[H$$D%JOK-7J>]GR2(]-TP*V.#AQ86TTQ
JKZ]GVGIW7HWXUUHI)0WV#3VD"?KJGV?;$=$=EB0Q(='!+E8)M.8)D&KL*E%
VTLW+]ZEJ685(07,8[-GJ7'2-G/LIG2[DE0IR\.GG.X3H]'
8GR[Z=,GGK:ZI+W,>9PY*)//8,79@[GB'VP"--8/VV@RP:?0ZHQ>Q.)]RGM)/P-+!E)JKZ+(
-"[L6S1J"&3;IMD'+7Q3DE4E/2;9T87.!'O7IGFI7\P8>1\-Y$63&)I&4+$-
[AG&&"J:O>@I\P3P0AVH&%>V7HGGNGK-.T]V:9F@]#>V*5AN[O&F-)3DD%6Y
FY0:84/9>%UNGL3+5JHM!KUV+80@8,7*!>["9E!,0!E/4-3)(-J^-.G"*:7@
U1\M]UVAAH:4HUIV1Q7Z:NZ:N%/VE-)>[T4!R^(JG=(2WJ0O<&U^GJE!S'*[
,$+7QGY-L@2<9-#)6A\I;*RYF%%!/8--G@\PAGHGEXY<9KM+TIQ.1$M:Q&J'
BP0M-GV*B<.FNLQ7+K]/LJ:NER:DD7MG;&0![23PXL?\$+-)F%]'<-3+"^JJ+4/QI0-9QG]-\8KG^E
")'M>G>$R#^9>X,!42MPM.F[]Q5)/Z1[F&.&K75W"OB@-G3L*.IXGJG^/*-W
B9*X=W"%G\@:G#8EAAN8YW-M-F+B51K$+%-MG]!U[T62@:P9'+:R@BY&V%AG
,>-1Y8PQFJ#!#HG!HW-T*VG\D"=V*QN2]&D&8+Y/@J[Y]'#!1KJ*%8,Z)XMQ-H(5J/"8JB$&[Y=I6D^4\)VL/EIK*$AB&8+^,T"5KA
HD7;O;=OMH#QI1==T3F,&8382IVQPX6.D%KV(!7V-&-"A*-!G-'ID??I1W&$
%->!GL;$HZFVE"$9.--+-1W1G*WEYGY'D]9F0U0L6GGT$?31>J-@"141G'1K
H('UE12EYE%#Z32%D#(*90V+]0O,R[1(LZ=&$J65"XR2LD)GA*J'1\\UP-Y<
U;G<01<>;*BP>*%-/2B$.VVF+1A8F-IF.-#E3A2#O"889G1#19\86&Q>K,G;
G8J:<-+Q&)<-]Y9)-9IB!#VWGH-P=J#?TT)3GGRGGB3'0-(N@DAP$$*P]G>:
^R#E3>U'@B+.2B(-XHFGD(G.FEG=P3G$6-H&NNI<60O%8+-4=]JQI
'"MLH,$X<4$*2)GJ)28J&+GXQD?X:5%U^;G-<49^7,'&QJONFR&2DH/.,-?B4%E"3K?%R69+-/B@2X?+6K6ZE.TJ**J2]Q3-5M^045M&T-A-%A)"0)6
M5&$=LI-'K$6J>*JV>XWB/8N,3BT$E)0"6*=8'<>4?7N2B]4@\&,-:38X-4
W)G7+G4+G:84#0O):E-W$-5GX:Q);+N:@R%/\1Q'8*G1ZQOMB@6=-XPA&A
GF"6RL$XB@>R;%:G3-='6,JV+>L?"[G9(-IZWG+I,(&!L>U9_(2/%K%XV!5
BRR#)8!2(K!G(@%$90H63J8;-78"P*D!WDYEWI&)(>6-GWO*!A+1JH9(:\"%
8Y4I;)ZO:2F%1>X@"?/2--W4--1MH/P-Y%J%G&.X%@T:
:&!-/<6G^59Z'5.[,&;![@T@#&W;*O@6'O7+#6[(-Y[KNJ&G)UW5Y9UX@/P;
7%^OZ5.532JK5HL)?KW(UG-I\IBBE);-(7\G]K\V/W3QQMKN\9!;*7G7OQ#'
:E(B=H/2D-D(H8*^(?-D4M@G:*-'?!OWY+5TH!;OR)H6+FN*Z"3H-L=7M"+9
=<8*D]%?604?8]*N=F=#7#P<2.ZWVR0-T,GQ8Y;LUZFX?@5,!M-0-I"?6MNZ
Y6JUI\>!D6VWM0Q@>/,]#L'I@#VT,5?G/'^1J-JNBKW&7<--^U5%2N+VR0O
EQM%87-[%8=O2>GJ-'D5ROMZ1$X=QU=-+|GG^/IO$-0-;R9GQ//B^VH-3W7)
G)-32VE[;Y[K14T!J,QT%:3JWQ%J<5/59GL[G"6(EEB]?X:P-"''^UV:/=D%
.&V:TTK*G9#W>['":"$-?8%+L>)\<3M
JP,9YG+[-GVU):64@+[JE'(")F@9@8H(F?
TKUU%'D"6"F>T[<!XH2;@OV&B0.EYUH"4I7GJ+Z$T9=X?K5ZQ@A#WG-
M$-M)1(]P@254(!)-7]?K4+-">9RPW^FV[V57X![G!NAA
2/#-0F%:=IL?0KG8'
&^64UJ.Q.'%03$15Q]F01U#])-!.#IKTR4\]-=#EY/7.^^A6(*)5I3G4ZB,?
,T6?%JRJXYOA6Y--VT8\I*&K?;G/H7@PRNZ>:.)?5E@\7/3#=Y)QN!#![^4
LEG1N^BF',HP$4.$<&I*BM#A#J]78G:=8(-'8PV7KFU-0G[GU:AN<[A+TK4@
3T-4E^4GG,5IF>T*83J/"?6/G-EYKV&UXR*Q-'TJ$]O&8BH56(EG25[5(8+*
5A,LXJG6E2T4)XA^-\D%A-ZR"3T3J3J2[I\;3F+DRK.WGJ-7/8,.O:YBM<7R

M/6S>([K8$(U3G;A@'F/@O<@;Y:XRZH9$,:QV# !6;H/T]'P28"K\5.+8O*4.
M[I$TV\J%#ZKH3 3JF*3O6A^/D9PJ#("B])L^344*@,(W6-)?<&?XD)"] '/,
MY>8&TPRZ?.O*07113\1,GXU?1%IED&[UADQ>*[1?TW-R!O5%6K!BGW'XFR'N
M2A\T4?P)8:SPUO:\Y%]4 $ ED,2'ZX[P6S=Z997,YF:R,^,Q.0Z;L/ Z%G\!
MB OI8V]!:JE:^9OGB&RN^\ZXGN<5C]:/:-E$E^XA 1$P)56 $Q9MV)UD!^Z>!;B'N3A\
M{"[X O.27?G>YK(V+I,P#A<<1E/I=@/ZC1,W>7=_;&"+,T;T
M#A8P?X'K*Y63KH(T[MKM!LQHFA=9,R#OI]X=$P 4#(E?K!-
MM'Y&M@9K.@?!K&">Q41>[EBWX,6J3% 2\N#BX-&>V]29P9*QU\-(;ABN:?A,})FX!J <_"'I,(-$5JV451&49,L4*3NKA5NR96RXAB"RH.[&(!
M)E\G\E0B@H+,P<*0,GG?PIP5%62U@\@'"G:.'\FFN2 NX6#IXI"KG4DY$\#K
M4J::I%@!3X3 W?V/8:..>W/!_E!Y%:8A(TW?LJ8A&0]!A8@Z4KB(ECJ7VQW"
M!PGOR9XM%9H\4G6Q<\S/V)N%E\DP4TP^5Y13G6>="S%Q4G,LG ^]U5N%%8HL
MY#A61+[,3+DX\@+?:SOIQ9)]R@F$H/V;MUK83L5G+B]@ L\?VMH%56GB'2P*
M"!O7T#:QRH2JE:7H,PB841 REEC@BNW5>Q{8"O?M5.OAR9Z,5D&F!XG
M9NGJ]A3PZPN,5 #)O!A%+
MVG,8P4WJY+&'!9N)"T%CGOX3,K@XO#2#M %:6^PE+>GJ[@]"K# &L96PMPGE
M9L$2G].T D4(:!G LF4 LK:"$"=\2+C<;"]-ZGCY%U2OKKQR%8I2B=V*YG&
M9^XNT)DE[U2%]F-6S45*R&R#2A='-)A@%.JG TLD3M0 5"< %=-8$"EZ5I%
M\(!P(=($B8"JRN=N'I 9L9G\4LB F^\WUB(%DZ*O3J..(P#8&4'/VG!G]9\>
MX J/5V'=K=+O^F'8(DO0H4B+E@XF.>\T^A.VIF:LO)\R)$(<^O-:(EL29%$M
M4@0G#I8&<'3X8*/]$P.[M]Y, ^F6#X\$Z>@'K(A1U5B[\2JJ(BT 9GEU#T*$
M$UNGX@XG=(5S>@?L8E%BSF7B-&7*T* 9-Z5A)B#EB6-!8FT#RC6)G>I/$F^%
MU ="#:@L0 GG?''"K]=%D]\%D;H?DX*W, B<;&5+S\<#>'GFYP2+??F,
M).,I((X02?ZFKGL0866L9GRL
M&,_TTG8R'E Z9D+G2D>A6W,)<9L2F*[*\O$C1OH1.#DL,64R]
M2S/AYJ%*#M[N]F6U9&?]S$8"0H5EPM% <
M;=#2Y"PAE4MBN>%%RPN7V8:(6J-CR>/5H!A+0'G2.H.
M1<'+?(Z)>?;R1\$0)!7'X X]@ G64]=71K8@'LDO ?I4\:J!&?E8L6ZF9!I
MYQ:C=$4HWQ!.UR7<:AN(,5GS>V S#G[N\^L* T4M!3$G*0;8"3G"W>E;XHLG
M:_F'!;(S&;?6)TAZLCQ& ?^W.GU,G2RNH=WX\5,5):')$PWP:OY "D V\%2$
MH[U[K*_$K@;HY7#B-L?K :I4OPJ'ZLHYO(5(WZM Q^H4QF 6KZ($9P+R[P-DDG"\M6$9FB\V-ZWFR<)]M)
M9A&8^O @Q[;>IZ@8E8\&] Y^X9GLTHHQ2O++#.9/A M#O9>2'R#-YFBO^'J-
M;[X\Z"'E9RU'FO'(N(&"LPNW:AL# >MH*#*8MQ9?3 N<%1"\,)=77H5& ?*"
M7CBCV6:8'""CLUA%C9.S#7QGE+W,/XPI8%QY
MRK?D2X H*.? TY$V>MA"EW$GA?1!FGG1IAX %<1J^39.SBU0->6972I:?U)
M^/747 ..../W%GFK OO&8=KHA!F*W GKYFO KI4/"RVJMX!%OB]:D7#R@A
#E4V@T3%P'+QYD5 U)%MWH4:S5>E20%I]@0S>KIV=OA(.YM#GK7 ?WTP7:^9
4+7+O]!FX Z*6(IOBSE=#G#V,L=""! TN\8<66ROX) $1D#..<"KZT H0GS
A=T@&OI :FUW44ZHH3!+5G5'ZAN3A&XPH [).<!!(A;#RU
TE 8Z5"QPJ"?H'L J'C%\MQ, Q.LKZHH]8\&5# OLNR.YC*:KKH:7[]2; 5]
]];,2(>TWF.%XMZ!QZ \U #;G(L0QM \U+:^9J\ 7\&4JY%3#VZ% 4'S2 =Q
:+)MBW.&O?':UMP>.U^TTF.+AGN;%.1#FJ :O7AO!;&H$K6TV&N6NM=R(;)"
;?.[J!B R7%2PT5.1^HEWL@K]S#U\9B]J3&+/ !$KY^FEY Q!*Y>$!6"
6\A 8X+UM97C!B@EOJ)9]O/N.X'U! !(PFU]2A>2$0J Y'F)2.PZ!5=YS[J
! P"\XQ=IR6?[^!C4D*:7+4LGV%^3>P]H\]TM9]%Z%(SOG+1(^SE4JMFS4H8
YIPY*ZB!*7O:Q4GP#W;M98@B E=J[YL'Y]5@V+.OG],UO(,O, O#L\.'Y)\X
/]\7)=X2+GX[W,$=SIO!3?OQA% V4PN&V'+V6.Z!OK1G8@$J%Q""T5L')AJH
9*. JJ2K8O]02G^ @]&9N622KEDB1?=;QC 1FX"7
&4>R"#:=]*@6]VL@"G6J4N8]H3J*&ZVH<6/R M68I%7(TZ3N
WG)4\:P=S$9/ N::ZTQ!Q9;JC1] Y 2[.7I1\WY:]R36LQHHGVL34G[! 27*03UX0;K\"<. VC2,V,+)@U*G H\A U,J^ZJPP8[N$E[
1^5E"E@@A# 1 O!7.+ ^\=RLT?B'J&X@RN8QM!=T,]Y6I(=WL9H$69,VBI\
&')Q[UL $I !B+:DI*5+\XIE 3X1IB6D52@W(6<$6XGQ1"6?#IPBXE2\62UJ
R5U>JQ6@Y@^8 (!*8',^< %WN$G+XN>T?):K/]U3 O5WG3>Y*G)>3@PD(_")
< (KP2K8^<&@ZO&8;LS*ZX@IJS8;78P57SO&^(B&%W3EK%R'O6#(]FL;#VK$
\ 5!S:Y@%6[EJ:/)3 I/PRZ[J8>>\QJZ[VG@:WO<< 1=N]UZAXR'
PQ2VN8LD8/1J'(^I)"+MHJ9B[X85&VYET4HV/EI6Q"4K:HMY T5,LYW/^3[/
R?)KXC"^Y\/(X!.1?WW3W?YLR/9C+;< HKGAE$.6XV%\A*6;D2B.51[HG /4
D]@ HG3U8RGZ. >6 ZA^^+& 1*4WZ<;H)'T2&[O"!O8H! [JG[@XX$9A" /6GB'K03) I6Q#
 &6SWGMIBZ3DJ[;,B4*%A[+RNP8GO2,&U8HKAL2@"T3(+7/1Y06^R"^>)5^IG]9^,$O%2L(^@FZ]X**5TG#U\ !
ZZLG2IVCGKI9^)>,=*U>>6)&QG" !])OOZ4L '!5NVCRD$XV!WGOI(82/MQ8K*<2]I LD FI!(KI;GQ3. 4 8=$8
PLQU(I+5A(JW '
\,^6E7[:7[0,$)^]5OKAY,/&895Z\: *8E$E:FDQDCX6 S8O^W2HN3U3O _W
GF X .XFCI=\!OCIW(3<.'B Q=6.K<>LS :Z[^IE??D\J96L&J*)6&WR*EX
^#RA32,YH;5#4\?1^G5Z*LCIN%^='%(B!,GU=*I7(Y99/CKDW$+W/RMKQP N
'?]RDX4S%S0ZOG1W2LU5FJ4EI Z[OLY*HBOZ@FY1%! L%EM:GN6W1B*#T?V)
&6&[XWT3'GY>]&J>(&%,0=+@&D$JG1VX>)*"3P5(>77#.+,9:PT:@'+FH,E=
Y /,G$XSH)H)"37C5"=F8XPQ\)M4,X)J5&DUV@ K$VOT]'P28"J2:^QPG'NB
E#76$)D%3)L=&)%U'5N['#PD(@P#6!>"HR)$.E7VPJLW4:J5?!I0ZDV2;13G
;/,PH)!:'1^3X47 *6/2KA%5<9G=09NX4G$B==%!L/7]{])SN+*YX!\E8(39 T> +ZQ:WD ZE@PLVT%:<&* A]<]{)[?,
US!?XJ+>)Y'A+%G]BO"3N2^,4;)[!CU(U+U'"/)!'YKK(8+ E!2M]H4O,%9@
F8.:&1#8\# ;*&= %FX13'W[72>Y>,>[G' G2 .B*J%?7
>$P9$>D5';ETYLKW=
)6E.$6'.GY/\R2QWKK^"77Z\DIB''(;*!6UXAW#V]!8Q0'A&O] W"<.(8#UE
1:=]8?W G'P^G^$Z+<^3/#]LF= 0#1.QV
>GWT/&RED\^\P) 9D&WU:.08&U5Q:A^ *CY.6 'E0.UNPT?)>4."9^WW7V@
A+[:UD5JS#.<7%W/@LJ(E\Q +WV=D6UAR59[3![S\]4^"E8@J(EY6/\ G ==
^XRH'>MI)#H5" .N64@KG E&;0 SPE=T3UKD.5$*>V U0$9FN@S2H69YDS &
V,?5&N=9]0%L< 64;=A[FW.SFBRD]>AY@\K6L.F%G
ZE]@Z:LR)5G5ZHUB=WJ?4M.&K+O&C)/,GU[G%*\GN8P4 T5=EE!O.G
 ]^U&7J@!B%G>QBEZ<4?&5>02[8 ,KY@Q1D'\TM]I+"1]F)%I?7,]>Y2?6(3
C[G"1;GQ5.P YR<.0F9.0Q.Y63\G=,U;'A:K5;Y/D(Y#GU&P+3FA(.;>6"0#
VD"*<@A<^V,(JRGG>G4+8Q=L "5QA=JG>M,1+0>SHFX!?Y,FGZ) G^Y$Y8"1<0"GQ58M$U*).+
 ,!=B/P(A6ALN819/S]42Q=L3G1G @I4*=J(*T:@:ZLPW+>GDOEZ%@;M3A
RD ^ $(B($5BRW3>^ *F7QN:L9$N]I,GN SIBO= %=[VG8&;LS&5] 3@K#9X20 +$QI#=\)UDY"Y$F,$!MEQ,XO'R8)=$="8IV!!1P0N5%>RIL.)S
JY:X9&O,Y8W"/YS:G,)WW %[OD&TLS"PCJ#V:X% T='8UYN !;[G=+=+LR>RK/T'6>@3^D B5M7D2&F(BEW%MEZ"'LXA!2^VT7D6W,"&
[@1X2OT:E!BLQ U8T!PS#;2POA*C1 9U0*'[+%PM4>D8':M7T+R()'OPA[4OX(T=&IM*=N%STRAAN8F9>Y"H,S[)EYYI5 F3],V**/=P[F]T7B\T#'WO),:GC=W$
&PGZIB,GH9I\?;'ZUSXE9/5#N>*K%IY 1,53@*[X@$0P"AB%^(6.1 02GX9;
&VB6'D,/R?(T0078$6+/";TLHZ,FF^<=V*0O$!3[W0ZE/5OHD(.I'*XV$\G
*H/\F6:GL]M,O,]*LNR S= LE>X0/]O][1.YPN\W&S@JEQF9PFB]X WSQ"6
=[!]VX9 635LU&(ZWOQ
#K"3 R%K"3D2 E0 ,[(Q\,*.AH0 X9#CV 79,!@52,B.W4N8>Q%OH]I(IA
E1G.^G%0" J?8NG=FGLK5F\G@Y^:IEZ42;9.\G5Q9 AO "W;]I'$:2I5S$ B
;/"\$ZG+:@"@'@'@OP#+#(A! #8*T!T&O96@ P%R(.!="QB/)4#WGJ.O)L
7Z09+(ISO'U,,W[7@K,B7<.< 6/Q]}3#)[(\.$^*Y\66CDMWQK(B;>R)%ER\
S!I2#N(E2#DYX8D()&B@!61!3!9@H7Z*<#GB:HW.\I2LZ'N11 QG>P[)$
["GA !L=H^W(2(?9S&JEOI2.P1:5,)&9J2;X@W:JH U>OW7=7TV*R+8N1;ZB9Z].R:.6B0=N^=G"L0;.F"53 &
G'/PP@Q&"&(;=4:.%G(:LYZ)V,:,*]XHDO1"V"^JIZ/4KE\^\[P $2MD>NFY0>,%YH^X7D)2)H!S"9H 0X%
UE91G&H73B"Y@*;BYWV*?4]VQ&RG=[^"69*GV'2EUD/ ;GVMHN5AIR39 ,DG
Z!YH$ &LI9W8M(WZ%#WGPDGR #$K=G"5;E*X E\K#1"QW$+VT/ Q("!TWN 5
=K, A@?6UE.,ND?]:I]W(2,EN,(Y7"6%1?'):,8G+T' X6E
J]03G;Z[DYY3" U=)OG?*557&G[E?M"@>UJ7@LX+03C,(6;.K1 Q[12#RZ

[illegible]

[illegible]

[illegible]

M)TOM/.S2#&&]C9+JPTPNC<#R"'8S9^/ZU.U&6'E! @*IE93BJ2R(/4B,^375
MZM$+\G#25EQ@(BV$5#\K0LE=1 ; 9@4 D.#MT$1%PT&>+VE [J0"'@I>7!N%
MC]@#&6Q-5&!*4!A]VO*I^T#*38LP3!5*\\L9*RA JHO
MQEZ"$*B:+-\BA?%D@JK=T5&@=6JLJ@!!J]6 Q9X)&:L]0/!J\VRR]T*COAOK
M?=CLN9!\@,Q1OBIC%>P)D7GUP1SH^$)5[,V(O$OS2XJECU8TJ\H, #E"F>RE
MB;P;U40HZV/;[!&*L3J)E(.M,#>"O6N9?)M2U"1G=QBK]DB KYR*Q5YN
M3)=YM6]%?GX>>^,P7?I-^ 0@G9.E^\N GM[^5A7+Y"TP 2COOG%^* +D@1?-
M?IHV:SVLK2\'"A@ &^OVD0"GZ!.3 MTO&M2EGAY0[4%9SM7L](ZJENHPGU,=
MLZN\M\ A F5MO2&)4PUD=*21U[0H7R![KP#IS/DS#B.*-34)9 /+V[E A0+W
M)?%AAR)35S)\3Y!]]P-D>;20%77CT!GL\3<+W)!(IZLXH.V2R<^Q(Q.Q+J/W
MN,=R)E*6R,\#&LJ]0NE 15*:9(SVUE]^37EG U-=:FR\DQ/S"R T=.%V/,FL
M2KBQ-04DBE<.\+O<,RS7TMBJ%WH7HY.:Q-(XC3T:4A+S&I1S!J'\TAQ'[H^>
M+,M63R -)BMYAJ[-'1, I)B?W88>IHTJ."?%FIY@;]#R= RW!/O3(-2>H@-
M.91>3!T #S19B,@6GA &3%>5,:(F>)[09HL#*]BEG%Y:0;"CJ8P;6BANG\\'
M"]J4$TQ"XMZRR\
M]9W83C13=6DXZJ23^/#2']S@@)R"/]QH38U\FJ<#F;;X&'HGS]:AS)V\
MB7/2[],&27XY3-RQX?4K"FPW!+J[!*CW>:85S;>)>) K6Y*Q\LS,?:(]KJ;D
MV570['/M=!BX[AI
MNM2#Y3JW J6U=2/+$YA2,R'EU72+YW)PUBL^UMIM1>#H2KA VZ+7L N4EYKJ
MXD.ITD:.$:)<(/?H34$=%VC!\.'PE=I-2%=TWBB&T&([^Q+?>\LGFV>CJ\K
MF@@.)#.78\ZX?FW84PIC<\IK-G(5*-4'C6%D?L6;1IF%6T4K@\K8E]C-MQ*&
MW: ,+V-+T;3BU:P',82,+4/+C5"%;LL>:!DKF[GA:;%:&%3360/8K RVZ0#6
MN2U&T 6!7XSO>:(8,I-\XE0%S*U=#-#$G[W'^UKXF='XU#K@R\I 18" [2$-
MOK2^ (!-D5
M-K79IBD[D15$;P9!6:D:!:SRZ^"]25CW$GQ8;PCIYM^;!$=NCI?*-J:B;T)\$3?]1; ?1[MT>5 P)V#]>%TU&)/L\OT#.W 32?@.M2I:$ T=S.
MP7P@RJO\D4/Z46*:QQL\U=QE9 J\QGS7*H";.S.]$X50PL4Q^Y?
M;ZLN6P U=J>Z0(GA'+LO[TNFDD:?>V-O,6=96#GGC*)BTE2;:*I--!53F(HI3,44
MI#WA,AN?SD^XS*V@H.)E[GE$SH^3C*W:@*?)=E-M=7: K8G> /2"M 1OI3DYZB9
MBH[^]H NRD]Z\/H1M<;)\CP%EA\2Q8MLD22D&=^W/MD&Q/2,"3D[
MU Z3!U?[ID!FFO*MC81!E)?'9MQU;JG%00RX0-G*/^%,Z>W6MI";G/(V CD?
M^1N$)*2^AG0;3E?CYLD]>WLYU7! B3!IP:V5V7.)77YAV3^0DD.
MKANE=8X6R+:V41QP]XT7H3QH>TC(^2)IQ'Z 83XCU88B]TC:-,9,<[V{0]=!
M1"JG> 4R]Q<'0(T=1%?W)'. Z(-'CFG9.=IIB@U4Q:R3&QS0&Z7*N?N$+U"B
M;'$'H(!$!WT)4HF\(C])-QHD$R<8^DW865AU 7Z 7Y,<@GR4%,^W2R8,N=
M:SV[7H(SD1E)M+)8@M+ONLT6.E8?8)1C49UGNT],^W2RP'Z^R;* 6HYY&F[M
M-D>^$;1/G(I3C\RC\X[=(]3;=B2J.G)?Y.W(,CWMDRJ.>N;E%KE%(53!O0SG
M)!WCUI?K50.2U=&VO*),&""Z6D-!N1)-8P? Y?J.2%ORJJ]A^R//V[%>,UEW
@7RT=+E]]/7?P G(^9^G^ZG81+Q\U'^OWA/SXM+Z$L0"N,+Q<[2,O5PN 7TQ
#7043^(*;0-DNVD>@> ,-O3)Y7 9ZB1G-"^I ^/^?V@!Q\I;Q!,11/!U,FJM(?3[(
1W%Z0C@](:S\4M\3PB+-ON/+P0HZ@WAZTC1#GG>"[\U G=/IG>"YL9VYY+T3
/#?VK2FH>QG 6\%G\ MUB;T5//]H/##'BB"6K]4R0(U]E2K9Y,#5=A-K$V?^
/=FX,]78S06\YM9#4^KPP)4NG +53\:>?M6H>..#<[<@N@S2W.
J4 -,U+O[BQ: $EMVC!#@^K@.: UI;-T9;:*B(GQ7P&MN!5I=\+;UGGHUUZ30
(2+ .0 JVMH.IM%#EV2+ >+>W)D@!9[F5D072+=I!+,J8X@U#3:X-XAL(/<2
R0H$O\B[LXQ'D" 5L.B0*[&"G?'0'F6J%BB>&GOC*\ 0E-M<0'QFK&$K&^*G
9'G6==W8"UV7[M U&4:Q%! D6[F8UL+H?RDZQ7' #WP*0,WUCTM^?86%7I@5
.$OTF].89"/-'/)\#\ +*#^;*]VP/4G8]9BY;S)P:W8E8'=M<'TP7\"MSJ
)MR'X*?X!:#FNM$EUTG X@4A"K# =:K+![L4T*RM$E(:ZXK71VPQU5C"CA-
]) !KV*E-Y8,*;"5ZRT> +6=]J0)=B4YTXP4!7U&Q MHOT\:5=CTU%)=G>!OK
R50O)F 1X7-S6\XHEAK<52T+J$\GU:*C%*DN=UH ?#;MY0Z^H!9P)3[R&L'N
!551+C#^,.D9'25$337M N&/QL;WU&L6 D79"]P 3<9))R]%:T' NG/DPP1
P+J]*40!\&0,2@R#<#<8R>' H*#IZIL*@S2UHRE .I7O;7]S()7@D&\8;),5
(,P$T9L")6\'54#S7A$TU X0Y!D?,-S]O0K4GHU59Z#MT ;NT'*;MP*K#\9&
 CCCUOS]^PK,/IKKR0"W2,0:^D(6P'\RU ,L"KR"IJ0%W!)U:1/@/O@8VN4V
A 6C AW9!%B[M4XNT#V=T#V4$6V]MPOL#,ZY$L>NJ9 Z@=Q[#:+R;[^5@2-:
S8-TQ-3/%VCYGO[W^^)VCW![&WMR<]@>#N, S8.5Y1^4MZTI/+D@7 ZK^K,?(T>(+3T9Q; G24%0V8<]U\G(B#Z4)SY?9
EK.\0C<-&<=/9/X7'K!%G/RQ%1=N[,2P2(5'20/V*;SD8H95[IZBCHO$=/3>
!.)CO-E8P8Z8-4PKRVSP E,4J^E(Q&H!2I^K)G6;''DMJ#DS^(NL2;9W(O
T2$[JE&\%!5+A HVA&1",YT^I0+7##%\88R2"S>6&R2^CF (HO^[W"N23SXT
4>A93E2RIO98%4,R+L04AQ9"BJ5#U>@BTJ&93I 2@6N&F'L]C!(*%;WN^&1!
;9.\WD1 F2/5;>G2D78=]8-F.LI[ZQT +M9,KX%,O 5CVN>'>=?"J# '$Z]
1T!-H)%$W^Z%2MY@W8^.2 B>= Q8'^F!J*08\Q/JZ\RGZ"98A#D1IWJJGP(
\+EN(=+SR:[C3GD3O>J:-!UO?QA=]9T"JYD1T0DXB/6I&?#/%8NNEE&2Y2O&
SD 7\V9)Y6S+7]%WO&DB"EG \-'J6H/-\'>5:%V3D$&!0=!L.4#HZF\
ZW:ZEY-4J^Q)G?L?Y&1,[I>"[B: .@ 5ITB2A1,6V0-&B:>#G/-\[GN%G&'A
65YZO0=M6QG5D@-19/ 75M+QW-555$M"N(T*]IW
 H&T=W B$&81B
SU*.BU60}^>PJB$CU"'P#22J*<+U&# B>SH"<^#V8OE>E31O\&E/DN4ZWO4
? %'V,(\3!A9+#0>ALECWZ O9X%@>6OTE=,, %3\W'/4N:0[7'\WA8<
[7RJ%25Y4=M\O(Y"A(N<8N6%9IM$.Q&5Y/#+/A6-FEE@(-9&R8BD6$96>3G%
!YB)6 M]WVFXQXPI?M%[-"!MZ=#Q\ .(3B) B@@ (&Z>(+B@;24O\88&3@4J
IC33&() .&9.L8>2E6Y9EH==((^6WTV2')+B]PEG1?5V(4]MUZ%4.VMY^7LN
\R?DK^TX4J\N6SDH88G[PB@QMT"1FS[/I9C44 .HZMO>K9T]IA0[,'>=?"J#-/5+2-&^5Y.6E7FQ7R
X04=.0CU+!.:.%1N!]2-W%%J0"FK-WG:V1$T>2"$>S9Z!## XFMJE#RZ1]$=
#L,'%"0>)I@,JOFX9[ESR)7BJ(L5^&2 %,,)B94&(JJ#1@B**
14!"Y
8=&.3GR[MI)2+C7"B AKRT -=9M%$1;DIEH3E%\G&Y,*ANZ+#/#B(Z>HQ4&KY
57K"##\ G 2U/7 OLLV:J*@NP1A;Q)*-$ II/91-JMJDEK#O &'1UW]1K3;6
/"LP:=4"/;)\QPIHVV@GMJ.,@YV Z&XF!+N/\V)K7RD-D4W$042[J,KYR7[3
350=$>NO*FG^* B> 1#MH1<4?#Y-5%1KTYLMD?U4RL]I#M$6AY8W7]YA?W5'
)*B3@IKV@4^UR#VT.QM(2H97;H#L<@!A.!18G)K"?H(UY&
/RV:7]#5Z!"AW%>9]0Y;DI^FCF3'#A.I EY7&YQ.UGD=#6!3#]H%EQCYJ7,B
)+<@(IHA.6J"!X"?GF*0GP++*6J YD46#]F!(,Y)$; A$#PK7IFQPK7 MB
WD)$M>%+QJ19+N0 5 R\$-M53*\$$E2MO*,5%6@+M,5!X7'MUO>0
V* 78>1NR#D%65>'7T(WNNU98ZW%.\U SEA37V?E?9WE+9;6>-W0(>4]P0RT]^,&K4X,,X ^3 -![EF&
VZ<)-X#:Q7#[,F[<.#3O JO3D4M\H W%GR:(W-,K"F*P0:
F"^P>S R.P20J\$P& FUP9&FP[":K@N>1"N&UR3XQ3+N&(+3;=":B5F -3Z)
?T@*+L-MY%< (!N;839=!:V9^ RLZ1[@>WS!$)ODOOAKG +%#R. $-2\[V+P
3O=&YG&J>P+(H)JNB^RZ:'GMR=":[HODK^%O?AF$&BZ083QV?TK:B.?PR7SJ
OD Y33QTSU@6>NF4J;\)">&73C5$8!F&)9?]ID>\O3^EQOH=H&7OT;T(QCCL.
-IM1'A KQ\+N421O-AT& &;"VVODQ!ZQ+8\3$\18AU"$9M,FF &&B.!KMD/9? WW/.GX%8XJK?[3F'C3'+2L/Y,)=P'-
!J&5%N?+BG0&N%*EBQ--G =+*TANB1L<;*Q;?TG DS E@@R8M.H7?X7:D 5*
-D,6R*%NV*6;IPH5"^0[=Z[U['HNC6^2W\4;Y(AO$NE#JZ]L$B7N&B(VT"WY
)^@E8=77P ?\'K+\:Q\%J]WU*U59PKN[RV]H\XP"7H.GD02,FV^62X.0R-JD
]"YQL,6I)Q#&$PQT/^"&Q'J;SZH(V:RT)74S.=/I55KACB^@5@.NJ9J?I\S6ZMR!$].D,'(ARS8-F;/
+$[&C9QJ?PO+8-8 M&J'8Y%0^PU9]'\7HA#HD>&RGT[,#LH%!74ZE@H5LZ^W)
PXPM9^X321H'@>NODJ(S,EQ*4@;65:WY8G=A>99OH\!0EQS)4XL>X^< D1T]X7DP>[%0)/ZT^A IXII62171%C)(X-=EU(G*'BU3/
4J>9QYYJWLNM=C^ (OXBF@L'L3[U% ZY\A3F,E6:-)21$10J$(H]RQ8N5O6H
-GG9D.U[$T?TGMS02K1I[3,:9O-#@06U3SC=IQZE5
D.FO'U4WDQE(N,]+2-R#2N6W8@%'X-64""#@<(\@F4@:L')N$*W92.I--+2U

[illegible]

~~M"H[5;J "O7/YZ/7I;GUT5[Z[=&V+%E/:;+%/-TOB$LP=V>3/9F&(DGSP.]=Z~~
~~M)GLLT~~
~~M5T32):+[NO"-T@L 7;*-ZRCIFTBZ=[X&.!1=I3T*NACO?O@KZ.B>!%6V]O?W~~
~~MY7[%\RQ@'Q&$'N5Y):?+J]Y%S6;<:(VC[~~
~~MQ[FUL<"A'$$R.G]ZW(*7!36,?10A ;6F6YCEEAN?4MH!02DZ'0L6&9\=W0'J~~
~~M/=N!)91/=TJKMR2~~
~~M/VU*@\SB-@-2&N0UJP02'8Z"T&/+R>\^,2#QRJ>V-^$E=S^R"HV(<)6HN[Z3~~
~~MPRUBJ/+3T]85JTN22(\Y(87<*KJTVKN[HX[5$+VXFA!LOUR24TP@\%WKFHI0~~
~~MHB:$Z/ #/LI>'.1-VODV"R/O5!=<+&9-$U@^T?%"ND@7~~
~~MF.PN?LX!Q)3O5[*$Y(;-&L(^HN#%M="MXA$^F592NH[>+([6B1I\;VW0%=Y8~~
~~MU(6*4&I;/1%>X?NAF8ZV2=SZQ$",J=JP<,,?T!W13*>'2-$)VJ^Y@E%J^B1$HA]25-T&:1?"*+=3P664#BU/M@EW-M9]U=%\ K+5KJBPL83]<&~~
~~M\&JHUJ&%E4=K *6<01M19A"UM^&IUUB)K4HE6)U-2 #G?6G)/ D,\'P89OE?~~
~~M=MW!?UVOP@N66V#LY*XR:+&%EPWI+:2<$#:/Z^' \"S2CO>P!Q5F[J~~
~~M%#\#R]L+ET.!I4?W8/6H',1 1B6 +P!IZ + >MU,APP%'/^OR@WZ7YK\EIY"~~
~~M$W4"88^HJ%*Z,^FGS.?Q]RHIDEUU-[W\'5RNGZ2L.9%D(9$D/#@M<*:),Y)@~~
~~M^A927D[I^%0-8@ ?AP&DEX99<'N%:S%ILEUVU]ER+!/G<-.((-Z0\7G>T2L~~
~~M?!I&(PXZK2-P5+W\A>+R&5- G%9)5@ I8O/\W@R^#7E5:^"!3,=,&7R&UBF7~~
~~MV6ZD0(XE:^8[J7*8:=Q%)?%F=J#!^77%L~~
~~M<,X,'8+:.AJM#3^E=:8NSA[G3%UTQY@*AK2H4%92D *B*BH/)*P\,D.B*6J@~~
~~MI+2,;%SXGBI>.DKJR 8.@,G)=Q=XD'3YFMN>;")W#RO]T- HAAK@<",+(9$+~~
~~MAZ3)G?G ZAF)L=BA$[+3]N.K% BU2K9U@8DYG7#(QFR:DG/3D:.B)N.'OG0~~
~~M09JL$5DG#U4>OT=%LU?=#+=GMV>4K[JBKK,EF?]6$^N.3%>:[;@U~~
~~M&4;)'8;^=/1E.9@,']/S%75.H).1R[)^. BE9!?K]GPI^J!?[4HL&;FO?BPQ~~
~~M(AOP: 23TOY \O5BOQE#7![Y#!/W%2XJ\[9\NU)^=4(2GPG^/!+H=>[7*~~
~~M<\W"/1I"G%5JH<-5= "[PLWW"#0%A2#,ZH#8+XO7+70W$267E9MO646KZT']YQB=Z)$+<#'^1[_J%)KKK[4W7WB(#%E3B-K4-6=>^-1FCU;*^-+2U~~
~~M%]E/!FO!1/R4I@Q>0G#AX]AI)A6SI((<>4+4(G8K)B22X'C@T!7%,P]3204[]AOK(A2DLL%CK)A7IN-&OX3J12!EA N#U(I1A>? [~~
~~MQQ.N6(X:VA[F]O*=P3#;#2T/<^O+@P?9:N9BB-#EV6GDQ,':^T0&I$]N>]NG~~
~~M=D"(*')~~
~~M5CV6[\@ R&<2-28$)R#2F?1HPJIGTR+?;(WR%CP)B+1W6,,*"H YU344GZ'H~~
~~M,E^\K7#',^RQT,L(@$*F J3M'09-&]/6(F)7OZU4&GQ$21DK40#5)6EZ2X36~~
~~MB(MAPXB>4VK9U+'G**]$6K.JLTG<*PFL\~~
~~M@V1;>S=^]A$^\ RF*;3=?>GM4=HG7XXE:7X&W7R.\FD8K9U[XD5"4OY*%R->~~
~~MPR: $KAJDA)6\J@83-Z>HH-JJ@89GI4*]C9$HEVI)(Q%!I.W&U%-^NQ$A644~~
~~M58:8MQD&&&+FU.4#E)^\S4: H%00W0]P?0Y&I4GADEQM.$#U959K$F^]62A^~~
~~MWH)1SYM,K'[\?#+L@TGRRV\'Q/R-J($1D]]]9!7GPSX#()=?&6;>UBG0QDQ^~~
~~ME9F5GW>P']W=P#]F8#W%[XGZV9O7FZHD?[E+9M>GXT.TJ<'XEA$H#GFF;IKI~~
~~M-"U'VQQ3SYO[3@7.0/3V=+ &8M/5"X#>91/'1HR (>EO[L(>DHWXT@'(,W\39Q:!~~
~~M9)%)!J2WG$1K0#9#V@C'^:R!YS]L\A8Q994DAQ/A:ZN'[>+^(THKLKCN47GTN^ED37L;~~
~~M'9]I^XVHS1 M+S-[$ AZV=T$+I?YF38V7,[&'W:UG]17)%I;2YQ,?3W/I8]~~
~~M^F2!U]-@5.8EAGM-RQZ"E,UI'S 94]DIB9T#[GL:4S6G.IA('PBTG6@>8!%~~
~~M3V&J/K9&:J<9(&-66DWJ'(S! ^<#ZM>H#:A'/Z(ZJ01O(7R./3"4)U/*'-4N2$\~~
~~MEC4<- I@*9\'*8L,,X?G(,D=8G8A@&=SA3S$?56(ON\4PG#TL((;-;">#T<&6~~
~~MMTTF('OM#A?% \J?W@FZPGTV;B!XY'0 9,3 1\71"BVODG6R)*-]QF19KE%>~~
~~M)B\I>M@OGZ<2QW^ XY0L+49V4@';"ZB(HG)!KM*TJHD~~
~~M:QMRG$V)T]KV/2Q:#8=J~~
~~MY6;?T%MD$B&6UK7V 3-3J98A/QZ$209 +&/,,UXY,VSV03Q^+*G'JL=:&S"~~
~~MAY34.@S+=6P(KRF)#R8,/T4MOJXT-F#]-J2I">7QS]DHVM:B=ONWDV!DD~~
~~MSO1'M>UK\7H$X=&?#N$BFGQAQXD6S[K2!FO^7#2SU@FCH'*\O7?KG:[+B~~
~~MZ8%&M>MJA3.3R =$(FRLOT"L9I@%U8(01EJ.&KHP@AZ/-%YHFDE:%*"RX)<3R~~
~~M]ZRJXQ-3TU@95:UQ>=3IO/]A - *QTSAN3@.YV'I.-0!0O];%';O@J%EG<$~~
~~MZ)8 WO+#AXQ>##J":04TAIF:78/[/"N3)>T^6:,G%%=D92>2D78.A=T3$ K6~~
~~M^4 =6O9#>HX2E-@?OD ,,96(%I4K]6D-@H:&AVE*6I"WM^T ?Z^V;WE]X-QU~~
~~MGN+3\7[Y-EP1%8ZZ+X6)"GQ!L*#4-3D'\ :A^@/NG^)X2*,,QF!1BK$,[B,B~~
~~M]DL2E[N5^"U+RN+QZ1M\12L$V5[:31@7M\V+" V3%PGW]$^;+^IRYUFBWILKF/5@:UK.WT;-LHG#U,GW-\UD&X8^B/YG&#RO(.PT*-$4"PG*]TG(P ^EM6S'FM9,QZ3~~
~~MN%RGK#![+;*[IA,KM8VUEI]DL?['A)"V?M(I?.3VR7?JI>;0"G-@952$+4AO~~
~~MJRS+-TI8%>YB"'E;&5T;H:/P)8/&V]+2#JSVP8+>+"7O;>GYP;,2PWV(X[?&~~
~~MAZ23G,;K?D1I 1I]E)>;9[+UBRBN;S4/=]NW3P\G)GN-AFXYVAG'=!46GRA&~~
~~MR9JJG,8@R6H&!2"5LJQ' =>:SD BQ'?G=X4=[SE#^MKF]OP0F(@6MQ G<\!260M-XTX!FIJ1BG.6I~~
~~MI*?OQ:;UBWDZ"M3!.% .Z%Z#6M:8%K[V3+G9*- W"RKI9+)=L.:>#R#3I*,Z~~
~~MU7 %E$#2.8*Q %@/(4$PDG+'@L@I&M/K?&":O[&.+6=&35P$H\L@'+B)D :~~
~~M./((%+LV6Y+"2 \K%#QO8L[:$T?XV"4U!\DOV\'LI^JE0 \KFC1=UZG2P8+8~~
~~M)I)'#EZ#AFS7N,U"+^5M1MR[BB:TKU 1YTF]J"!>K40(M(Y#4]#7J*2)H,U7~~
~~MG)7O1 3]P9T@U4ZDBS'#=I#N(EB@ M*8AE.!['[XHH*//AMZ4 ZMHC=,U~~
~~M?328*-7%ZR71=-G%(TF)P,-UZO=$5.3R-HMS6@E8.]}J)+O/RJ;W/(LGHG"B~~
~~MY2+[(\J36O\36+:=)#%T"L,B[7T%&^@[7O9"'$$/>>K+M#PY'L!?HY^T9/L%~~
~~MSG/\@WR$R^B# ++$,'DV@Y2M\]6HZR06 :TG#'Q&Q#U'XB5ARMJ<^$H.W +~~
~~M44T?@U8RUA)F>PVALJ37W+=?&WZ#BM\>!NLGRE=T[G#\GEO!^GQ-(T#3@B(7~~
~~M4?8W6<^[=4X,==@HU')L5Z%N,5.#.M3<]DX'#+18- J";0\K>9Y"5^ZO-8.~~
~~M!PQ=MMVVP- GDQ%3GX84]JH/J*LD IR:868W5L4RG X>^M5YK=V:3'#E(!#@~~
~~M=MGTDHC!O6:Q$/?#!Y@;8AFG9N14,\,J&$-@8\S6~~
~~MK-2@D*[TJE22'*:-"!;JHT<,54#\"MT]Q[-Y-KA'*#$4A>!PK*?>4LV43H"~~
~~M6.FJ.$VG3GN?=3W*]BX[\Q$]Y+PBD8'/IA>'E[[,OQ$@?[~~
~~M]M"&L J6"19Q\9O-XR%+7M:+TD\P&Q,V YQ(+QHKLN> WDWZ&<^GD-Z#G?2&J\[_!U!+-0(4-Q0- (*2E:D@N%(-MF*P" $YM~~
~~M00-0 " 0 !R=6XM,G-Q-3R,SN>&UL4$L! A0#% ~~
~~M @-I*5J2&TJAJH:) ><8! ! (!QJP" ')U;BTR,#$U~~
~~M,3(S,2YX~~

"
-

SEIA

Solar Spotlight: Arizona

EXHIBIT

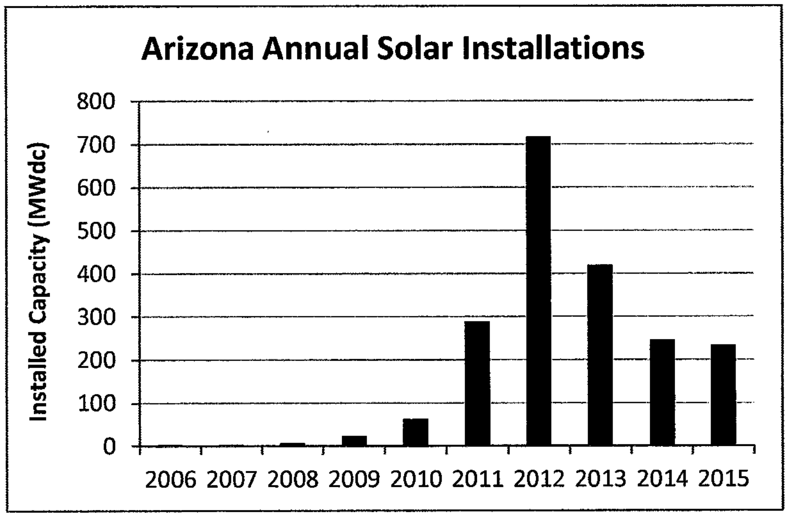
A/C-13

~~ADMITTED~~

A/C 13

At a glance

- There are currently more than **399 solar companies**[1] at work throughout the value chain in Arizona, **employing 6,900 people**[2]. These companies provide a wide variety of solar products and services ranging from solar system installations to the manufacturing of components used in photovoltaic panels. These companies can be broken down across the following categories: 66 manufacturers, 28 manufacturing facilities, 197 contractor/installers, 21 project developers, 39 distributors and 76 engaged in other solar activities including financing, engineering and legal support.



- **93 MW of solar energy were installed** in Arizona in the fourth quarter of 2015. Arizona ranked eighth nationally in fourth quarter installations.[3]
- In 2015, Arizona **installed 234 MW of solar electric capacity**, ranking it sixth nationally. Of this capacity, 110 MW were residential, 19 MW were commercial and 106 MW were utility-scale.
- The **2,303 MW of solar energy currently installed** in Arizona ranks the state second in the country in installed solar capacity. There is enough solar energy installed in the state to power 327,000 homes.
- In 2015, **$582 million was invested** on solar installations in Arizona.
- Installed solar photovoltaic system **prices in the U.S. have dropped steadily**- by 6% from last year and 48% from 2010.

Notable Projects

- Agua Caliente in Yuma County was completed in 2013 by developer First Solar. This photovoltaic project has the **capacity to generate 290 MW of electricity**– enough to power over 100,000 Arizona homes. An additional 12 MW will come online later this year.[4]
- At 125 MW, Arlington Valley Solar Project II is among the largest solar installations in Arizona. Completed in 2015 by LS Power, this photovoltaic project has **enough electric capacity to power more than 17,700 homes**.[5]

EX-21.1 10 scty-ex211_9.htm EX-21.1 - SUBSIDIARY LIST

Exhibit 21.1

LIST OF SUBSIDIARIES OF SOLARCITY CORPORATION (as of February 10, 2016)

EXHIBIT AIC-14 ADMITTED

Name of Subsidiary	Jurisdiction of Incorporation
Allegheny Solar 1, LLC	Delaware
Allegheny Solar Manager 1, LLC	Delaware
Andrews County Solar, LLC	Delaware
Asterix Solar Managing Member I, LLC	Delaware
AU Solar 1, LLC	Delaware
AU Solar 2, LLC	Delaware
Banyan SolarCity Manager 2010, LLC	Delaware
Banyan SolarCity Owner 2010, LLC	Delaware
Basking Solar I, LLC	Delaware
Beatrix Solar I, LLC	Delaware
Bernese Solar Manager I, LLC	Delaware
Blue Skies Solar I, LLC	Delaware
Blue Skies Solar II, LLC	Delaware
Building Solutions Acquisition Corporation	Delaware
Caballero Solar Managing Member I, LLC	Delaware
Cardinal Blue Solar, LLC	Delaware
Castello Solar I, LLC	Delaware
Castello Solar II, LLC	Delaware
City UB Solar, LLC	Delaware
Clydesdale SC Solar I, LLC	Delaware
Common Assets Capital, LLC	Delaware
Common Assets Financial, LLC	Delaware
Common Assets Securities, LLC	Delaware
Common Assets Technologies, LLC	Delaware
Common Assets, LLC	Delaware
Dom Solar General Partner I, LLC	Delaware
Dom Solar Lessor I, LP	Cayman
Dom Solar Limited Partner I, LLC	Delaware
Eiger Lease Co, LLC	Delaware
Energy Freedom Coalition of America, LLC	Delaware
Ever CT Solar Farm, LLC	California
Falconer Solar Manager I, LLC	Delaware
Fontane Solar I, LLC	Delaware
FOTOVOLTAICA GI 1, S. de R.L. de C.V.	Mexico
FOTOVOLTAICA GI 4, S. de R.L. de C.V.	Mexico
FOTOVOLTAICA GI 5, S. de R.L. de C.V.	Mexico
FOTOVOLTAICA GI 6, S. de R.L. de C.V.	Mexico
FOTOVOLTAICA GI DOS, S. de R.L. de C.V.	Mexico
FOTOVOLTAICA GI TRES, S. de R.L. de C.V.	Mexico
FTE Solar I, LLC	Delaware
GivePower Foundation	Delaware
Hammerhead Solar, LLC	Delaware
Haymarket Holdings, LLC	Delaware
Haymarket Manager 1, LLC	Delaware
Haymarket Solar 1, LLC	Delaware
Ikehu Manager I, LLC	Delaware
IL Buono Solar I, LLC	Delaware
ILIOSSON, S.A. de C.V.	Mexico
Klamath Falls Solar 1, LLC	Delaware

Klamath Falls Solar 2, LLC	Delaware
Klamath Falls Solar 3, LLC	Delaware
Knight Solar Managing Member I, LLC	Delaware
Knight Solar Managing Member II, LLC	Delaware
Landlord 2008-A, LLC	Delaware

Name of Subsidiary	Jurisdiction of Incorporation
Louis Solar II, LLC	Delaware
Louis Solar Manager II, LLC	Delaware
Louis Solar Master Tenant I, LLC	Delaware
Louis Solar MT Manager I, LLC	Delaware
Louis Solar Owner I, LLC	Delaware
Louis Solar Owner Manager I, LLC	Delaware
Mako Solar Holdings, LLC	Delaware
Mako Solar, LLC	Delaware
Master Tenant 2008-A, LLC	Delaware
Matterhorn Solar I, LLC	Delaware
Megalodon Solar, LLC	Delaware
Monte Rosa Solar I, LLC	Delaware
Mound Solar Manager V, LLC	Delaware
Mound Solar Manager VI, LLC	Delaware
Mound Solar Manager X, LLC	Delaware
Mound Solar Manager XI, LLC	Delaware
Mound Solar Master Tenant IX, LLC	Delaware
Mound Solar Master Tenant V, LLC	California
Mound Solar Master Tenant VI, LLC	Delaware
Mound Solar Master Tenant VII, LLC	Delaware
Mound Solar Master Tenant VIII, LLC	Delaware
Mound Solar MT Manager IX, LLC	Delaware
Mound Solar MT Manager VII, LLC	Delaware
Mound Solar MT Manager VIII, LLC	Delaware
Mound Solar Owner IX, LLC	Delaware
Mound Solar Owner Manager IX, LLC	Delaware
Mound Solar Owner Manager VII, LLC	Delaware
Mound Solar Owner Manager VIII, LLC	Delaware
Mound Solar Owner V, LLC	California
Mound Solar Owner VI, LLC	Delaware
Mound Solar Owner VII, LLC	Delaware
Mound Solar Owner VIII, LLC	Delaware
Mound Solar Partnership X, LLC	Delaware
Mound Solar Partnership XI, LLC	Delaware
MS SolarCity 2008, LLC	Delaware
MS SolarCity Commercial 2008, LLC	Delaware
MS SolarCity Residential 2008, LLC	Delaware
MT Solar Corporation	Delaware
NBA SolarCity AFB, LLC	California
NBA SolarCity Commercial I, LLC	California
NBA SolarCity Solar Phoenix, LLC	California
Needham Solar I, LLC	Delaware
Obelix Solar I, LLC	Delaware
PaCo Solar Holdings, LLC	Delaware
PaCo Solar Lessee 1, LLC	Arizona
PaCo Solar Lessee Manager 1, LLC	Delaware
PaCo Solar Lessor 1, LLC	Delaware
Panoramix Solar I, LLC	Delaware
Paramount Energy Fund I Lessee, LLC	Delaware
Paramount Energy Fund I Lessor, LLC	Delaware
PEF I MM, LLC	Delaware
Poppy Acquisition LLC	Delaware
Presidio Solar I, LLC	Delaware
Pukana La Solar I, LLC	Delaware
Remora Holdings, LLC	Delaware
Remora Solar, LLC	Delaware
Sequoia Pacific Holdings, LLC	Delaware
Sequoia Pacific Manager I, LLC	Delaware

Sequoia Pacific Solar I, LLC	Delaware
Sequoia SolarCity Owner I, LLC	Delaware
SERVICIOS DE TECNOLOGÍA Y ADMINISTRACIÓN ILIOSS, S.A. de C.V.	Mexico

Name of Subsidiary	Jurisdiction of Incorporation
Shortfin Solar, LLC	Delaware
Sierra Solar Power (Hong Kong) Limited	Hong Kong
Silevo China Co. Ltd	China
Silevo Germany GmbH	Germany
Silevo, LLC	Delaware
Solar Aquarium Holdings, LLC	Delaware
Solar Energy of America 1, LLC	Delaware
Solar Energy of America Holdco, LLC	Delaware
Solar Energy of America Manager 1 Corporation	Delaware
Solar Explorer, LLC	Delaware
Solar Grove Holdings, LLC	Delaware
Solar House I, LLC	Delaware
Solar House II, LLC	Delaware
Solar House III, LLC	Delaware
Solar Integrated Fund I, LLC	Delaware
Solar Integrated Fund II, LLC	Delaware
Solar Integrated Fund III, LLC	Delaware
Solar Integrated Manager I, LLC	Delaware
Solar Integrated Manager II, LLC	Delaware
Solar Integrated Manager III, LLC	Delaware
Solar Marsh, LLC	Delaware
Solar Odyssey Holdings, LLC	Delaware
Solar Ulysses Manager I, LLC	Delaware
Solar Ulysses Manager II, LLC	Delaware
Solar Voyager, LLC	Delaware
Solar Warehouse Manager I, LLC	Delaware
Solar Warehouse Manager II, LLC	Delaware
SolarCity Alpine Holdings, LLC	Delaware
SolarCity Amphitheatre Holdings, LLC	Delaware
SolarCity Arbor Holdings, LLC	Delaware
SolarCity Arches Holdings, LLC	Delaware
SolarCity AU Holdings, LLC	Delaware
SolarCity Electrical New York Corporation	Delaware
SolarCity Electrical, LLC	Delaware
SolarCity Engineering, Inc	California
SolarCity Finance Company, LLC	Delaware
SolarCity Finance Holdings, LLC	Delaware
SolarCity FTE Series 1, LLC	Delaware
SolarCity Fund Holdings, LLC	Delaware
SolarCity Giants Holdings, LLC	Delaware
SolarCity GivePower	California
SolarCity Grand Canyon Holdings, LLC	Delaware
SolarCity Holdings 2008, LLC	Delaware
SolarCity International, Inc	Delaware
SolarCity Investments Canada Ltd.	Canada
SolarCity LMC Series I, LLC	Delaware
SolarCity LMC Series II, LLC	Delaware
SolarCity LMC Series III, LLC	Delaware
SolarCity LMC Series IV, LLC	Delaware
SolarCity LMC Series V, LLC	Delaware
SolarCity Mid-Atlantic Holdings, LLC	Delaware
SolarCity Orange Holdings, LLC	Delaware
SolarCity Pierpont Holdings, LLC	Delaware
SolarCity Series Holdings I, LLC	Delaware
SolarCity Series Holdings II, LLC	Delaware
SolarCity Series Holdings IV, LLC	Delaware
SolarCity Ulu Holdings, LLC	Delaware
SolarCity Village Holdings, LLC	Delaware

Solare Warehouse Manager III, LLC	Delaware
SolarMarsh KL, LLC	Delaware
SolarMarsh RB, LLC	Delaware

Name of Subsidiary	Jurisdiction of Incorporation
SolarMarsh SM, LLC	Delaware
SolarMarsh VM, LLC	Delaware
SolarRock, LLC	Delaware
SolarStrong Holdings, LLC	Delaware
SolarStrong, LLC	Delaware
Sparrowhawk Solar I, LLC	Delaware
Sunshine Storage I, LLC	Delaware
Sunshine Storage II, LLC	Delaware
Sunshine Storage III, LLC	Delaware
The Alliance for Solar Choice, LLC	Delaware
Three Rivers Solar 1, LLC	Delaware
Three Rivers Solar 2, LLC	Delaware
Three Rivers Solar Holding Company, LLC	Delaware
Three Rivers Solar Manager 1, LLC	Delaware
Three Rivers Solar Manager 2, LLC	Delaware
USB SolarCity Manager 2009, LLC	Delaware
USB SolarCity Manager 2009-2010, LLC	Delaware
USB SolarCity Manager III, LLC	Delaware
USB SolarCity Manager IV, LLC	Delaware
USB SolarCity Master Tenant 2009, LLC	California
USB SolarCity Master Tenant 2009-2010, LLC	California
USB SolarCity Master Tenant III, LLC	California
USB SolarCity Master Tenant IV, LLC	California
USB SolarCity Owner 2009, LLC	California
USB SolarCity Owner 2009-2010, LLC	California
USB SolarCity Owner III, LLC	California
USB SolarCity Owner IV, LLC	California
Viceroy Solar Holdings, LLC	Delaware
Visigoth Solar 1, LLC	Delaware
Visigoth Solar Holdings, LLC	Delaware
Visigoth Solar Managing Member 1, LLC	Delaware
Zep Solar Australia Pty Limited	Australia
Zep Solar Hong Kong Limited	Hong Kong
Zep Solar LLC	California
Zep Solar Trading Ltd	China
Zep Solar UK Limited	United Kingdom

AIC 15

sunrun®

2015 Q4 REVIEW

March 10, 2016

Creating a planet run by the sun

Safe Harbor & Forward Looking Statements

This presentation contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934, which statements involve substantial risks and uncertainties. Forward-looking statements in this presentation include, but are not limited to, statements related to financial and operating guidance and expectations for our first quarter and full year 2016, momentum in our business and our business strategies, expectations regarding customers, cost reduction, project value, MW booked, MW deployed, product mix and NPV as well as our ability to raise debt and tax equity, manage cash flow and liquidity, leverage our platform services and deliver on planned innovations and investments including in products, services, sales and facilities as well as expectations for our growth, the growth of the industry, macroeconomic trends and the legislative and regulatory environment of the industry.

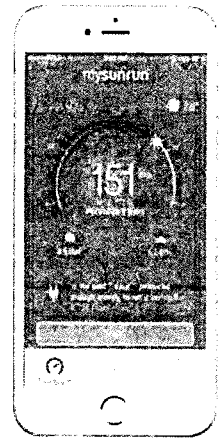
These forward-looking statements are subject to a number of risks, uncertainties and assumptions. The risks and uncertainties that could cause our results to differ materially and adversely from those expressed or implied by such forward-looking statements include: the availability of additional financing on acceptable terms; changes in the retail prices of traditional utility generated electricity; changes in policies and regulations including net metering and interconnection limits or caps; the availability of rebates, tax credits and other incentives; the availability of solar panels and other raw materials; our limited operating history, particularly as a new public company; our ability to attract and retain our relationships with third parties, including our solar partners; our ability to meet the covenants in our investment funds and debt facilities; and such other risks and uncertainties identified in the registration statements and reports that we have filed with the U.S. Securities and Exchange Commission, or SEC, from time to time. You should not rely on forward-looking statements as predictions of future events.

Although we believe that the expectations reflected in the forward-looking statements are reasonable, we cannot guarantee that the future results, performance or events and circumstances reflected in the forward-looking statements will be achieved or occur. All forward-looking statements in this presentation are based on information available to us as of the date hereof, and we assume no obligation to update publicly these forward-looking statements for any reason, except as required by law.

We are creating a modern, customer-centric energy infrastructure

Value to Customer

- Save 20% or more on electricity over initial 20-year agreement
- No or low upfront cost, low annual escalators
- Worry-free service, maintenance, and repairs included
- Agreement easily transferable in case of home sale



Sunrun's strategy drives durable competitive advantage

Project Value & NPV Maximization

- History of focus on high revenue markets and customers, premium service
- Smart customer targeting
- Residential-only focus

Cost Structure

- Cost advantages from scale
- Unique advantage from monetizing platform services
- Broad multi-channel distribution leads to lower customer acquisition cost

Flexibility

- Low cost debt and tax equity runway into Q4[1] with attractive advance rates and low capital costs
- No recourse debt outside working capital line, due 2018
- Blend of fixed and variable costs

(1) Includes executed term sheets.

Sunrun delivered strong growth and focus on value creation in Q4 2015

80 MW Booked

117% year-over-year growth

68 MW Deployed

83% year-over-year organic growth

596 Cumulative MW Deployed

52% increase year-over year
2nd largest residential fleet

$4.50 Project Value Per Watt

Compared to $4.70 in Q3 2015

$3.64 Creation Cost Per Watt

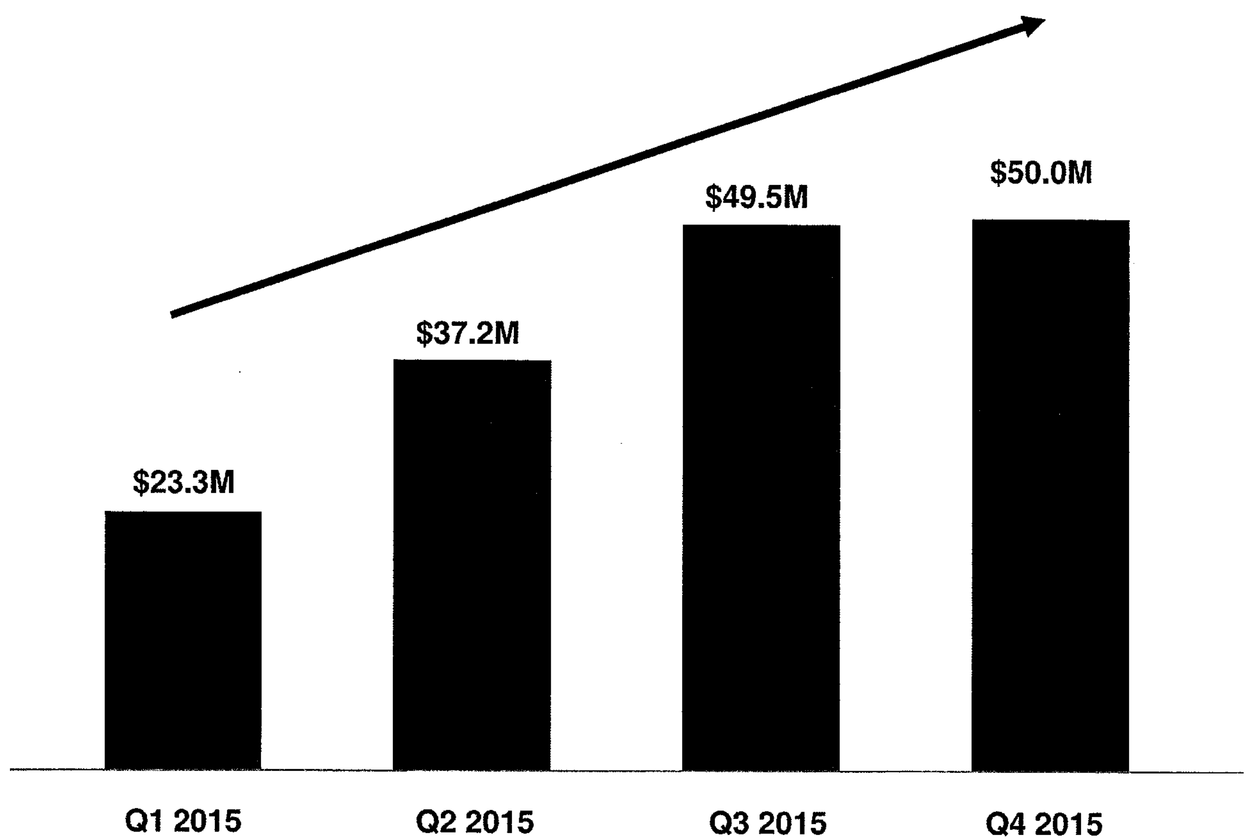
$0.72 or **17%** decrease from Q1 2015

$50M NPV Generated

115% growth over Q1 2015

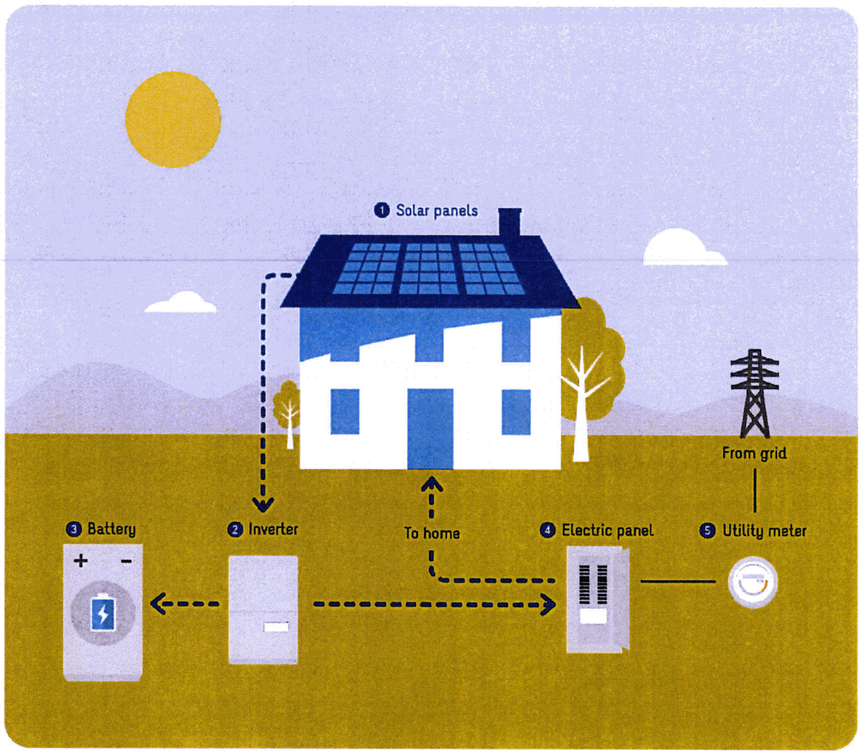
See appendix for glossary of terms.

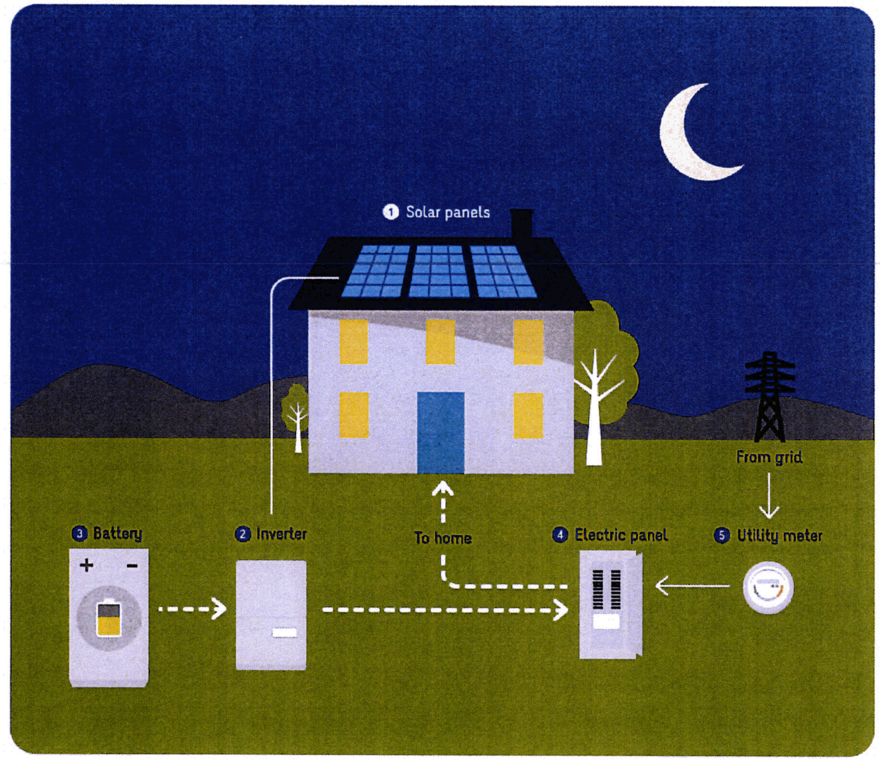
Q4 2015 NPV grew 115% from Q1 2015



See appendix for glossary of terms.

Commercialization of storage and energy management allows Sunrun to expand the in-home offering

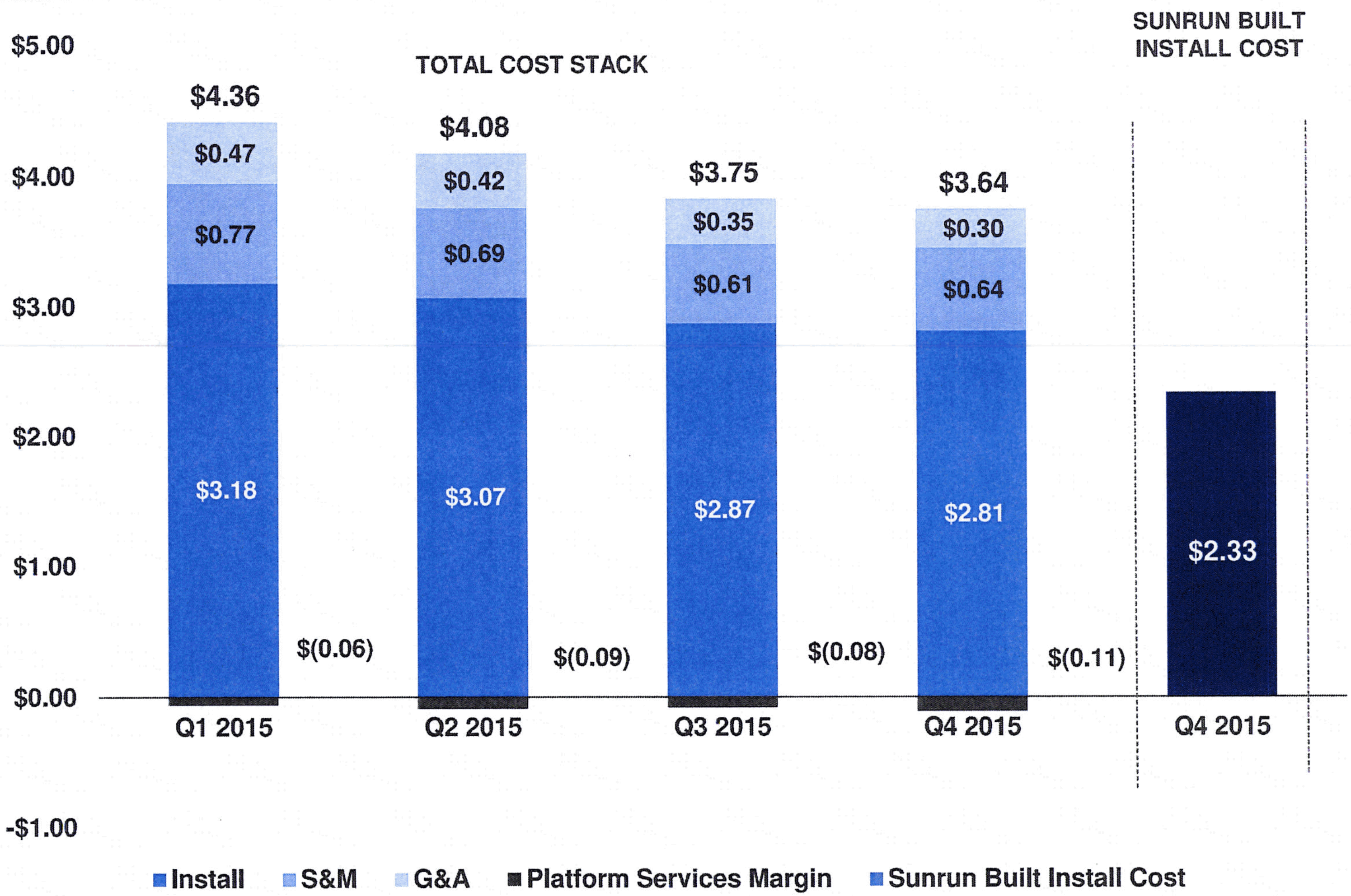




See appendix for glossary of terms.

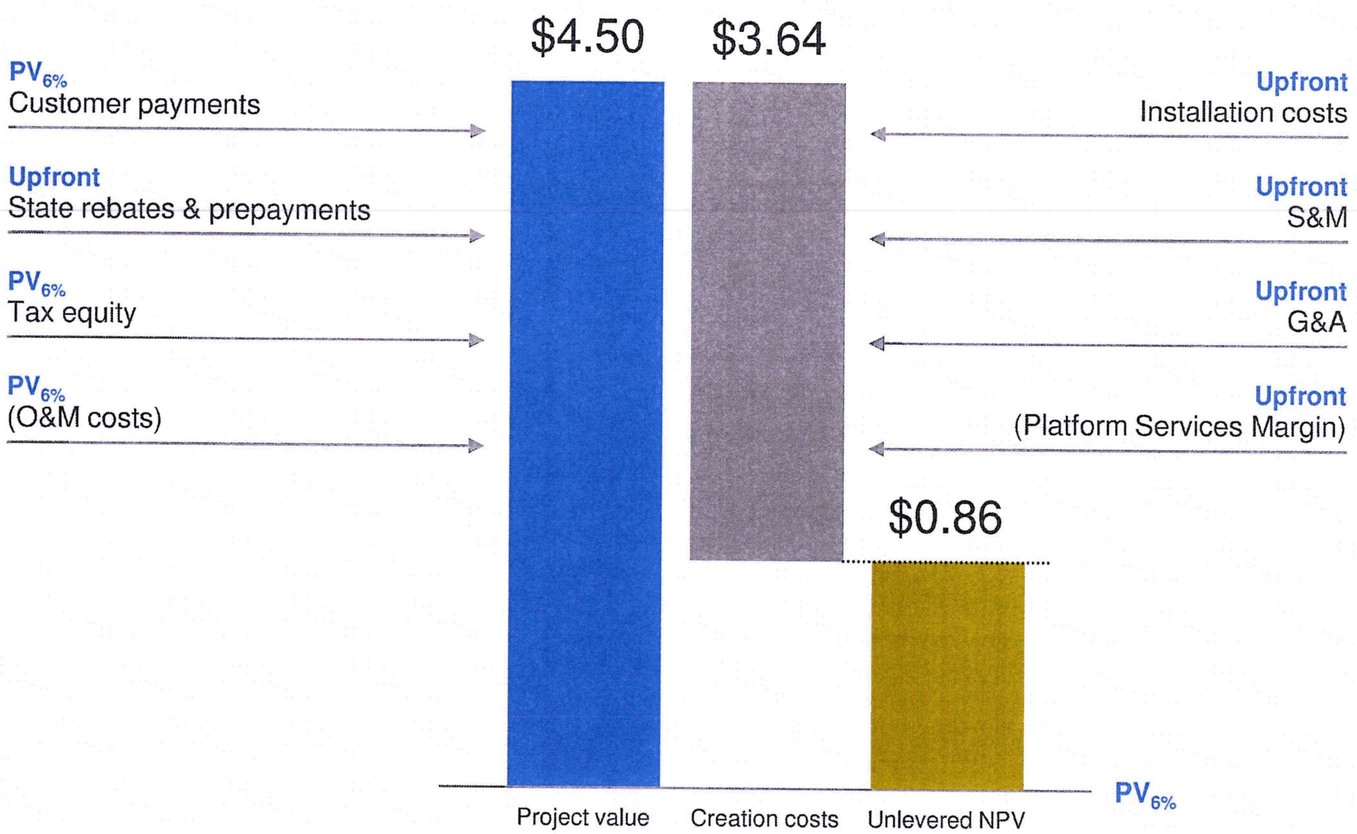
Sunrun continues to realize rapid cost reductions

Sunrun built install cost at $2.33 / watt



See appendix for glossary of terms.

We generated unlevered NPV of $0.86 per watt in Q4



See appendix for glossary of terms.

$1.5B in retained value and $1.0B in net retained value

Gross Retained Value (6%) **as of December 31, 2015**	**$1,517**	$2.33 per watt
- Long-term debt	($343)	
- Lease pass-through financing	($157)	
- Line of credit	($195)	
+ Cash and cash equivalents	$213	
Net Retained Value	**$1,035**	

See appendix for glossary of terms.

High quality of our assets is recognized by the markets

Performance Exceeds Expectations

- Total cumulative production has exceeded forecast production to date
- Cumulative solar electricity production approaching 1,400 GWh to date

Production over-performance

Customer Pay Their Bills

- Sunrun's credit standards yield a high credit customer pool
- Cumulative lost billings rate since inception is less than 1.0% (1)

< 1% Cumulative loss rate on billings

Easy To Transfer

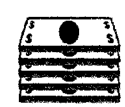
- In-house service transfer specialists successfully completed thousands of service transfers to date
- Service transfers achieve an average of 99% in total NPV recovery (2)

~99% Service transfer recovery rate

Market Believes in Quality

- First securitization in sector to achieve a single A rating
- Class A notes priced at 4.4%, competitive with commercial bank debt

Rewarded with low cost of capital



Note: All figures represent fleetwide statistics as of December 31, 2015.

(1) Losses include uncollected recurring billings 5 months after invoice date, write downs and appeasement credits.

(2) Based on analysis of completed service transfers for monthly customers; Recoveries >100% arise from prepayments.

Supply of tax equity from both new and existing Sunrun investors remains strong

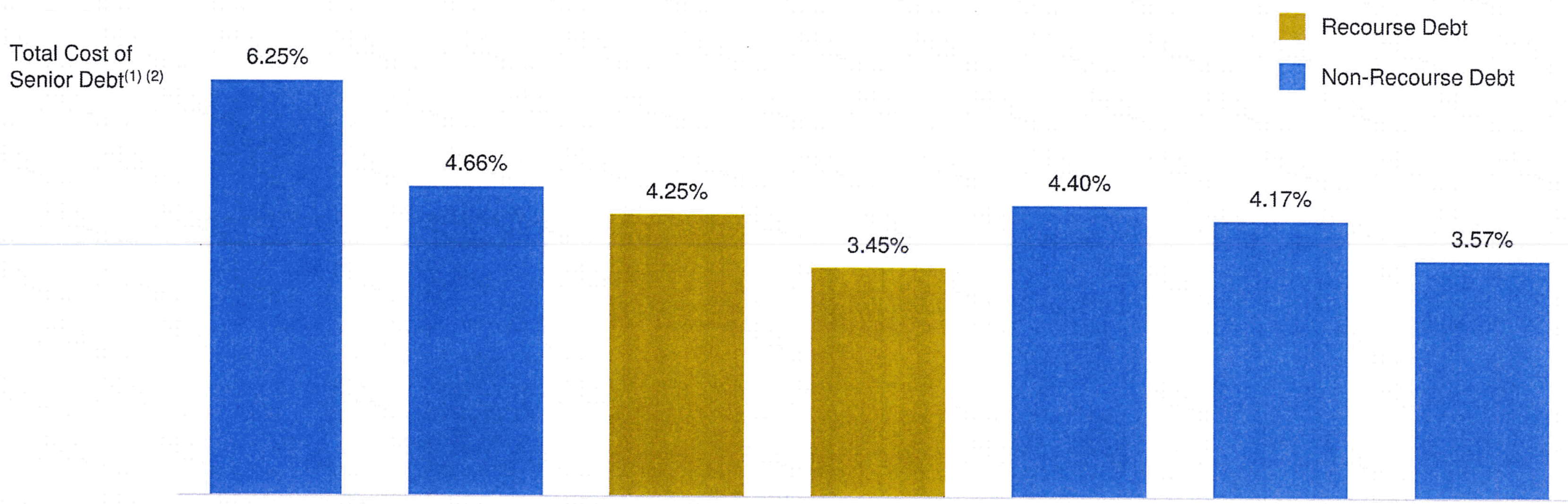
- In 2015, Sunrun focused on adding new tax equity investors. As a result, we have a large stable of existing relationships to support our growth in 2016 & 2017, as all 2014 and 2015 investors have expressed interest in another transaction.
- Relationships with individual counterparties are increasing. From 2010 to 2015, the MW capacity of the average Sunrun tax equity fund grew 240%. From 2014 to 2015, average MW per Fund grew 40%.
- As of today, Sunrun has committed tax equity financing or executed term sheets to provide tax equity capital to fund our forecasted growth into November.

Tax Equity Investment Amounts[1]

Year	MW Funded	New Investors	Repeat Investors	Total Dollars
2008–2012	173	$316	$380	$696
2013	86	181	100	281
2014	170	0	470	470
2015	238	300	262	562

(1) Dollar amounts in millions
See appendix for glossary of terms.

As performance track record has aged, credit costs have come down as market has deepened



Closing Dates	Dec 2013	Dec 2014	Dec 2014	Apr 2015	Jul 2015	Jan 2016	Mar 2016
Size of Debt Issuance[2]	**$38.0**	**$195.4**	**$50.0**	**$205.0**	**$111.0**	**$250.0**	**$24.5**
Cumulative # of Counterparties[2]	**6**	**12**	**12**	**15**	**19**	**19**	**19**

Note: Proceeds from several credit facilities have been used in part to repay previous indebtedness.

(1) Total Cost of Debt is equal to the fixed interest rate for fixed-rate debt instruments, or, for variable instruments, the actual interest rate incurred if the debt facility has been repaid, or, if a current debt facility, the spread plus the actual or estimated LIBOR swap rate, including swap premium.

(2) Total Cost of Debt in the graph excludes two subordinated term loans entered into in Dec 2014 and Jan 2016 at 6.00% and subordinated notes issued in July 2015 at 5.38%. The dollars raised in these subordinated debt facilities are reflected in the two lines below the chart.

See appendix for glossary of terms.

Combining Sunrun's 2016 realized cost of debt and a 10% cost of project equity results in a 6% retained value discount rate.

- Given the 4.5%[1] cost of debt Sunrun secured in January 2016, and assuming a 70% advance rate, a retained value discount rate of 6% implies the discounting of contracted equity cash flows at about 10%.

- If cost of equity were 8.0%, the retained value discount rate for contracted cash flows would be appropriately 5.5%. If cost of equity were 12.0%, it would be appropriately 6.7%.

	Cost	% of Capital	Total
Project-level debt [1]	4.5%	70.0%	3.1%
Project-level equity	9.6%	30.0%	2.9%
Capital			6.0%

Net RV Discount Rate Sensitivity

Cost of Equity	Implied Cost of Capital
8.0%	5.5%
10.0%	6.1%
12.0%	6.7%

(1) Weighted average between A and B tranches. Assumes credit facility was swapped given market rates on March 9, 2016.
Analysis considers only contracted portion of customer cash flows

Guidance

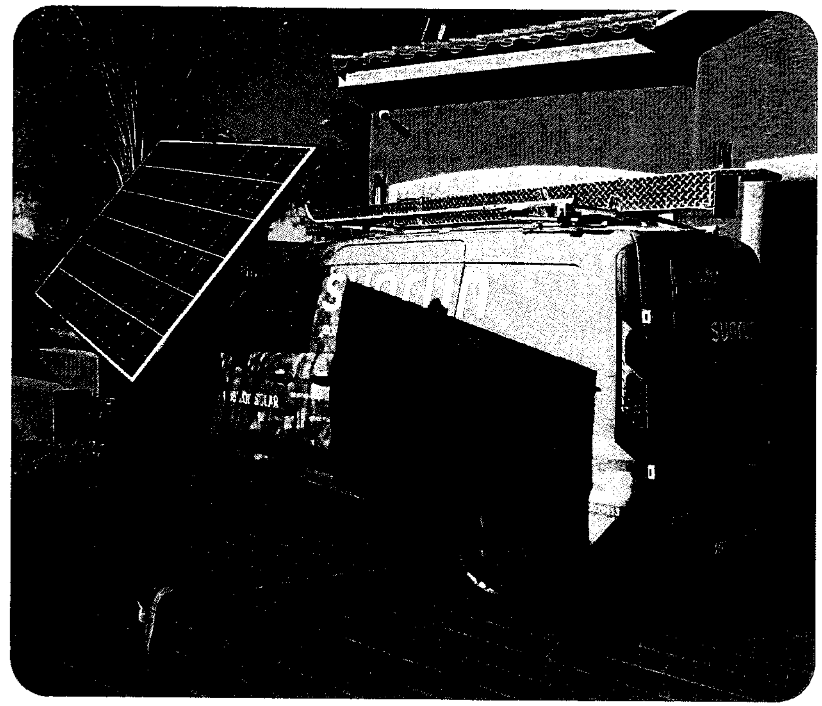
2016 Deployments

Annual Growth Rates

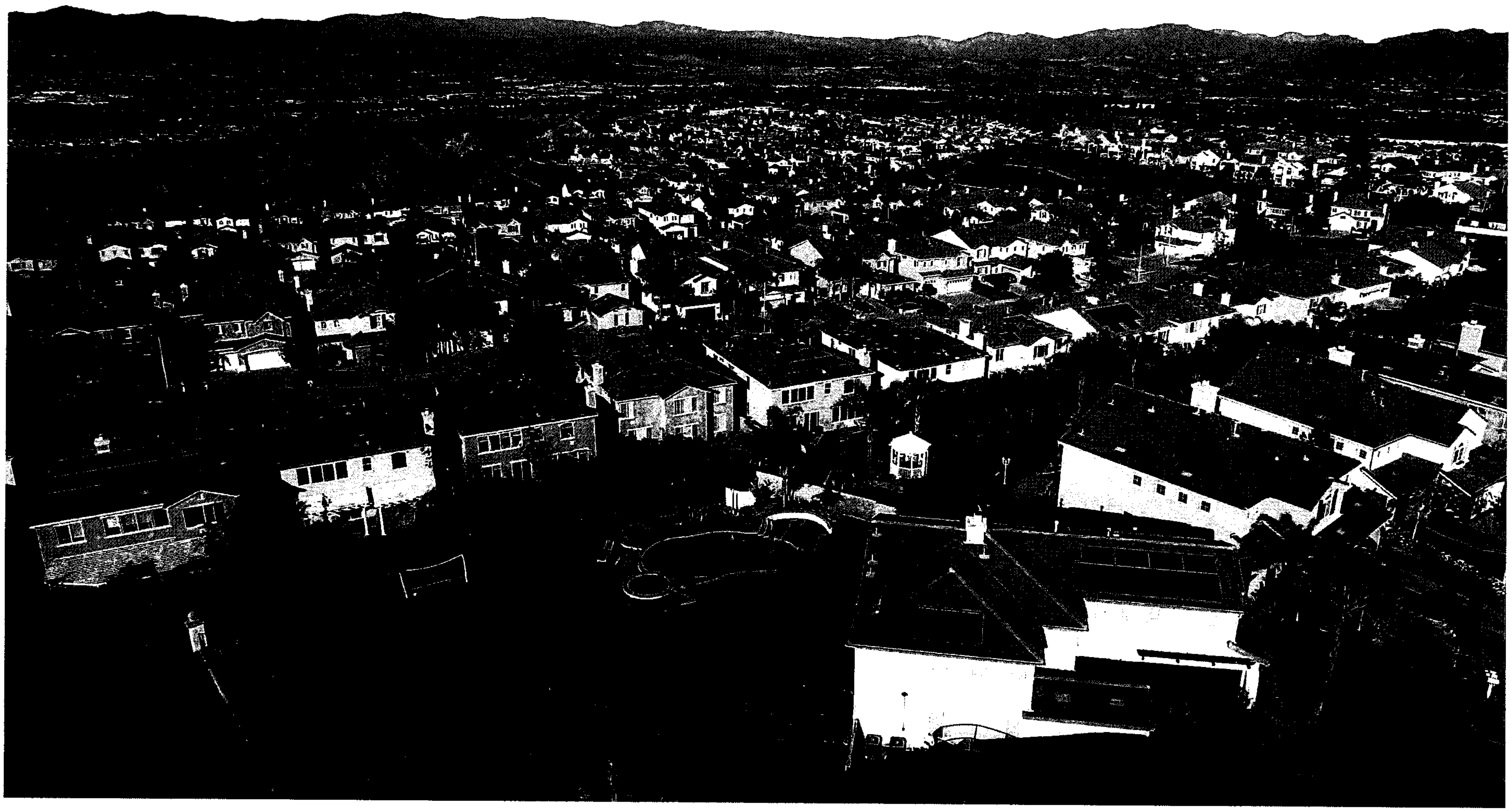
- ~100% for Sunrun deployed systems
- ~40% overall

MW

- 56 MW in Q1 (excludes ~12 MW of Nevada backlog not built due to market exit)
- ~285 MW in 2016



Question & answer



APPENDIX: Key Operating Metrics

	Year ended	
	Dec. 31, 2014	**Dec. 31, 2015**
MW Booked (during the period)	163 [1]	274
MW Deployed (during the period)	130 [1]	203
Cumulative MW Deployed (end of period)	393	596
Estimated Nominal Contracted Payments Remaining (in millions)	$1,597	$2,404
Estimated Retained Value (in millions)	$1,000	$1,517
Estimated retained value under energy contract (in millions)	$643	$1,029
Estimated retained value of purchase or renewal (in millions)	$357	$487
Estimated retained value per watt	$2.40	$2.33

	Three months ended	
	Dec. 31, 2014	**Dec. 31, 2015**
MW Booked (during the period)	37	79
MW Deployed (during the period)	37	68
Cumulative MW Deployed (end of period)	393	596
Estimated Nominal Contracted Payments Remaining (in millions)	$1,597	$2,404
Estimated Retained Value (in millions)	$1,000	$1,517
Estimated retained value under energy contract (in millions)	$643	$1,029
Estimated retained value of purchase or renewal (in millions)	$357	$487
Estimated retained value per watt	$2.40	$2.33

(1) Includes 14.7 MWs associated with purchase of asset portfolio in the second quarter of 2014.

APPENDIX: Key Operating Metrics

	Three Months Ended				Year Ended
	March 30, 2015	June 30, 2015	Sept. 30, 2015	Dec. 31, 2015	Dec. 31, 2015
Project Value (per watt)	$5.02	$5.00[1]	$4.70	$4.50	$4.76
Creation Costs (2) (per watt)	$4.36	$4.08	$3.75	$3.64	$3.89
Unlevered NPV (per watt)	$0.66	$0.92	$0.95	$0.86	$0.87
NPV (in millions)	$23	$37	$50	$50	$160

(1) Excludes materially all SREC value.

(2) Excludes IDC costs paid prior to deployments and excludes non-cash items such as amortization of intangible assets and stock-based compensation, and contingent consideration related to an acquisition

APPENDIX: Glossary

MW Booked represents the aggregate megawatt production capacity of our solar energy systems sold to customers or subject to an executed customer agreement, net of cancellations.

MW Deployed represents the aggregate megawatt production capacity of our solar energy systems, whether sold directly to customers or subject to customer agreements, for which we have (i) confirmation that the systems are installed on the roof, subject to final inspection or (ii) in the case of certain system installations by our partners, accrued at least 80% of the expected project cost.

Customers refers to residential customers with solar energy systems that are installed or under contract to install, net of cancellations.

Estimated Nominal Contracted Payments Remaining equals the sum of the remaining cash payments that customers are expected to pay over the initial terms of their agreements (not including the value of any renewal or system purchase at the end of the initial agreement term), including estimated uncollected prepayments, for systems contracted as of the measurement date.

Estimated Retained Value represents the cash flows (discounted at 6%) we expect to receive pursuant to customer agreements during the initial agreement term, excluding substantially all value from solar renewable energy credits ("SRECs") prior to July 1, 2015. It also includes a discounted estimate of the value of the purchase or renewal of the agreement at the end of the initial term. Estimated retained value excludes estimated distributions to investors in consolidated joint ventures and estimated operating, maintenance and administrative expenses for systems contracted as of the measurement date. We do not deduct amounts we are obligated to pass through to investors in lease pass-throughs. Estimated retained value under energy contract represents the net cash flows during the initial 20-year term of our customer agreements. Estimated retained value of purchase or renewal is the forecasted net present value we would receive upon or following the expiration of the initial contract term.

Project Value represents the value of upfront and future payments by customers, the benefits received from utility and state incentives, as well as the present value of net proceeds derived through investment funds. Project value is calculated as the sum of the following items (all measured on a per-watt basis with respect to megawatts deployed under customer agreements during the period): (i) estimated retained value, (ii) utility or upfront state incentives, (iii) upfront payments from customers for deposits and partial or full prepayments of amounts otherwise due under customer agreements and which are not already included in estimated retained value and (iv) finance proceeds from tax equity investors. Project value includes contracted SRECS. Project value does not include cash true-up payments or the value of asset contributions in lieu of cash true-up payments made to investment fund investors, the cumulative impact of which is expected to be immaterial in 2015.

Creation Costs includes (i) certain installation and general and administrative costs after subtracting the gross margin on solar energy systems and product sales divided by watts deployed and (ii) certain sales and marketing expenses under new customer agreements, net of cancellations during the period divided by the related watts booked.

Unlevered NPV equals the difference between project value and estimated creation costs.

Sunrun Direct Business refers to solar service offerings installed by Sunrun.

Expected impact of changes in long-term interest rates is limited

During 2016, base rates are expected to be about 50 bps lower than at June 30, 2015. Even a decade from now, they are forecast to climb only about a third of a point from June 30, 2015.

Interest Rates(1)	Actual 6/30/15	Forward 9/30/16	Forward 9/30/27
7-Year Swap (for debt costs)	2.15%	1.62%	2.51%
Average of 10 & 30-Year Treasury (for retained value calculation)	2.74%	2.28%	3.08%

(1) Source Data: Bloomberg, March 9, 2016.

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PV Safety and Firefighting

By: **Matthew Paiss**

Published In: Issue #131, June / July 2009

Fire safety is typically the last thing people think of when planning their rooftop solar-electric system, but it quickly becomes a hot topic when a blaze ignites. Here's a look into the potential hazards of PV systems when a fire breaks out—and how to minimize risks to firefighters.

Why do firefighters climb up on the roof of a burning building? In a house fire, superheated smoke and gases (which can exceed 1,200°F) rise to the ceiling and then bank down back to the floor. Just one lungful of this smoke can kill. Cutting a hole in the highest point of the room allows the superheated gases and fire to rise out of the building, rapidly improving visibility as well as the survivability of the structure and those trapped inside. This also allows firefighters on the hose line to advance inside to locate the seat of the fire and any victims. This "vertical ventilation" has saved many lives and valuable property—besides actual rescue, this is one of a firefighter's primary responsibilities.

But the presence of rooftop-mounted PV arrays has made cutting through a roof more challenging. In the past, the fire service had plenty of room to ventilate where it is most effective—directly above the fire. With PV arrays now covering large areas of roofs, firefighters are limited in where they can cut and where they can exit the roof. Since the PV modules cannot be cut through, and moving them is time-consuming and potentially dangerous, rooftop PV systems pose some risks—mainly shock and trip hazards.

Most firefighters have had some education in electrical theory but usually employ the tactic of avoidance when it comes to electrical equipment. However, there are still those who believe that anything is manageable if you can swing an axe hard and fast enough—clearly not the best approach when dealing with electricity. Most firefighters will just ventilate as close as they can to the high point of a room. If an array is in the way, they will move to where they can cut safely and rapidly. One problem is that most roof systems employ lightweight trusses, held together by lightweight metal gusset plates. With small fastening points, they can warp and pull out in fire conditions. These roofs are known as "20-minute roofs," meaning that firefighters have 20 minutes or less to get up, make the necessary cuts, and get down before the roof gives out. So, time is of the essence when navigating a hot roof with a PV system.

Fire Safety Steps

Assessing the Situation. One of the first things firefighters do at the scene is to take a "hot lap"—a quick walk around the building to see all sides and to locate the utility shutoffs. It is usually at this point that a PV system is noted if the array was not visible upon arrival. An inverter—often outside near the meter and service panel—also serves as a signpost. Likewise, if metal conduit is present in an attic, that's a red flag that a PV system may be present.

But there are some cases where obvious indicators of a PV system are not evident—such as in cases where the modules are integrated into the roof or the inverter is located indoors. Besides visual identification, a common way to note a PV system is to look at the labels on the main service panel, typically located on an exterior wall. The labeling may be on the outside or inside of the main panel. There should be a dedicated breaker for the inverter, labeled "solar inverter" or some variation. This breaker also may be in a subpanel inside the structure, but a label on the main service panel should always state that there is a second generating source onsite as well as identify the dedicated breaker for the inverter. New guidelines from the California Office of the State Fire Marshal advocate labeling along the PV array's DC conduit run as well.

Shutting Down the System. With any structure fire, shutting off all the circuit breakers at the main distribution panel, closing any gas mains, and notifying all on the scene that the utilities are secure is standard operating procedure. Shutting down a PV system is not as simple or straightforward.

With grid-direct systems, the first step is to disconnect the inverter, which happens automatically when the utility power is shut off. Inverters also are designed with very good ground-fault interruption (GFI). If an inverter detects voltage between the ground and any of the metal conduit, the modules themselves, or the mounting racks, the inverter trips the

GFI and opens the circuit. The circuit is also opened when the inverter is shut down manually by tripping the main circuit breakers either for just the inverter or for the whole house.

However, even with the inverter off, there's no easy way to shut off the high-voltage DC electricity flowing through the array and the DC wiring. In daylight when there is an open circuit, the modules are still putting out full voltage. There's no current flowing—that is, unless it finds a path to ground, like through a firefighter or an axe breaking through walls or ceilings.

The use of a rooftop disconnect at the array can lead to a false sense of security, since that merely opens one side of the circuit. Complicating matters is that many PV systems have more than one subarray—which can be located on another section of roof. These subarrays could backfeed power through the inverter or combiner into the conduit that was supposed to be de-energized by the rooftop disconnect. The concept of having both the line and load sides of a disconnect energized is a potentially dangerous situation in this application. For this reason, the California Office of the State Fire Marshal frowns upon the installation of rooftop disconnects.

During daylight, there can be enough voltage and current to injure or even kill a firefighter who comes in contact with the energized conductors. A hanging conduit with wires sticking out of it is nothing out of the ordinary on the scene of a fire, so firefighters must exercise extreme caution when navigating a fire. It is best to always assume that a PV system is energized and steer clear of the modules and conduit. Here's an example: If a firefighter accidentally or deliberately axes through a string of twelve 44 VDC modules, he or she will experience a potentially deadly surge of 528 volts.

Off-grid and grid-connected systems with battery backup have a few more circuits to consider. First, PV array disconnects should be shut off. Second, the battery banks in these systems are another power source that need to be shut down via a main DC battery disconnect to fully de-energize the inverter and any AC circuit fed by the inverter, as well as any DC circuit that might be present. Like the PV array, battery banks are live even after they have been disconnected from the rest of the system. And even though most battery banks are wired to low DC voltages (commonly 24 V to 48 V), which pose less of a shock hazard than the high-voltage DC circuits discussed earlier, their low voltage and high current nature can cause fires from overheated connections. Batteries are also full of sulfuric acid and emit hydrogen gas that is highly flammable.

Battery banks are usually contained in a plastic, metal, or wooden storage box located near the system control panel—typically in the garage, basement, or shed. Battery banks also may be placed somewhere on the exterior of the house. If the heat and flames of the fire are near the battery bank, firefighters should use dry chemical or CO_2 extinguishers instead of water to avoid the potential for shock hazard of spraying a live inverter and to minimize damage to the batteries. That said, salvaging a battery pack is always secondary to firefighter safety and saving the structure. However, when dealing with a minor fire or an overheated battery connection, firefighters should act prudently and do their best to avoid damaging thousands of dollars' worth of equipment.

Eliminating the Source. One option for shutting down a PV system is to cover the arrays with opaque material, such as heavy canvas tarps or black plastic. Most fire response vehicles carry some type of salvage covers or tarps that are commonly used to protect belongings from water damage during firefighting. These same tarps can also be used to prevent light from reaching the PV cells, shutting off the flow of electricity to the inverter. However, high winds, tarp sizes, structural conditions, and the size and shape of the array may prevent using this option. Some departments do not carry suitable tarps, and common blue poly tarps will not work because they let too much light through.

Dealing with Conduit. If the array cannot be tarped, it is important for the crews inside to be careful when opening holes in the ceiling, as they may contact the conduit from the array with their tools. Since plastic insulated wire (Romex) is all that's typically required for home wiring, metal conduit is rarely used in an attic spaces.

Firefighters must verify whether a metal conduit run is intact. If so, it is grounded from the array to the inverter, so any wires that may be shorted to it from the high heat of a fire will carry any voltage/current to ground rather than to the firefighter who contacts it. In other words, it is safe to touch. But if portions of the roof have collapsed, it should be assumed that the conduit is no longer grounded and therefore dangerous to touch. Most fire departments carry noncontact voltage detectors that can be used to find hot AC lines. Unfortunately, DC noncontact voltage detectors, which would alert firefighters to the presence of PV-generated electricity, are unavailable.

In a nighttime fire where the attic space was exposed to severe heat damage, the conduit and wires inside may have become compromised. Some arcing could begin as the rising sun energizes the modules the following morning—a potential for starting a new fire. A qualified solar contractor should be called in to disconnect the arrays. Unfortunately, most PV companies do not have an on-call technician available, so the disconnect usually must wait until the next day—not always the safest measure. In this case, most fire departments will post a "fire watch" until a qualified contractor can ensure the array is disconnected. Local utility companies are not responsible for the customer side (the house side of the meter) appliances and will not respond just to secure PV systems. This is where cooperation with the solar industry comes into play. The fire service recommends that all PV installers have an after-hours response contact for such emergency situations.

Keeping Safety in Mind

Identification is the key to understanding these systems and avoiding injury. Taking precautions with a PV array is one way to ensure the safety of firefighters and reduce the risks to your system. Beyond siting your system for optimal safety in the event of a fire, homeowners should consider installing interior fire sprinklers, which could be the critical difference between saving or salvaging your home and system. Invite your local fire department to tour your PV system if it's a rarity in your locale and provide them with a schematic of the system for their records. Further information about installing safe PV systems can be found in the California Office of the State Fire Marshal's draft guidelines.

Access

Fire engineer **Matthew Paiss** has been a member of the San Jose (California) Fire Department for 13 years. He teaches classes in PV safety, and has degrees in both fire science and solar technology. He has PV and solar thermal systems on his home.

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AIC 17

Fire Fighter Safety and Emergency Response for Solar Power Systems

EXHIBIT
AIC-17
ADMITTED

Final Report

A DHS/Assistance to Firefighter Grants (AFG) Funded Study

Prepared by:
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May 2010
Revised: October, 2013

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FOREWORD

Today's emergency responders face unexpected challenges as new uses of alternative energy increase. These renewable power sources save on the use of conventional fuels such as petroleum and other fossil fuels, but they also introduce unfamiliar hazards that require new fire fighting strategies and procedures.

Among these alternative energy uses are buildings equipped with solar power systems, which can present a variety of significant hazards should a fire occur. This study focuses on structural fire fighting in buildings and structures involving solar power systems utilizing solar panels that generate thermal and/or electrical energy, with a particular focus on solar photovoltaic panels used for electric power generation.

The safety of fire fighters and other emergency first responder personnel depends on understanding and properly handling these hazards through adequate training and preparation. The goal of this project has been to assemble and widely disseminate core principle and best practice information for fire fighters, fire ground incident commanders, and other emergency first responders to assist in their decision making process at emergencies involving solar power systems on buildings. Methods used include collecting information and data from a wide range of credible sources, along with a one-day workshop of applicable subject matter experts that have provided their review and evaluation on the topic.

The Research Foundation expresses gratitude to the members of the Project Technical Panel, workshop participants, and all others who contributed to this research effort. Special thanks are expressed to the U.S. Department of Homeland Security, AFG Fire Prevention & Safety Grants, for providing the funding for this project through the National Fire Protection Association.

The content, opinions and conclusions contained in this report are solely those of the authors.

Note: This report was revised in October of 2013. Changes other than editorial are indicated by a vertical rule beside the paragraph, table or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. This report was issued in May 2010 and revised in October 2013. Changes have been made to the information on page 57 to address the hazards of PV at nighttime. The information described on page 57 for the electrical energy hazards of a PV system from other than sunlight (e.g., mobile lighting plant) were taken from citation 137 when this FPRF report was prepared in May 2010, which was the best information available at that time. Since then a subsequent separate study from Underwriters Laboratories has further clarified through empirical tests that a hazard may exist from non-sunlight sources, i.e., at nighttime. This UL report is "Firefighter Safety and Photovoltaic Systems" and was issued in November 2011, and is available through the UL website.

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(AFG Fire Prevention & Safety Grants)

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FIRE FIGHTER SAFETY AND EMERGENCY RESPONSE FOR SOLAR POWER SYSTEMS

A U.S. Department of Homeland Security
(AFG Fire Prevention & Safety Grants)
Funded Project

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May 2010
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EXECUTIVE SUMMARY

As the use of alternative energy proliferates, the fire service has identified a number of areas of concern with hazard mitigation and emergency response. This includes solar power systems, which are introducing new and unexpected hazards to fire fighters and other emergency responders.

The goal of this report is to assemble and disseminate best practice information for fire fighters and fireground incident commanders to assist in their decision making process for handling fire incidents in buildings equipped with solar power systems or in the systems themselves. Specifically, this study focuses on structural fire fighting in buildings and structures involving solar power systems utilizing solar panels that generate thermal and/or electrical energy, with a particular focus on solar photovoltaic panels used for electric power generation. The project deliverables will be in the form of a written report, which will include best practices that can serve as the basis for training program development by others.

The deliverables for this project collectively review the available baseline information, identify the fundamental principles and key details involving fire/rescue tactics and strategy, provide a summary of core basics, and address and clarify related issues such as training needs, areas needing further research, revisions to codes/standards, and other applicable topics.

A companion study to this report focuses on electric and hybrid electric vehicles rather than solar power systems (*"Fire Fighter Safety and Emergency Response for Electric Drive and Hybrid Electric Vehicles"*, FPRF). This has taken an identical approach and focuses on assembling and disseminating best practice information for fire fighters and fireground incident commanders to assist in their decision making process. This companion report addresses emergency events involving electric drive and hybrid electric vehicles, both near or within structures (e.g., residential garage).

This overall initiative (consisting of the reports *Solar Power Systems* and *Electric Drive and Hybrid Electric Vehicles*) is funded through a U.S. Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) Assistance to Firefighters Grant (AFG).

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1. Introduction and Background

Amongst the new challenges facing the U.S. fire service is the changing nature of emergency response to incidents where alternative energy sources are in use. The term *alternative energy* describes any of the various renewable power sources that can be used in place of conventional fuels such as petroleum and other fossil fuels.[1]

The fire service has identified a number of areas of particular concern with respect to hazard mitigation and emergency response in these scenarios. As the use of alternative energy proliferates, it introduces new and unexpected hazards that confront and challenge responders in an emergency.

Some fire service organizations are in the process of developing recommended emergency response procedures and best practices on a local or regional basis; in other jurisdictions, basic information on the hazard and appropriate response is lacking or not currently available. This project will take a comprehensive national look at the needs of the fire service for credible information and best practices in order to address these topics for first responders and provide an overall coordinated perspective on this topic.

The goal of this report is to assemble and disseminate best practice information for fire fighters and fireground incident commanders to assist in their decision making process for handling fire incidents in buildings equipped with solar power systems or in the systems themselves. Specifically, this study focuses on structural fire fighting in buildings and structures involving solar power systems utilizing solar panels that generate thermal and/or electrical energy, with a particular focus on solar photovoltaic panels used for electric power generation (see Figure 1-1 for an example of a solar power system on a typical residential occupancy).

While this report addresses issues of concern on *solar power systems*, a separate companion report addresses electric drive and hybrid electric vehicles, and it specifically addresses those emergency events involving electric drive and hybrid electric vehicles either near or within structures (e.g., residential garage). The project deliverables will be in the form of a written report, which will include best practices that can serve as the basis for the development of training programs by others.

This report will focus on solar power systems through the following specific tasks:

(1) Collect and analyze applicable scientific studies, case study reports, and available operational and training guidance from various sources;
(2) Synthesize this information in the form of best practice guidance for emergency response;
(3) Make the project deliverables broadly available to the fire service through on-line and print methods, and generate awareness of its accessibility; and

(4) Determine if standardization of safety practices is feasible and if so disseminate information to those involved, including submittal of possible revisions to applicable codes and standards.

The first of these tasks is key, which is to collect and analyze all applicable scientific studies, training guidance, case study reports and loss data, and available emergency response guidance relating to solar power systems. This task includes an interactive one-day workshop involving experts on fire service and other subject matter..

The goal of the one-day workshop was to identify, review, and assemble best practice information for tactical and strategic decision making by fire fighters and fireground incident commanders, to assist in their decision making process when responding to fire and/or rescue emergency events involving solar power systems. The workshop will focus on the following objectives:

- Collectively review the available baseline information provided to participants prior to the workshop;
- Identify the fundamental principles and key details involving fire/rescue tactics and strategy, and provide a summary of core basics; and
- Address and clarify related issues such as training needs, areas needing further research, revisions to codes/standards, and other topics applicable to the overall workshop goal.

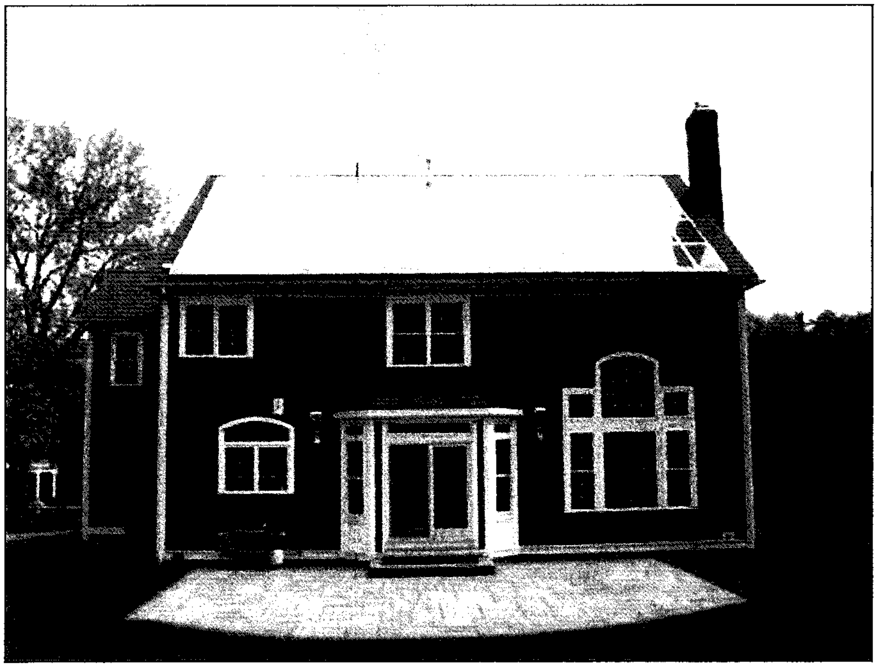

Figure 1-1: Example of Home with a Photovoltaic Solar Power System in Milton, MA
(Photo courtesy of NREL Photographic Information Exchange)

2. Overview of Solar Power Systems

Technology offers great advantages that generally make our world a better place. Yet when it fails it can introduce new and unusual challenges for emergency responders. As solar power systems proliferate, fire fighters and other emergency first responders need to be prepared to handle the hazards they present.

This section provides the baseline information necessary to understand and adequately address the technology used for solar power systems. This includes some brief historical information on the development of the technology, clarification of the basic solar panel types currently available and marketplace trends, discussion of available loss information, and a summary of applicable information resources.

Evolution of Technology for Harnessing Energy from the Sun

Life on planet Earth is fully dependent on the incredible energy of the Sun. As mankind has intellectually evolved, he has learned to directly harness this energy for practical everyday uses. Today, solar power has come into the mainstream and today is a practical and increasingly common alternative power source to conventional fossil fuels.

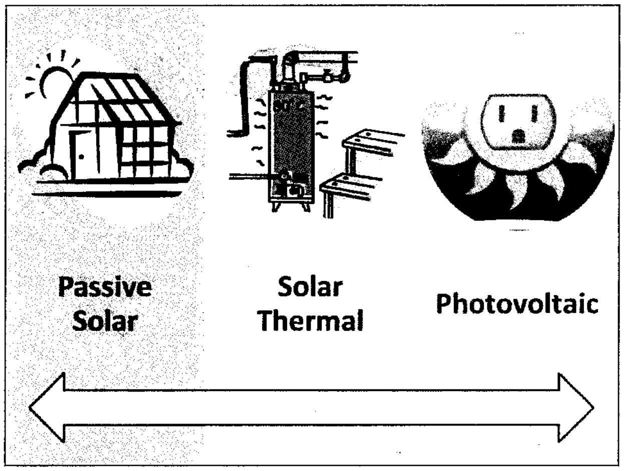

Figure 2-1: Basic Methods for Harnessing Solar Energy

The three basics means of capturing the sun's energy are: *passive solar* (i.e., capturing the Sun's energy in building design and construction); *solar thermal* (i.e., sunlight converted to heat); and *photovoltaics* (sunlight converted to electricity).[2] These basic methods for harnessing solar energy are illustrated in Figure 2-1. Generally, the evolution of the technology for harnessing the sun's energy occurred first with passive solar many centuries ago. In the last several centuries this has given way to the development of solar thermal technology and in more recent decades by photovoltaic technological advancements.

Mankind has been harnessing the energy of the sun for thousands of years. Since as early as the 7th century BC, building construction and structural positioning were done so as to take advantage of maximizing solar heating potential. Common techniques of construction included the use of south-facing windows to capture the sun's warmth.[3] Today, perhaps the most obvious direct application of passive solar concepts is with greenhouses used for agricultural or horticultural purposes.

The scientific advances of the last two and one half centuries have propelled solar technology into mainstream everyday applications. The concept of capturing the sun's thermal energy is credited to Swiss naturalist Horace de Saussure, who during the 1760s created a *hotbox* that effectively captured heat within multiple insulated boxes with plate glass windows.[4]

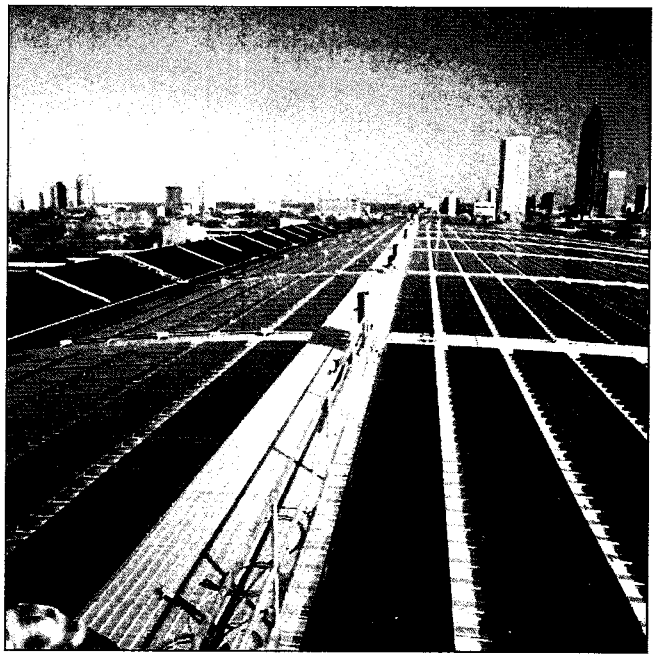

Figure 2-2: Rooftop Installation of Solar Thermal and PV Systems in Atlanta, GA
(Photo courtesy of NREL Photographic Information Exchange)

A century and a half later in the 1800s this application was expanded to metal water tanks painted black that would heat water when exposed to sunlight on rooftops. In 1891 Clarence Kemp of Baltimore received a patent for the first commercial solar water heater that was successfully marketed under the name *Climax*. This represented the world's first modern solar power system.[5]

Today, the use of solar panels for heating water are common in certain countries such as Australia, Israel, and Japan, and for certain application such as heating swimming pool water in the United States and elsewhere. Figure 2-2 shows a combination solar thermal system (on left) and photovoltaic system (on right) at the Georgia Tech Aquatic Center in Atlanta, Georgia. As shown in the illustration, the two types of systems have similar outward visual features, and it may not be immediately obvious to emergency responders which type of system they are handling.

While solar thermal power technology was under development, so too was solar electric power technology. In 1839, French scientist Edmond Becquerel discovered a way to convert light into an electric current using an electrolyte cell made up of copper oxide electrodes in an electrically conductive solution.[6] The photoconductivity of the element selenium was discovered by Willoughby Smith in 1873, and 10 years later American inventor Charles Fritts is credited with the design of the first practical solar cell using selenium wafers.[7]

The conversion of sunlight into electrical energy remained a scientific curiosity until the development of a crystal silicon cell. In the early 1940s, Russell Ohl at Bell Telephone Laboratories received a series of patents for thermoelectric-type devices using high purity fused silicon that paved the way for the development of the modern solar cell.[8] In 1954, a Bell Laboratories team led by Daryl Chapin, Calvin Fuller, and Gerald Pearson created a crystal silicon cell that had good conversion efficiency (~6% light-to-electricity). This resulted in the first commercial uses of photovoltaics in 1955 at remotely located telephone repeaters, and in the first communications satellites launched in 1958.[9]

Photovoltaics soon established itself as the power source of choice for satellites in space, and it has held this role ever since. The high cost of the early PV technology has steadily dropped over the years with increasing advancements in technology updates. Today, photovoltaics, commonly known as "PV", has firmly established itself as one of the premier methods of sustainable energy and as a realistic alternative to conventional fossil fuels.[10]

Types of Solar Power Systems

From a consumer's standpoint, the fire service has an interest in all methods of harnessing solar energy when it comes to their own fire stations and related facilities. However, from the standpoint of fireground operations at a structural fire, their focus on the topic of solar power is, for all practical purposes, entirely on solar panels for thermal systems (direct heating) and photovoltaic's (generating electricity). Accordingly, these two basic methods are the primary focus of this report, as illustrated in Figure 2-3, types of solar power systems of interest to the fire service.

Fire fighters engaged in fireground operations at a structural fire are most likely to encounter solar panels on the roof of the structure, since this is normally the area most exposed to sunlight. The scope of this report includes all thermal systems and photovoltaic systems that are directly supporting the energy use of a particular structure. In such a case the solar panels may be located on the structure (i.e., roof) or be immediately adjacent and directly supporting the building's energy use. This study does not intend to include independent solar power generating facilities. An example would be a large array of ground-mounted solar panels that are directing their combined electrical energy into the power grid for collective consumption by the community.

Thermal systems are generally less complicated than photovoltaic systems. The basic concept used by a thermal system is to use sunlight to directly heat a fluid that is used to transfer the thermal energy.[11] Often the fluid is water, and on a structure this may or may not be connected to an internal storage tank such as a conventional hot water heater. Fluids other than water may be used in certain closed-loop systems to avoid freezing and enhance the fluid's heat transfer characteristics.[12]

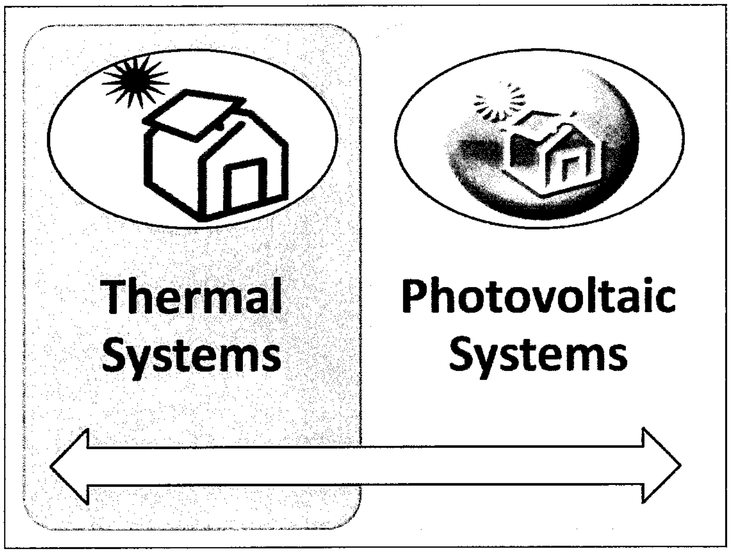

Figure 2-3: Types of Solar Power Systems of Interest to the Fire Service

Thermal systems are often further recognized as either passive thermal or active thermal systems, depending on whether or not they have a pump that actively circulates the fluid. A common application of a thermal system is to heat swimming pools, primarily because the fluid (swimming pool water) and pump (swimming pool filtration system) are already readily available. The four primary classifications of solar pool collector designs are: plastic panels, rubber mats, metal panels, and plastic pipe systems.[13] The overall risk from thermal systems presented to fire fighters involved with fireground operations is generally considered to be low.

Marketplace Trends

Solar power is an important source of sustainable alternate energy. The benefits of harnessing solar energy often outweigh the barriers, which most often is the initial installation cost. Most of the common solar energy applications available today are highly reliable, require little maintenance, have minimal operational costs, are sustainable with limited environmental impact, reduce our dependence on foreign energy sources, and provide a flexible and adaptable supply of power.[14] Figure 2-4 illustrates a typical residential solar power installation located in Maine.

Figure 2-4: Typical Residential Installation of a Solar Power System
(Photo courtesy of NREL Photographic Information Exchange)

The overall health of the solar power industry is strong. Worldwide solar heating capacity increased by 15 percent from 2007 to 2008, and for the first time ever more renewable energy than conventional power capacity was added in both United States and the European Union.[15] In the United States photovoltaics show strong promise for supporting our future electrical energy needs. Since early 2000 the production of photovoltaics had been doubling every two years until 2008 when it doubled in just one year.[16]

The solar power marketplace in the U.S. has experienced significant growth over the most recent decade. This is due to strong consumer demand, rising energy prices from conventional energy sources, and financial incentives from the federal government, states and utilities. These factors have resulted in the installed cost of consumer-sited PV systems declining substantially since 1998.[17]

The PV market is dominant in a small number of states led by California, but this is expanding as installations doubled in more than eleven states during 2008. The top states in 2008 based on installed megawatt (MW) capacity of PV installations were: (1) California - 178.7; (2) New Jersey – 22.5; (3) Colorado – 21.7; (4) Nevada – 14.9; (5) Hawaii – 8.6; (6) New York – 7.0; (7) Arizona – 6.4; (8) Connecticut – 5.3; (9) Oregon – 4.8; and (10) North Carolina – 4.0. The remaining states accounted for a cumulative capacity of 15.9 MW.[18]

Over 62,000 installations were completed in 2008, and the industry experienced a growth of 78 percent in 2008 with more than 5.4 gigawatts (GW) of capacity in shipments.[19] Similarly, the average size of PV system installations also increased during this time frame. Examples occurring in 2008 include a 12.6-MW installation in Nevada and a 3-MW installation in Pennsylvania, which together accounted for 5% of the annual installed capacity that year.[20] An example of a large commercial installation located in Boston, MA is shown in Figure 2-5.

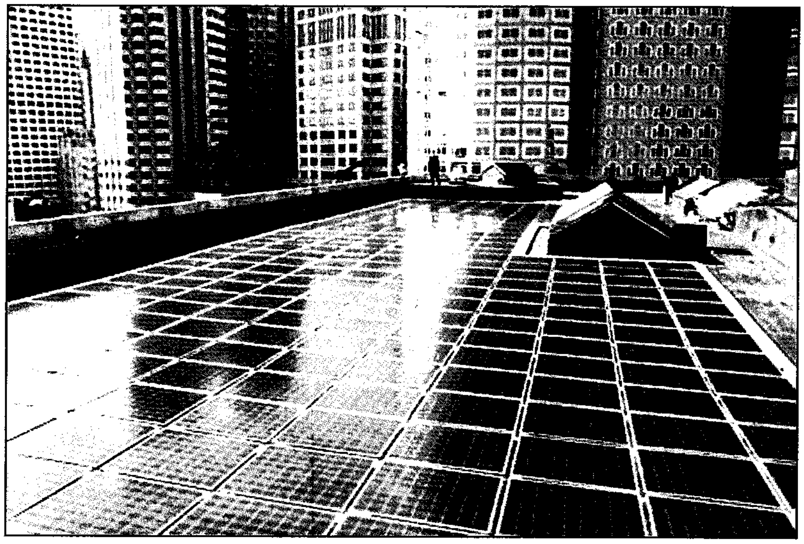

Figure 2-5: Example of a Large Solar Power Commercial Installation
(Photo courtesy of NREL Photographic Information Exchange)

Each year in the last decade the manufacture and shipment of components for solar thermal and photovoltaic solar power systems has increased at a noteworthy rate. For solar thermal, Table 2-1 illustrates solar thermal collector shipments each year from 1998 to 2007, demonstrating the vibrant overall health of the solar thermal industry in the United States.[21] Similarly, the annual U.S. shipment of photovoltaic cells and modules remains strong and has increased sharply from 1998 through 2007. The increase in annual shipments of photovoltaic cells and modules in peak kilowatts over this time period is illustrated in Table2-2. At this time indications point to this growth continuing.

Table 2-1: Solar Thermal Collector Shipments Annually from 1998 to 2007[22]

Year	Import Shipments (1000 Sq Ft)	Export Shipments (1000 Sq Ft)	Total Shipments (1000 Sq Ft)	Number of Companies
1998	2,206	360	7,756	28
1999	2,352	537	8,583	29
2000	2,201	496	8,354	26
2001	3,502	840	11,189	26
2002	3,068	659	11,663	27
2003	2,986	518	11,444	26
2004	3,723	813	14,114	24
2005	4,546	1,361	16,041	25
2006	4,244	1,211	20,744	44
2007	3,891	1,376	15,153	60

Table 2-2: Photovoltaic Cell/Module Shipments Annually from 1998 to 2007[23]

Year	Import Shipments (Peak Kilowatt)	Export Shipments (Peak Kilowatt)	Total Shipments (Peak Kilowatt)	Number of Companies
1998	1,931	35,493	50,562	21
1999	4,784	55,585	76,787	19
2000	8,821	68,382	88,221	21
2001	10,204	61,356	97,666	19
2002	7,297	66,778	112,090	19
2003	9,731	60,693	109,357	20
2004	47,703	102,770	181,116	19
2005	90,981	92,451	226,916	29
2006	173,977	130,757	337,268	41
2007	238,018	237,209	517,684	46

The largest barrier to the proliferation of PV technology is its initial cost, and reducing this cost will further promote its widespread use. This obstacle hinges directly on the manufacturing process used to create the solar cells and related technology components. Intense research is under way that is focusing on improved processes to reasonably manufacture PV solar cells, and in the coming years it is anticipated that the affordability of PV solar systems will improve.[24]

The attractiveness of solar power is of course dependent on the available sunlight. However, the cost of purchasing electricity tends to be a greater marketplace influence, which is why some of the states with less than ideal optimum sunlight rank high on the list of states with the most installations. For example, New Jersey, New York, Connecticut, Oregon, and North Carolina all ranked in the top ten among states with the most installed MW capacity in 2008, despite ranking lower in terms of annual total sunshine. Further, certain states (e.g, California) and certain regions within states have aggressive legislation and active incentive programs promoting the use of solar and other sustainable forms of alternative energy. Therefore, fire fighters should not assume they won't encounter a solar power system simply because their jurisdiction is in an area of the U.S. lacking a reputation for abundant sunshine.

An example of a proactive state activity is the "California Solar Initiative Program", which provides significant rebate incentives through selected participating public utilities to promote the use of solar energy.[25] Table 2-3 illustrates the growth of solar energy systems in California from 1981 through 2008, and the impact of two major legislative initiatives to promote its use that were initiated in 1998 and 2007, respectively. In 2010, an estimated one percent of all buildings in California have some type of solar power system.[26] The program started in 1998 focused on incentives for stimulating utilities to broaden their use of solar energy, while the independent 2007 program additionally addresses consumer-based incentives.

Table 2-3: California Grid-Connected Photovoltaic Systems 1981–2008[27]

Year	Total Kilowatts	Year	Total Kilowatts
1981	37	**1995**	4,193
1982	75	**1996**	5,046
1983	86	1997	5,465
1984	1,231	1998	6,263
1985	1,245	1999	7,228
1986	2,217	2000	8,929
1987	2,217	2001	15,180
1988	2,221	2002	29,820
1989	2,280	2003	58,460
1990	2,295	2004	95,984
1991	2,312	2005	139,516
1992	2,801	2006	198,257
1993	4,064	2007	279,463
1994	4,606	2008	449,216

All corners of planet Earth have some number of sunny days, and thus this technology can be found virtually everywhere. The remoteness and ease of access to an area also provide a strong motivation for using solar power, and it is ideal where delivery of conventional fuels is very difficult. For this reason solar power has been the energy source of choice for the space exploration program, as well as isolated, difficult to access sites such as telephone repeater stations on mountain-tops and other remote locations.

As solar power technology is enhanced, it will reduce the complexities of installation and make system installation more readily available in the broad consumer marketplace. This raises the questions regarding non-OEM-type (OEM: Original Equipment Manufacturer) installations by unregulated consumers (i.e., purchase of self-install kits from a local hardware store). Additional monitoring by safety professionals may ultimately be required to assure safe and proper installations for occupants and emergency first responders. Unregulated private occupant installations raise questions that are not necessarily within the present regulatory infrastructure (e.g., via building and/or electrical permits). Further attention to this issue will likely be required as these self-installed systems become more common.

The convenience of an energy source that minimizes the need for replenishment is highly attractive. For example, solar power has already replaced small batteries in various convenience items such as wristwatches and calculators, thus greatly extending their lifespan without the need to replenish the power source (i.e., battery). Another example includes new motor vehicles that are considering solar energy collectors to supplement their electrical power system.[28]

Use of solar power for emergency preparedness and disaster planning is an obvious application of alternative energy independent of the electrical power grid. Numerous initiatives are underway to supplement disaster critical support functions. One example is an initiative to establish a PV back-up power supply in the City of Boston for evacuation routes out of the city for critical traffic controls, gas station pumps, emergency evacuation repeaters, etc.

Figure 2-6: Example of PV Systems Mounted on Fire Apparatus[29]
(Photo courtesy of San Rafael Fire Department)

The utilization of vehicle-mounted solar panels already exists within the fire service. In particular, an approach gaining traction in California is the installation of fire apparatus PV systems to address fire apparatus deployment over long periods of time (e.g., a wildfire event).[30] This provides them with a dependable electrical power supply for radio operation and other critical electrical equipment, and supplements the energy provided from conventional fuels that need periodic replenishment. Figure 2-6 illustrates PV panels mounted on the roof of fire apparatus in San Rafael, California.[31]

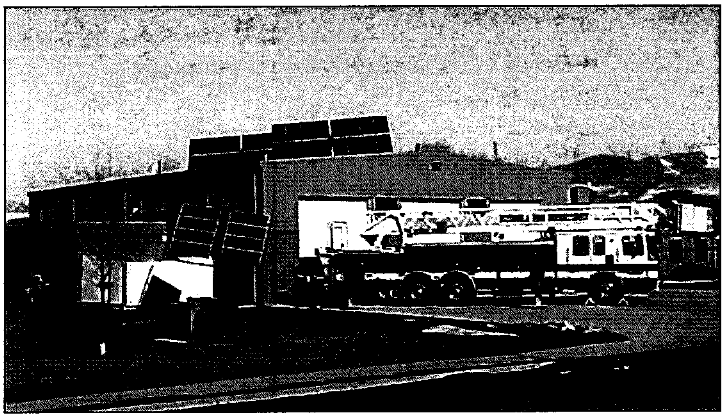

Figure 2-7: Example of Fire Station with a Photovoltaic Solar Power System in Missoula, MT
(Photo courtesy of NREL Photographic Information Exchange)

In addition to vehicle-mounted systems, fire stations are an integral part of almost all communities, and these civic structures are possible candidates for solar power system applications. Multiple examples exist over the last several decades of fire departments that have effectively installed solar power systems on their fire stations.[32,33] Figure 2-7 illustrates an example of a PV installation at Station Number 4 in Missoula, Montana.

Fire service facilities in remote areas utilize solar power systems more by necessity than for cost savings or similar reasons. This is not unusual for installations in the urban/wildland interface where commercial electric power from the local utility is simply not available. Figure 2-8 illustrates a PV installation on the Hawley Lookout Tower, which is operated by the U. S. Forest Service and located in the Boise National Forest in Idaho.

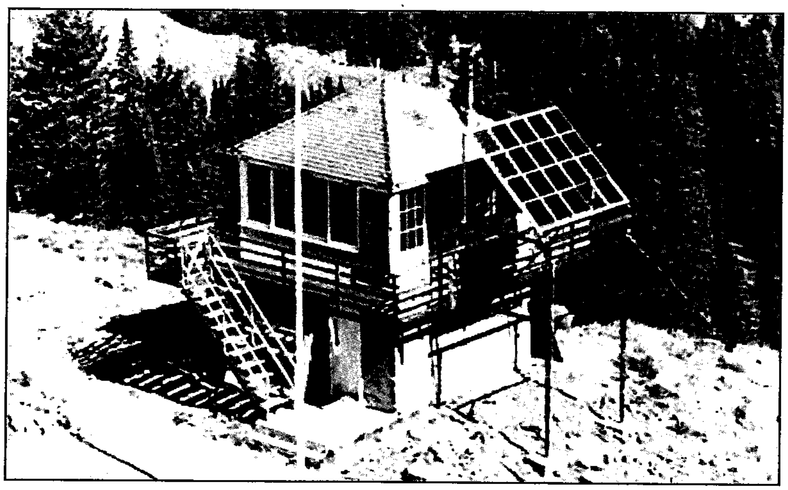

Figure 2-8: Example of PV System at a Remote Fire Lookout Tower in Idaho
(Photo courtesy of NREL Photographic Information Exchange)

The value of solar power systems as a source of sustainable energy is clear. While the fire service is obviously interested in clarifying fireground operations for structures equipped with solar panels, they also have a genuine interest in this technology as a general consumer.

Loss History and Data

Statistical data indicates that on average 40,270 fire fighters were injured during fireground operations in the United States annually from 2003 through 2006. Of these injuries, there were on average 215 fire fighters engaged in fireground operation at a building fire whose injuries were due to "electric shock." Further, 50 of these annual injuries were considered moderate or severe injuries.[34] Statistical data from present data collection efforts does not address whether or not photovoltaic power systems were involved with any of these occurrences.

The danger of electric shock on the fireground is a real hazard for fire fighters. Exemplifying this hazard is a report containing thirty-two specific incidents from the Fire Fighter Near Miss Database for the calendar years 2005 and 2006.[35] These incident reports provide anecdotal information on actual incidents involving fire fighters exposed to electric shock. While these are useful case studies, the level of detail in these reports does not always include the type or source of the specific electrical equipment involved, and none of these reports mentions the involvement of a solar power system.

To facilitate a review of loss information, structural fires involving solar power systems can be one of three basic types depending on the point of ignition. These are: (1) an external exposure fire to a building equipped with a solar power system; (2) a fire originating within a structure from other than the solar system; or (3) a fire originating in the solar power system as the point of ignition.

Detailed loss information to support each of these scenarios is lacking due to the relative newness of this technology. Traditional fire loss statistics such as NFIRS (National Fire Incident Reporting System) handled by the U.S. Fire Administration and FIDO (Fire Incident Data Organization) administered by the National Fire Protection Association, do not provide the necessary level of detail to distinguish the relatively recent technologies of solar power systems. A preliminary scan of the NFIRS data yields 44 incidents that involve "solar" in some manner, but a detailed review indicates that most are not applicable and involve fires that started with sunlight through glass, landscape lighting, are non-structural fires such as vehicles, vegetation, rubbish, etc. Further, proprietary information may exist with certain insurance companies and similar loss control organizations, but this is typically focused on their specific constituents and transparent data summaries are not known to be readily available.

In summary, statistical data involving solar power systems is not readily available to provide quantifiable data analysis of these systems. We do, however, have quantifiable data on the number of structure fires in the United States each year. For example, in 2007 there were 530,500 structure fires resulting in 3,000 deaths, 15,350 injuries, and $10.6 billion in direct property loss. Of these fires, one- and two-family homes accounted for 399,000 fires, 2,865 deaths, 13,600 injuries, and $7.4 billion in direct property loss.[36] While the actual percentage of overall buildings with solar power systems and those involved with fire remains a quantifiably mystery, we have a general expectation of how the data will likely trend in the future. As solar power systems continue to proliferate, the likelihood of fire fighters encountering them at a structural fire will similarly increase.

Fire service emergencies will more likely be responding to smaller installations commonly found on residences and similar occupancies since they comprise most of today's installations. However, large commercial systems will be equally noteworthy since even though they will be encountered much less frequently (due to fewer overall installations), they present unique fire fighting challenges that will require special tactical and strategic considerations.

Several Individual fire reports of specific events are able to supplement our understanding of fires involving solar power systems. Comparatively, there are very few incidents of fires originating with or directly involving solar power systems. This implies that the solar power industry has a relatively good record when it comes to their equipment and components contributing to the source of ignition. The following seven reported incidents provide information on distinctly different fire emergency scenarios.

The first of these incidents involved a residential structure fire in Colorado during May 1980. This involved a solar thermal system on a new unoccupied home with a small fire starting in a solar module due to faulty insulation materials. The fire resulted in minimal damage, but it did raise concern about this particular module design and its ability to properly endure the anticipated heat and weather conditions.[37,38,39] This fire occurred in 1980 and in the three decades since, significant advances have been made with the components and materials in this type of application.

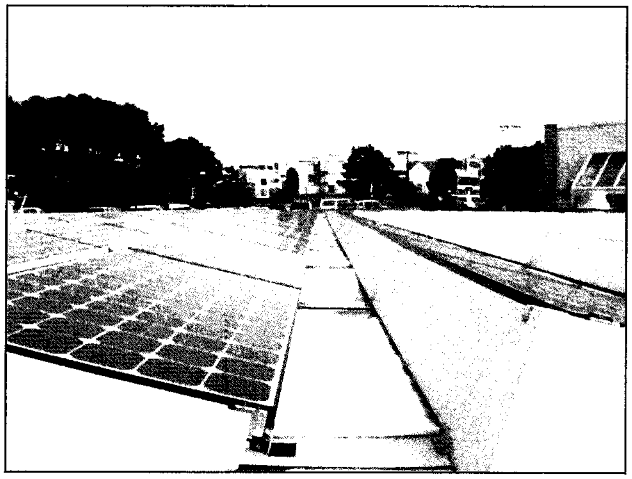

Figure 2-9: Type of Arrays Involved in May 2008 CA Incident[40]
(Photo courtesy of Matt Paiss, San Jose CA)

The second incident involved photovoltaic panels in May 2008 on a structure at the University of San Francisco. Figure 2-9 provides an illustration of the type of arrays involved in this event, which was a relatively extensive installation and had the potential for significant fire spread. However, the building engineers on site were certified to handle high voltage, and the local electrical utility crew also arrived early in the event, and they took multiple steps to isolate energized conductors and power down the system, allowing responding fire fighters to extinguish the fire in one of the combiner boxes using portable extinguishers and a blanket of foam. Property damage was kept to the components of the solar power system involved in the fire, with minimal damage to the host building.[41]

The third fire of interest occurred in February 2009 at a California residence equipped with a newly installed photovoltaic system. The system was tied to the grid and was installed under cloudy conditions, and turned on prior to receiving a final electrical inspection. The system remained in an underpowered mode of operation for an extended stretch of rainy days. Ten days after the installation when exposed to full sunlight conditions, the system caught fire due to an electrical malfunction. Damage was limited to the roof-top system components.

A fourth fire occurred in a PV solar module installed on the roof of a home in California during March 2009. Unlike the residential fire in Colorado that involved a solar thermal system, this fire involved electrical arcing with a photovoltaic module that initiated the fire. This fire resulted in minimal damage to the residence, but portions of the solar system required replacement.[42]

The fifth fire occurred in California during April 2009 and involved a large PV solar array comprised of 166 strings of 11 modules each on the roof of a department store.[43] Figure 2-10 illustrates the solar power system involved in this event.

Figure 2-10: Solar Power System involved in April 2009 CA Incident[44]

A diagram of the rooftop installation is shown in Figure 2-11, and this illustrates how "strings of arrays" in terms of the physical configuration are not necessarily consistent with the "strings of electrically connected arrays." Explained in another way, the separate strings of 11 modules each is based on their electrical interconnections, and these do not directly equate to physical strings of 11 modules in a single individual row. This can cause confusion as emergency responders attempt to work with electrical system experts to isolate the system.

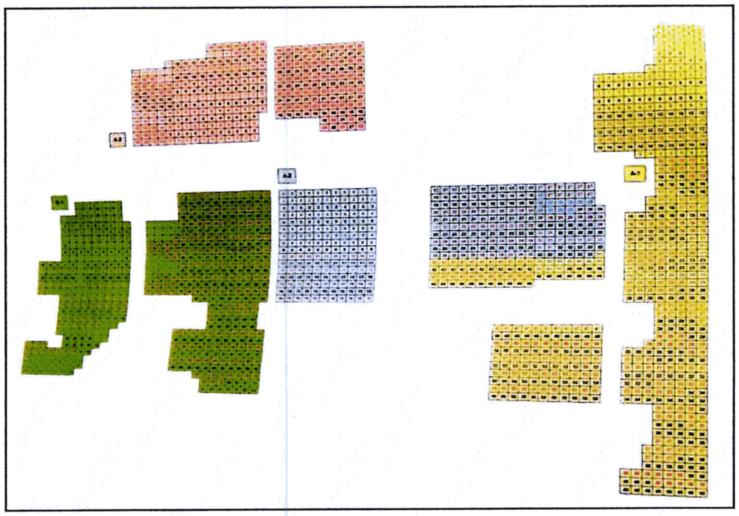

Figure 2-11: Diagram of Rooftop System in April 2009 CA Incident[45]

Two separate electrical fires broke out remote from each other, and were caused by electrical arcing. One of these fires consumed a complete string of solar modules. The resulting two-alarm fire was confined to the solar modules and was kept from penetrating the store's roofing materials. The arcing occurred when metal electrical conduits separated at their couplings due to significant contraction and expansion from sunlight, which exposed wiring that ultimately shorted. Figure 2-12 illustrates one of the arrays damaged by fire.

Figure 2-12: Fire-Damaged Array in April 2009 CA Incident[46]

The fire department was challenged by the lack of accessible means to readily isolate the modules on fire. This fire occurred on a bright sunny day, and the modules continued to generate electricity throughout the event with no means available to isolate them or de-power them. The electrical energy generated at the time of the fire by the system was appreciable and dangerous, and fortunately no injuries occurred. Although the installation met the requirements of the applicable electrical code, this event indicates a need to revise code requirements to provide emergency responders with appropriate measures to readily isolate solar modules.

A sixth fire incident occurred in March 2010 and involved a PV system at a residential occupancy in Maryland.[47] First arriving units reported that they had smoke and fire venting through the roof, but they soon realized the fire was confined only to the rooftop solar panels, after finding no smoke or fire within the structure. The fire was effectively controlled with a hose stream from the ground. Indications are that leaves and similar debris around and underneath the solar panels contributed to the fire's ignition. Figure 2-13 provides an illustration of the fire scene.

Figure 2-13: Residential PV Fire in March 2010 MD Incident[48]

The seventh fire occurred in a photovoltaic solar power system located on a residential occupancy in Southern California during April 2010. This fire was the result of an electrical fault within the inverter unit, and it resulted in an estimated $4,000 in damage and no injuries.[49] Despite relatively minimal damage, the event gained attention due to the challenge to the fire department to fully extinguish the fire while they attempted to safely remove electrical power that was generated by sunlight powering the photovoltaic panels. The fire department kept the small fire effectively contained within the inverter unit for several hours, and eventually fully extinguished the fire after locating and obtaining the assistance of a properly credentialed and equipped electrician to assist with removing the electrical power.

One issue not yet addressed and included in the identified loss data, is the potential future impact of solar power systems on the spread of wildland/urban interface fires. In recent decades these large-scale fires have increased in frequency and their loss magnitude has been enormous, dwarfing other traditional fire events. Some of these incidents have involved vast areas of vegetation and included the loss of hundreds of structures.

Concern exists on the ability of structures to withstand the onslaught of a wildland fire in these interface areas, which is testimony to the requirements of NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildland Fire* that was originally issued in 1935.[50] The ability of a structure to resist an encroaching wildfire (including flying brands) is a critical defense for the wildland/urban interface fires, and how solar panels resist or fail to resist the fire attack is important. At this time, however, no data has been compiled nor any specific known losses recorded that indicate the impact of rooftop solar power systems for wildland/urban interface events.

More specifically it is unknown how rooftop solar panels perform when exposed to radiant heat or flying brands of an approaching wildland fire. Fire protection professionals have for many decades fought to prohibit building construction that uses certain types of roofing materials (e.g., untreated wood shingles) unable to resist building-to-building conflagrations. This has led to roofing material standards to protect from exposure fires such as ASTM E 108, *Standard Test Methods for Fire Tests of Roof Coverings*.[51]

Certain questions remain unanswered about the performance characteristics of roofs equipped with solar power systems and their ability to withstand external fire exposure. One recent research project through Underwriters Laboratories has further explored this topic, but this work is still in progress and the results are currently pending.

Information Resources

Solar power system installations have steadily grown in numbers in the first full decade of the 21st century. Factors contributing to this growth include strong consumer demand, rising energy prices from conventional energy sources, and financial incentives from the federal government, states, and utilities.[52] This has resulted in the development of multiple resources available from government entities, independent membership associations, and other similar broad-based organizations.

A useful resource addressing PV installations is the Open PV Project administered by the National Renewable Energy Laboratory (NREL), which provides updates of current PV market trends as well as specific details on existing U.S. photovoltaic installations.[53] The Open PV Project is a collaborative effort between government, industry, and the public that provides a community-driven database of PV installations. It utilizes a comprehensive web-based data collection process focusing on PV installation data for the United States. Its goal is to collect, organize, and distribute knowledge addressing the location, size, cost, and commissioning date of all U.S. PV installations.

The Open PV Project utilizes an active data-collection approach that is continually gathering input from contributing sources. Trend information starts in the year 2000, and NREL administrators bolster the collection efforts by using data from organizations such as large utilities and state-run incentive programs. The ongoing data compilation process includes multiple features to enhance quality and screen duplicates, although they acknowledge that statistics, rankings, and other estimates are only estimates and do not represent the actual current market status. Figure 2-14 illustrates information from the Open PV Project located at openpv.nrel.gov. In the future it is hoped that other private and government databases that track permits and similar information (i.e., through building departments and fire departments) will be able to directly contribute to the Open PV Project and other on-line tracking efforts focused on this topic.

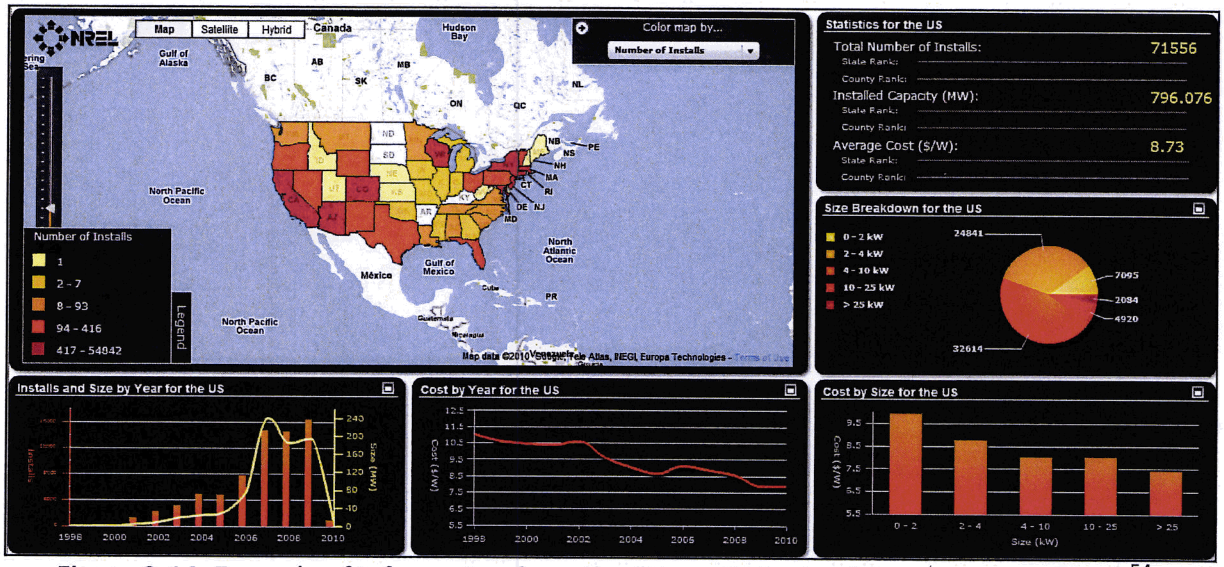

Figure 2-14: Example of Information from the "Open PV Project" (at openpv.nrel.gov).[54]

A few local jurisdictions track the solar power systems installations within their domain, and this provides useful information for emergency responders with their fire emergency pre-planning efforts. An example of one such jurisdiction is the Building Department in the City of San Francisco. They provide useful information on the installations located throughout the city, including detailed case studies of selected solar power systems. This information is readily available on a website (sf.solarmap.org), and Figure 2-15 provides an example of this particular web-based resource.[55] Other cities have similar web-based inventories, such as San Diego, which is considered to have the most Megawatt capacity among U.S City based jurisdictions.

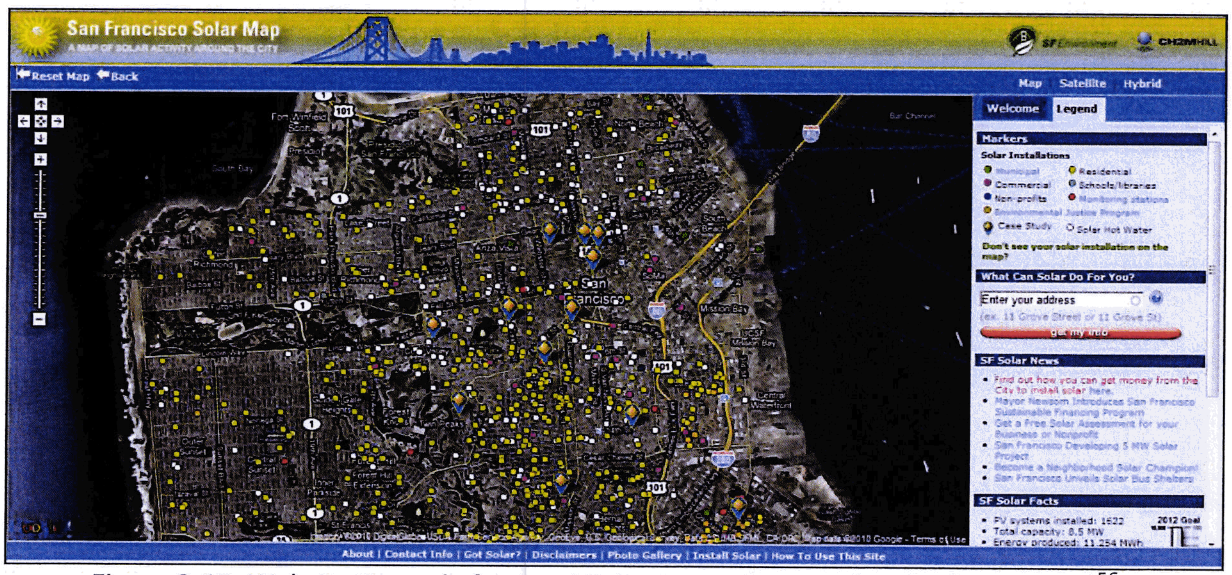

Figure 2-15: Website Example for Local Solar Power Systems (at sf.solarmap.org)[56]

Illustrations are a critical aspect of training programs for emergency responders, and a valuable source of useful pictures on a wide range of alternative energy related topics including solar power systems is the NREL PIX (National Renewable Energy Laboratory Picture Information Exchange). This website is located at www.nrel.gov/data/pix/ and offers a substantial library of illustrations that can be freely downloaded and used, and also provides a service for obtaining high resolution pictures if needed.

The growth in recent years of solar power industry has led to multiple national organizations that provide a supporting infrastructure for the use of solar power. Some of these organizations are focused on industry lobbying efforts or activities of interest to industry constituent groups. Their applicability to emergency responders may, in some cases, be arguably limited, but understanding them is nevertheless important to gain a full appreciation of the solar power industry. The following provides a summary of the key membership and resource organizations addressing solar power in the United States:

American Solar Energy Society (ASES)
The American Solar Energy Society (ASES) is a membership organization with approximately 13,000 energy professionals and grassroots supporters, dedicated to advancing the use of solar energy for the benefit of U.S. citizens and the global environment. ASES promotes the widespread near-term and long-term use of solar energy, has regional chapters in 40 states, and is the U.S. section of the International Solar Energy Society.[57]

Database of State Incentives for Renewables & Efficiency (DSIRE)
The Database of State Incentives for Renewables & Efficiency (DSIRE) was established in 1995 is a consortium of multiple government and non-government organizations that provides a comprehensive source of readily accessible information on state, local, utility, and federal incentives that promote renewable energy and energy efficiency. Funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), the database is administered by the National Renewable Energy Laboratory (NREL) and is an ongoing project of the North Carolina Solar Center and the Interstate Renewable Energy Council (IREC).[58]

Interstate Renewable Energy Council (IREC)
The Interstate Renewable Energy Council (IREC) is a nonprofit organization that addresses renewable energy programs and policies, and is a premier resource for current information, education, credentialing, and best practices regarding renewable energy. IREC was founded in 1982 and has been focused on rulemaking initiatives for connecting distributed power to the utility grid, workforce development, consumer protection, and stakeholder coordination.[59]

National Renewable Energy Laboratory (NREL)
The National Renewable Energy Laboratory (NREL) is the nation's primary laboratory for renewable energy and energy efficiency research and development. In 1977 NREL began operating as the Solar Energy Research Institute, and in 1991 was designated a U.S. Department of Energy national laboratory and its name changed to NREL.[60]

Solar America Board of Codes and Standards (Solar ABCs)
The Solar America Board for Codes and Standards (Solar ABCs) is funded by the U.S. Department

of Energy to help facilitate widespread adoption of safe, reliable, and cost-effective solar technologies, primarily through the development, implementation, and dissemination of codes and standards addressing solar power. Solar ABCs coordinates recommendations to codes and standards making bodies as a collaborative effort of affected stakeholders.[61]

Solar Energy Industries Association (SEIA)

The Solar Energy Industries Association (SEIA) was established in 1974 and functions as the national trade association of solar energy industry. SEIA accomplishes its mission by expanding markets, removing market barriers, strengthening the industry and educating the public on the benefits of solar energy. SEIA also administers a separate nonprofit organization called the Solar Energy Research and Education Foundation (SEREF) that oversees policy-driven research and develops education outreach programs to promote solar as a mainstream and significant energy source.[62]

Solar Energy International (SEI)

Solar Energy International (SEI) was founded in 1991 and is a nonprofit educational organization that provides education and training to decision makers, technicians and users of renewable energy sources. The SEI mission is to empower people around the world through the education of sustainable practices, and they work cooperatively with grassroots and development organizations in the Americas, Africa, Micronesia, and the Caribbean.[63]

Solar Living Institute (SLI)

The Solar Living Institute (SLI) is a nonprofit educational organization that promotes sustainable living through inspirational environmental education. SLI was founded in 1998 and has its headquarters in Hopedale, California.[64]

Other national organizations address solar power and directly address its virtues, but tend to represent the interests of system consumers, the general public, or other broad-based general interest group. The following is a summary of these organizations:

International Solar Energy Society (ISES)

The International Solar Energy Society (ISES) was founded in 1954 as the "Association for Applied Solar Energy". The organization revised their name in 1963 to the "Solar Energy Society" and again to the "International Solar Energy Society" in 1971. ISES is a global, nonprofit, non-governmental membership organization serving the needs of the renewable energy community. With world headquarters in Freiburg, Germany, ISES is a UN-accredited organization with a presence in more than 50 countries.[65]

Solar Alliance

The Solar Alliance is a U.S. oriented, state-focused alliance of solar manufacturers, integrators, and financiers dedicated to facilitating photovoltaic energy. The Alliance works closely with corporations, state-level trade associations, grass roots organizations, academic institutions, and local governments to advocate the virtues of solar energy.[66]

Solar Electric Power Association (SEPA)
Solar Electric Power Association is a nonprofit membership organization focusing on electric utility use and integration of solar electric power. SEPA is a business-to-business utility-focused activity that provides customized, localized and practical advice, research and events that are of specific interest to the electric utility industry. Funding comes from membership dues, individual and corporate donations, event revenue, and support from the U.S. Department of Energy.[67]

Solar Nation
Solar Nation is a program of the American Solar Energy Society that is a national grassroots campaign working to harness and facilitate public support for solar energy. Their focus is to positively affect state and federal policy and to enable solar power to become a significant part of America's energy future. Solar Nation promotes networking for advocacy groups with similar interests to build alliances and support long-term mutual goals linked to specific policy actions.[68]

Vote Solar
The Vote Solar Initiative is headquartered in San Francisco and works to resolve regulatory roadblocks impeding solar adoption. Established in 2001, Vote Solar operates at the local, state, and federal level to implement programs and policies that promote a strong solar market.[69]

In addition to the national organizations, various regional organizations have also found their way into various levels of mainstream recognition. Some of their work has had noteworthy impact and serves as a model for others with interest on these topics. Virtually every state and/or region has some organization that is supporting the local interest of solar power. These are summarized in multiple listings, such as the Action Partners section maintained by Solar Nation that provides a summary of their fifty-two Action Partner organizations.[70] Some examples are summarized in Table 2-4, Regional Organizations Addressing Solar Power.

Table 2-4: Regional Organizations Addressing Solar Power.[71,72,73,74,75]

Organizations	Website
Arizona Solar Energy Industries Association (AriSEIA)	www.arizonasolarindustry.org,
California Solar Energy Industries Association (CALSEIA)	calseia.org
Florida Solar Energy Resource Center (FSEC)	www.fsec.ucf.edu
Northeast Sustainable Energy Association (NESEA)	www.nesea.org,
Texas Renewable Energy Industries Association (TREIA)	www.treia.org

When compared to other energy technologies, solar power is relatively new and its usage has become more mainstream in the last several decades. Consequently, the model codes and standards arena is actively engaged in addressing the latest technologies and application methods.

Consensus-based model codes and standards provide the baseline for the design, installation, operation, maintenance, and other important aspects of solar power systems. A key organization providing support in this topic is the aforementioned Solar America Board of Codes and Standards, also popularly known by their acronym Solar ABCs.[76] Funded by the U.S. Department of Energy, their charter is to support efforts towards development, implementation, and dissemination of codes and standards addressing solar power, with the intent of facilitating widespread adoption of safe, reliable, and cost-effective solar technologies. There role is particularly important to help address safety and other concerns from the emergency response community, as they coordinate recommendations to codes- and standards-making bodies as a collaborative effort of affected stakeholders.

Several internationally recognized codes and standards directly address solar power systems, either within the entire document or in part. Included are certain emergency responder concerns for solar power systems, such as certain features that assist them during an emergency such as component labeling or electrical isolation switches. The following technical documents are directly applicable documents in the codes and standards arena:

- IEC/TS 61836:2007, *Solar Photovoltaic Energy Systems – Terms, Definitions, and Symbols*
- IEC 60364-7-712 (2002-05), *Electric Installations of Buildings* – Part 7-712: Requirements for Special Installations or Locations – Solar Photovoltaic (PV) Power Supply Systems
- ISO 9488:1999, *Solar Energy* – Vocabulary
- NFPA 70, *National Electrical Code*, 2008 edition (Article 690, Solar Photovoltaic Systems)

These documents provide detailed requirements, but the relatively rapid introduction of this technology has required them to be continually updated. For example, NFPA 70, *National Electrical Code* is presently undergoing revisions for the upcoming 2011 edition of the NEC, and multiple enhancements are proposed in Article 690 to address additional safety details for PV installations. This includes routing PV source and output conductors, directories for remote multiple inverters, and qualification requirements for installers.[77]

Other model codes address the topic of solar as part of their overall scope, such as the various model building codes, fire codes, and other related documents. Model codes continue to be updated to include the latest requirements and guidance information, some of which pertains to the design and installation of solar power systems for buildings. This is especially important for new and unusual technologies and configurations (e.g., flame spread characteristics of vertically mounted solar panels rather than horizontal rooftop panels). Examples of applicable model codes include:

- *NFPA 5000, Building Construction and Safety Code*, 2009 edition
- *ICC International Building Code*, 2009 edition
- NFPA 1, *Fire Code*, 2009 edition
- *ICC International Fire Code*
- *ICC-700, National Green Building Standard*
- *ICC International Energy Conservation Code*
- *ICC International Residential Code*

Individual states typically utilize the model codes to provide direction and approach for their own legislation. Some state-based requirements are already well established, and in other locations it is under development. Examples include:

- *2008 Building Energy Efficiency Standards for Residential and Nonresidential Buildings*, (California Energy Commission, effective 1 Jan 2010).[78]
- *Oregon Solar Energy Code*, Draft Document dated September 2009.[79]
- *Guidelines for Fire Safety Elements of Solar Photovoltaic Systems* (Orange County Fire Chiefs' Association, California, December 1, 2008).[80]

Both the model codes as well as the specific state-applied local codes are typically oriented as overarching documents focused on basic design, installation, and maintenance as they relate to the use of solar power in buildings and structures. They normally refer to other more specific standards often by mandatory reference (administered by organizations such as ASTM International, Underwriters Laboratories, etc.), for the particular details important to maintain safe and reliable construction of the solar power systems and components. In addition to assuring safety, these documents also provide useful consumer marketplace conformity to facilitate interoperability in the solar power infrastructure and marketplace (i.e., matching thread sizes for component interconnections.

Two aspects of regulatory oversight that have not been resolved for the solar power industry are reliable methods for assuring qualified installations, and ongoing maintenance and long-term service. From the vantage point of building officials, electrical inspectors and fire inspectors, solar power systems arguably should be addressed similar to other building systems that present potential hazards to the occupants or emergency responders. These other systems have requirements to assure quality installations and proper ongoing service. The present oversight of solar power systems is not as robust as with other similar building systems.

As a comparative example, in France a report was issued that one in three photovoltaic systems are not meeting the required safety standards, this being related to inadequate installation, maintenance, and/or enforcement oversight.[81] This study is based on installations in France and not the United States, and a similar analysis for the U.S. is not readily available. Nevertheless it raises the question of the status of these characteristics, and how best to address these topics in the future.

The fire service literature includes multiple published articles that specifically address emergency situations and emergency responder interests involving solar power systems. A summary of the readily available literature addressing fire service interests and concerns is provided by Table 2-5, Literature Review Summary for Solar Power Systems and the Fire Service.

Table 2-5: Literature Review Summary for Solar Power Systems and the Fire Service

	Title	Publication	Author(s)	Year	Vol/Iss	Pg(s)	Format	Comment
1	Solar Energy Units and Fire Safety	Fire Engineering	Bare, W.K.	1978 Jun	131/6	51-52	Article	Fire safety & building code concerns with solar power systems
2	Fire Experiments and Flash Point Criteria for Solar Heat Transfer Liquids	NBSIR 79-1931	Lee, B.T., Walton, W.D.	1979			Report	NIST BFRL Publication on characteristics of solar heat transfer fluids
3	Fire Occurs Within Solar Panel	Fire Command	Harvey, C.S.	1980 Sept	47/9	40-41	Article	Case study of solar panel fire in Boulder CO in May 1980
4	Fire in a Residential Solar Panel: A Potential National Problem	International Fire Chief	Harvey, C.S.	1980 Sept	46/9	55-57	Article	Case study of solar panel fire in Boulder CO in May 1980
5	Fire Within A Residential Solar Panel	Fire Chief	Harvey, C.S.	1980 Sept	24/9	31-33	Article	Case study of solar panel fire in Boulder CO in May 1980
6	Solar Collector Fire Incident Investigation	NBSIR 81-2326	Walton, W.D.	1981 Aug			Report	NIST BFRL Publication on 1980 case study fire in Boulder CO
7	Fire Testing of Roof-Mounted Solar Collectors by ASTM E 108	NBSIR 81-2344	Walton, W.D.	1981 Aug			Report	NIST BFRL Publication on roof covering fire tests per ASTM E108 with solar panels
8	Fire Testing of Solar Collectors by ASTM E 108	Fire Technology	Waksman, D., Walton, W.D.	1982 May	18/2	174-186	Article	Roof covering fire tests per ASTM E108 with solar panels
9	Rooftop Photovoltaic Arrays: Electric Shock and Fire Health Hazards	Solar Cells	Moskowitz, P.D., et al.	1983	9	1-10	Article	Review of health hazards of solar cells exposed to fire
10	Toxic Materials Released from Photovoltaic Modules During Fires	Solar Cells	Moskowitz, P.D., et al.	1990	29	63-71	Article	Review of health risks from solar cells exposed to fire
11	Here comes the sun: Solar Energy for Emergency Medical and Disaster Use	Emergency	Ross, C.	1993 Dec	25/12	34-37	Article	

	Title	Publication	Author(s)	Year	Vol/Iss	Pg(s)	Format	Comment
12	Inspecting Solar Electric Systems For Code-Compliance	Building Standards	Brooks, B.	2000 Sep Oct	69/5	22-25	Article	Safety concerns of PV for building, fire and electrical inspectors
13	Photovoltaic Power Systems	NEC Digest	Wiles, J.	2002 Nov	1	26-34	Article	Review of NEC Article 690 criteria for PV
14	2005 Code Revisions: Proposed Changes to Article 690	NEC Digest	Brown, J.M.	2003 Fall		70-75	Article	Review of revisions to NEC Article 690 criteria for PV
15	Photovoltaic and 2005 NEC	IAEI News	Wiles, J.	2005 Mar Apr		80-84	Article	Review of revisions to NEC Article 690 criteria for PV
16	Solar power: A Hot New Trend in the Fire Service	Firehouse	May, B.	2005 Apr		134	Article	Review of solar power systems installed for fire station
17	Solar systems: Strategies for Neutralizing Solar-Powered Homes	Fire Rescue Magazine	Nadel, S.	2005 Oct	23/9	88-89	Article	Review of hazards at residential properties using solar power
18	Fundamentals of Photovoltaics for the Fire Service	California Solar Energy Industries Association	Slaughter, R.	2006 Sep			CDRom	
19	Tips for Firefighters Facing "Green" Photovoltaic Electric Systems	WNYF	Woznica, Joseph	2008	3	26-27	Article	
20	Growth Strategy	Reason		2009	2	36-39	Article	Review of hazards with green roofs and solar power systems
21	The Impact of Solar Energy on Firefighting	Fire Engineering	Kreis, T.	2009 Jan	162/1	79-80	Article	Review of basic PV hazards to firefighters
22	Simi Solar Panel Fire Raises Safety Issue	Ventura County Star	Gregory, K.L.	2009 Mar 14			Article	Online newspaper article describing residential fire at www.vcstar.com/news/2009/mar/14/

	Title	Publication	Author(s)	Year	Vol/Iss	Pg(s)	Format	Comment
23	Solar Panel Dangers	MCAFDSO Newsletter	Leechan, J.	2009 Mar-Apr	IV/2	4	Article	Monroe County Association of Fire Dept. Safety Officers, Spencerport NY
24	Roof PV Fire of 4-5-09	City Memo	P. Jackson to P. Burns	29 Apr 2009			Memo Fire Report	Fire report on PV roof fire at dept store in Bakersfield CA
25	Solar Electric Systems and Firefighter Safety	Fire Engineering	Paiss, M.	2009 May	162/5	83-88	Article	Review of multiple fire fighter concerns with solar panels
26	PV Safety & Engineering	Home Power	Paiss, M.	2009 Jun / Jul	131	88-92	Article	Overview of fire fighter concerns with solar panels
27	Building Construction: Solar Energy Systems	Coffee Break Training – Fire Protection Series	USFA National Fire Academy	2009 Sep 29	FP-2009-39		One-Page Flyer	Review of potential hazards from solar energy collection systems

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3. Photovoltaic Solar Power

Photovoltaic systems are based on fundamentally different technology from thermal systems. This section provides additional background information on photovoltaic technology and the systems that use this technology, including details on the materials and methods used and how this relates to emergency first responders required to handle them during an emergency. Photovoltaic systems present certain special concerns to fire service personnel through electric shock, and thus this section provides additional information on this particular type of solar power.

Photovoltaic Basics

The photovoltaic process converts light to electricity, as indicated by the root words *photo* meaning "light" and *voltaic* meaning "electricity", and often represented by the acronym PV. The process involves no moving parts or fluids, consumes no materials, utilizes solid-state technology, and is completely self-contained.[82] The primary concern for emergency responders with these systems is the presence of electrical components and circuitry that present an electrical shock hazard.

The basic components of a photovoltaic system include the photovoltaic unit that captures the sun's energy, and inverter that converts the electrical power from DC to AC, electrical conduit and other electrical system components, and in some cases a storage battery. At the heart of the system is the unit that is actually capturing the sun's electromagnetic energy in the form of light. Figure 3-1, illustrates the basic photovoltaic components used to capture solar energy.

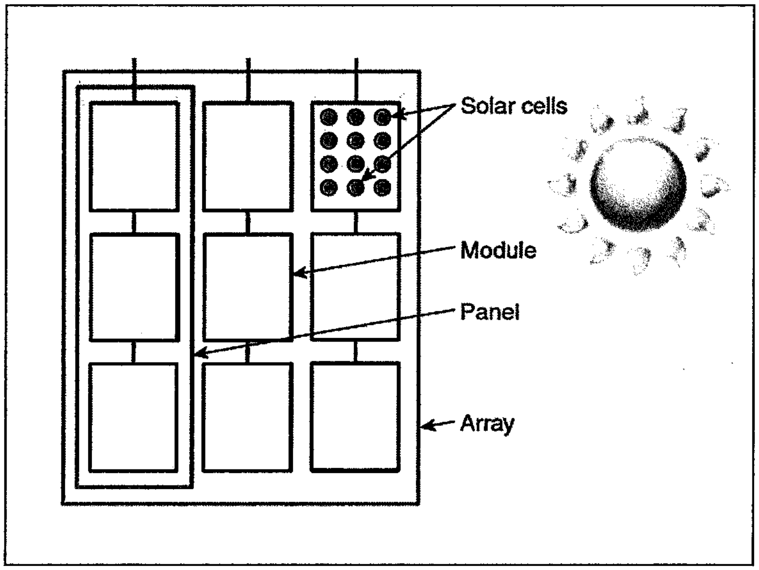

Figure 3-1: Basic Photovoltaic Components Used to Capture Solar Energy

A photovoltaic unit includes one or more solar *cell* or *photovoltaic cell* components that convert the sun's electromagnetic rays into electricity. These are the most elementary photovoltaic devices or components in the system.[83] An environmentally protected assembly of interconnected photovoltaic cells is referred to as a *module, solar module,* or photovoltaic module.[84] Modules are mechanically integrated, preassembled and electrically interconnected units called a *panel, solar panel,* or *photovoltaic panel.*[85] In the solar industry these are also referred to as *strings*.

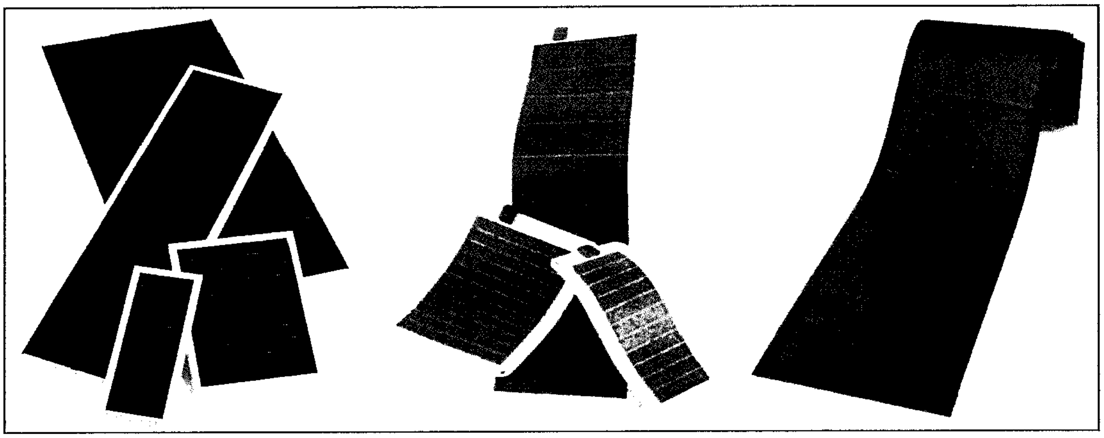

Figure 3-2: Configurations of Solar Modules, Including Framed, Flexible, and Rolled
(Photo courtesy of NREL Photographic Information Exchange)

Common configurations of modules include framed, flexible and rolled. Figure 3-2 illustrates these basic types of solar modules. Multiple modules (in panels or strings) are often mechanically integrated with a support structure and foundation, tracker, and other components to form a direct-current power-producing unit, and these are termed an *array* or *photovoltaic array.*[86]

Solar Cell Technology and Photovoltaic Systems

From the perspective of fire fighters on the fireground, the photovoltaic modules are the fundamental components within the photovoltaic system that converts the sunlight to electricity. These have physical dimensions in the general range of 2½ feet by 4 feet by ½ foot, and large systems might have hundreds of modules arranged in strings as part of the solar array.[87]

A typical PV module includes not only the solar cells, but several other important components including the concentrators that focus the sunlight onto the solar cell modules, array frame and associated protective components, electrical connections, and mounting stanchions. Figure 3-3 provides a relatively detailed illustration of the primary components of a PV solar power system, and Figure 3-4 illustrates the fundamental electrical interrelationship for photovoltaic systems that are stand-alone, hybrid, or interactive with the building's conventional electrical system.[88]

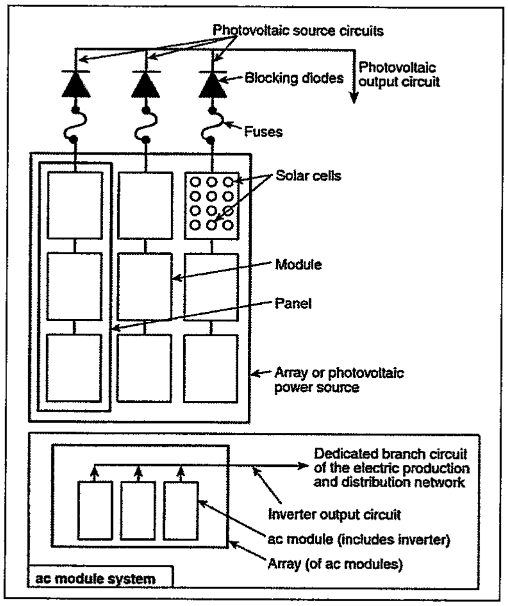

Figure 3-3: Basic Components of a Photovoltaic Solar Power System.[90]

All of these components are designed with significant attention given to their endurance, recognizing that a typical solar panel will be exposed to ongoing harsh weather conditions that will promote degradation. Some of the materials used might have excellent weather endurance characteristics, but not necessarily be resistant to exposure fires. Today, the lifespan of a typical solar array is typically in the 20 to 25 year range, and component endurance is an important performance characteristic of the overall solar energy system.[89]

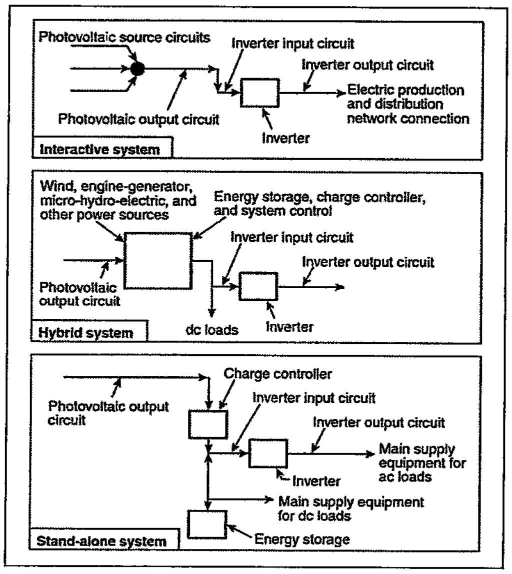

Figure 3-4: Photovoltaic System Interrelationship with Conventional Electrical Systems.[91]

In addition to the solar module, the other key components of the PV system are the inverters, disconnects, conduit, and sometimes an electrical storage device (i.e., batteries). The electricity generated by PV modules and solar arrays is dc (direct current), and an inverter is required to convert this to ac (alternating current). As with any electrical equipment that is tied into a building's electrical circuitry, disconnect switches are required for purposes of isolation. Some systems also include batteries to store the additional energy created during sunlight hours for use at a later time.

Present PV technology is based on the use of solar cells, which are the primary subcomponent within the system that converts light to electricity. Most often this is done through the use of high purity silicon wafers. Solar cells are interconnected in series and parallel to achieve a predetermined output voltage when operating at capacity. Current technologies allow new and unusual geometric configurations, such as films that adhere to a roof or vertical building surfaces. An example is a system using building-integrated photovoltaics, which are photovoltaic cells, devices, modules, or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of that building.[92] As an example, Figure 3-5 illustrates a PV panel shaped like a roof shingle.

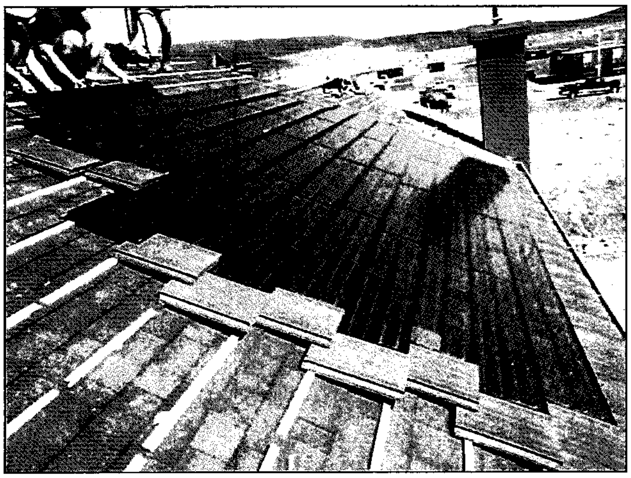

Figure 3-5: Example of PV Roof Panels Shaped Like Conventional Roofing Shingles
(Photo courtesy of NREL Photographic Information Exchange)

Several new technologies are under development for solar cells that have promise for future applications. Examples include gallium-arsenide cell technology and multijunction cell technology. Other new methods and approaches are experiencing rapid proliferation, such as thin-film cadmium telluride cell technology. From the standpoint of the fire service, these new technologies will likely result in greater solar panel performance and greater proliferation of installations, but likely will not result in additional or unusual hazard characteristics from what they are already facing with the current solar cell technologies.[93] Figure 3-6 shows a thin film PV system on a large commercial building in Detroit, Michigan, and exemplifies how this technology allows the PV system to blend with other building components (e.g., roof assembly).

Figure 3-6: Example of Thin Film PV System on a Commercial Building in Detroit, MI

Photovoltaic modules that are integrated into the building's components are generally referred to as *Building Integrated Photovoltaic* (BIPV) modules. These are allowing new and unusual applications of PV systems, including expansive vertical configurations. Among the most widely recognized recent BIPV installations using a vertical configuration is the Condé Nast Building in Times Square, New York City. This 48-story skyscraper is considered to be one of the first major commercial applications of vertically configured BIPV in the United States. The PV skin extends from the 37th through the 43rd floor on the south and east facades over the glass components, and blends in seamlessly with the building's exterior. Figure 3-7 provides an illustration of the Condé Nast Building.

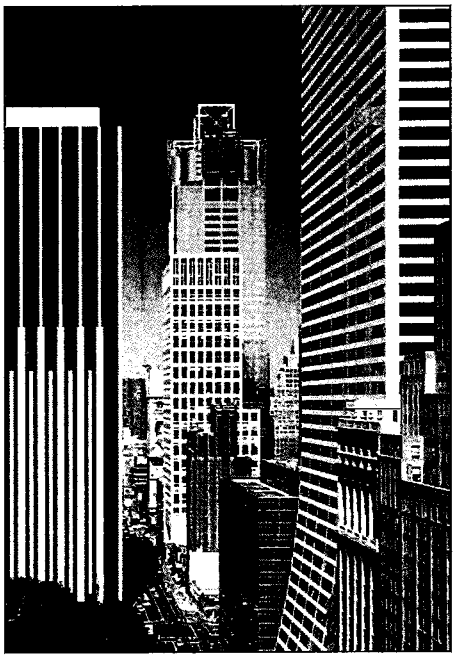

Figure 3-7: BIPV System Using a Vertical Module Configuration in New York City
(Photo courtesy of NREL Photographic Information Exchange)

New York City is addressing the needs of solar panel installation in the same fashion as other jurisdictions, but the numerous variations utilized is a challenge for the regulatory approval agencies that require variances from their building code. In a recent report by the NYC Green Codes Task Force, their findings included the recommendation to "clarify standards for Attaching Rooftop Solar Panels." This addresses the issue that the NYC Building Code does not specify acceptable criteria for the attachment of solar panels to rooftops, which inhibits the installation of solar energy systems. It further includes a recommendation that the Department of Buildings develop detailed criteria for roof attachment of solar panels.[94]

Background on Fireground Electrical Hazards

Electrical shock while extinguishing a building fire is a realistic fireground hazard. A critical task during fireground operations at any building fire is to shutdown the utilities, including the electrical utilities to remove the electrical shock hazard. This is a relatively straightforward one-step process for a building receiving electrical power from the local communities' power grid. However, it becomes considerably more challenging when multiple sources provide electrical power (i.e,. distributed power generation) such as with a building equipped with a photovoltaic power system.

How much electrical energy is required to cause harm to the human body? Electricity and electrical equipment is widespread in today's modern civilization. Each year in the U.S. among all industry sectors there are approximately 30,000 nonfatal electrical shock accidents.[95] Data from a 1998 CDC/NIOSH summarizing electrocution fatalities in their data surveillance system indicates that during the decade of the 1980s approximately 7% of the average 6,359 annual traumatic work-related deaths were due to electrocution. This report also indicates that during the period from 1982 to 1994, twice as many fatal work-related electrocutions occurred with voltage levels greater than 600 volts.[96]

Understanding the dangers of electricity requires clarifying the terminology used to describe this danger. We often describe the magnitude of an electrical system in terms of *voltage* or *amperage*, and it is important to have a limited understanding of these terms. From a fire fighters perspective, the following describes these two terms:[97]

- Voltage—the electromotive force or potential difference, measured in volts. Voltage is the "pressure" that pushes an electrical charge through a conductor.
- Amperage or Current—The amount of electrical charge flowing past a given point per unit of time, measured in amperes or amps. Amperage is the measure of electrical current flow.

The flow of electrical energy in electrical wiring is analogous to the flow of water in a closed circuit of pipes. Hydraulics and the movement of water is a fundamental field of knowledge used by the fire service, and this visualization is useful to better comprehend the dangers of electricity. Instead of the transfer of water, electricity involves the transfer of electrons or other charge carriers. The voltage difference between two points corresponds to the water pressure difference between two points. If there is a difference between these two points, then flow will occur. Voltage is a convenient way of measuring the ability to do work.

The basic relationship between voltage and amperage is defined by Ohm's Law. This tells us that Volts x Amps = Watts, where wattage is the rate at which an appliance uses electrical energy. Wattage is considered the amount of work done when one amp at one volt flows through one ohm of resistance. The power generation of a photovoltaic system is normally described in terms of watts or kilowatts (1000 watts).[98]

The term *high-voltage* is defined differently depending on the particular application. This understandably can create confusion among emergency responders who are faced with handling emergencies with electrical equipment. For example, voltage ratings for buildings and structures in the built infrastructure treat high voltage as being any voltage exceeding 600 volts, based on Article 490 of the National Electrical Code.[99] Voltage ratings for electrical equipment generally conform to the ANSI C84.1 standard, which considers low voltage as 600 volts and below.[100] In addition, levels of voltage (i.e., high, medium, low) are defined differently with non-building applications, such as motor vehicles. Despite the lack of universal definitions of high, medium, and low voltage; from the perspective of emergency responders, any voltage level that can cause injury or worse is a direct safety concern.

It is common to speak about the dangers of electricity in terms of voltage, but the amperage or current is the key measurement parameter of danger to humans. An electrical shock involving high voltage but very low current would be less dangerous than low voltage and high current. Table 3-1 provides some examples of the observable effects of electricity on the human body. The current required to light a 7½ watt, 120 volt lamp, if passed across the chest, is enough to cause a fatality.[101]

Table 3-1: Estimated Effect of 60 Hz AC Current on Humans.[102,103]

Milliamperes	Observable Effect
15K/20K*	*Common fuse or circuit breaker opens*
1000	*Current used by a 100-watt light bulb*
900	Severe burns
300	Breathing stops
100	Heart stops beating (ventricular fibrillation threshold)
30	Suffocation possible
20	Muscle contraction (paralysis of respiratory muscles)
16	Maximum current an average man can release "grasp"
5	GFCI will trip
2	Mild shock
1	Threshold of sensation (barely perceptible)

*Note: 15 to 20 Amps (15,000 to 20,000 Milliamperes) is current required to open a common residential fuse or circuit breaker.

These electricity effects are also described in Figure 3-8, human body reaction to shock hazards. Nearly all materials will conduct electrical current to some degree, and this includes the human body. Each situation involving an individual receiving an electrical shock is unique, and will depend on multiple factors that alter the manner in which the electricity passes through the human body and the detrimental effect that results. Variables affecting the physiological impact include: amount of current flowing through the body; length of contact time; travel path through the body; area of contact; pressure of contact; moisture of contact; body size and shape; and type of skin.[104]

Shock Hazard Levels

Reaction of Human Body to Electric Current

Effect of Current	AC Current in Amps–Men	AC Current in Amps–Women
Perception threshold (tingling sensation)	0.0010	0.0007
Slight shock–not painful (no loss of muscle control)	0.0018	0.0012
Shock– painful (no loss of muscle control)	0.0090	0.0060
Shock–severe (muscle control loss, breathing difficulty–onset of "let-go" threshold	0.0230	0.0150
Possible ventricular fibrillation (3-second shock)	0.1000	0.1000
Possible ventricular fibrillation (1-second shock)	0.2000	0.2000
Heart muscle activity ceases	0.5000	0.5000
Tissue and organs burn	1.5000	1.5000

Figure 3-8: Human Body Reaction to Shock Hazards.[105]

4. Overview of Fire Service Operational Material

Training and education are important for preparing fire fighters to properly perform their assigned tasks. Arguably of greater importance, however, are the operational guidelines and operational procedures used by fire departments to perform their duties to mitigate an emergency situation. Standard Operating Procedures (SOPs) and Standard Operating Guidelines (SOGs) are widely used in today's fire service.

The terms *Procedures* and *Guidelines* are sometimes used interchangeably. However, in fire service parlance they are considered to be different. Procedures imply relatively inflexible instructions, prescriptive task steps, and appreciable detail. In contrast, guidelines are more performance oriented and imply discretion in performing the required tasks.[106]

There is significant overlap with the interpretation and final implementation of these descriptors, and ultimately it can sometimes be hard to distinguish the difference between them. Multiple precise definitions can be found in the fire service literature. As one example, the following definitions are from the 2008 edition of NFPA 1521, *Standard for Fire Department Safety Officer*:

> *Standard Operating Guideline: A written organizational directive that establishes or prescribes specific operational or administrative methods to be followed routinely, which can be varied due to operational need in the performance of designated operations or actions. (Note: Standard operating guidelines allow flexibility in application.)*[107]

> *Standard Operating Procedure: A written organizational directive that establishes or prescribes specific operational or administrative methods to be followed routinely for the performance of designated operations or actions. (Note: The intent of standard operating procedures is to establish directives that must be followed.)*[108]

The wide range of possible unpredictable emergency scenarios requires a degree of flexibility in terms of written procedures, but conversely too much flexibility and discretion reduces control and increases the likelihood of mistakes. Litigation sometimes provides the basis for interpreting the difference between procedures and guidelines, but the courts tend to ignore actual terminology and focus on content. They tend to consider liability based on factors such as: national standards and other recognized regulatory requirements, adequacy of training activities; demonstration of training competence; procedures for monitoring performance; unique needs of the fire department; and procedures for ensuring compliance.[109]

Actual fire service education and training materials can be obtained from a number of sources. General emergency responder operational materials are readily available, and these can be adapted and used directly by members of the fire service. These include, for example, the training manuals provided by the International Fire Service Training Association (since 1932), fire service training materials provided by Jones and Bartlett Publishers, and various books and publications provided through Delmar Learning.[110,111,112] Specific details of these organizations include the following:

International Fire Service Training Association (IFSTA)
The mission of IFSTA is to identify areas of need for training materials and foster the development and validation of training materials for the fire service and related areas. With origins that are traced back to 1934, this association of fire service personnel provides oversight and validation of the manuals, curricula, training videos, CD-ROMs, and other materials developed by Fire Protection Publications (FPP). FPP is a department of Oklahoma State University and serves as the headquarters for IFSTA in Stillwater, Oklahoma.[113]

Jones and Bartlett Publishing (J&B)
J&B publishes an extensive line of training materials for the fire service, including comprehensive online resources for fire service students and instructors. As an independent publisher headquartered in Sudbury, MA, they are the seventh largest college publisher in the United States, publishing training materials as professional and reference books as well as a variety of multimedia and online products. The content for their training materials is developed in collaboration with the International Association of Fire Chiefs and the National Fire Protection Association.[114]

Delmar Learning
Delmar is a sub-group within Cengage Learning and they offer a portfolio of emergency services educational and training materials. Headquartered in Clifton Park, NJ, there products include printed books, multimedia, online solutions, certification tests, reference products, instructor teaching and preparation tools.[115]

A key federal government organization serving as an external training source for fire departments is the National Fire Academy (NFA) of the USFA.[116] The NFA is the Fire Administration's training delivery arm and is located in Emmitsburg, Maryland. The creation of the NFA has its genesis in the landmark report *America Burning* written in 1973, which recommended the establishment of a "National Fire Academy for the advanced education of fire service officers and for assistance to state and local training programs".[117]

With more than three decades of operation, the NFA has earned the respect of the fire service and provides an important stabilizing influence that helps to unite the fire service on the myriad of specific training topics. As a central focus point for the development and refining of fire service training materials, the NFA works closely with not only the vast range of local and regional fire departments throughout the country, but equally with the various national organizations that administer important sub-components of the training infrastructure. At the state level the NFA works closely with the state fire training directors through their association, the "North American Fire Training Directors" (NAFTD).

The NFA provides an important forum for the centralized development, refinement, and dissemination of fire service training materials on specific topics. An alternative to the training courses delivered on-site at the NFA is to build special topic curricula, which are then made available for internal fire department training activities through NFA "Endorsed Courses".[118] The NFA also provides hand-off training programs for individual training academies that are usually based on two days worth of content.

These Endorsed Courses at NFA provide a mechanism for outside organizations to cultivate and promote the development of applicable, state-of-the-art, accurate, useful and timely training information. As a specific example worthy of consideration, the training information contained in U.S. DOE online training packages such as "Hydrogen Safety for First Responders" and "Introduction to Hydrogen for Code Officials" may be candidates for material used in NFA endorsed courses.[119,120]

One NFA activity that serves a critical role in disseminating training information to the various state and local training agencies is the *Training Resources and Data Exchange (TRADE)* program.[121] This is a network of the state fire service training systems, along with the senior executive training officers from the Nation's largest fire departments protecting populations greater than 200,000 and/or who have more than 400 uniformed personnel. As a regionally based network established in 1984, TRADE facilitates the exchange of fire-related training information and resources among government organizations at the local, state, and federal levels.

The TRADE system operates using geographic regions that correspond to the ten FEMA regions, with coordinated networking within the respective regions and between regions. The National Fire Academy works closely with TRADE on various training details, and refers to them for functions such as the review of NFA Endorsed Courses. Specifically, TRADE serves their mission through the following:

- Identifying regional fire, rescue, and emergency medical services training needs;
- Identifying applicable fire-related training and education national trends;
- Exchanging and replicating training programs and resources within regions; and
- Provide annual regional assessments of fire training resource needs to NFA.

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5. Assembly of Best Practice Guidance for Emergency Response

Every emergency incident to which a fire department responds is unique. Despite the differences, however, there are common characteristics that allow fire service personnel to better understand the tasks that need to be performed and to prepare for their duties. This section provides a review of the common elements of most interest to fire fighters when handling emergencies involving solar power systems.

Identification of Common Themes and Principals

Based on today's proliferation of solar power system technology, a fire-related emergency incident involving a structure with one or more solar panels would not be considered an unlikely or rare occurrence. Structure fires are relatively common for any particular municipality, on the order of several significant events per year per station and/or department. The rapid growth of the solar power industry is increasing the likelihood that some of these structures are presently or soon will be utilizing some type of solar power.

Solar Thermal Hazards Versus Photovoltaic Hazards

From a fire service perspective, the comparable hazards between thermal systems and photovoltaic system are similar with two noteworthy exceptions: a photovoltaic system includes an electric shock hazard, while a thermal system includes potential scalding from hot fluid. Figure 5-1 summarizes the primary hazards of solar power systems for emergency responders, and illustrates a side-by-side comparison of the fire fighter hazards for these types of solar power systems.[122]

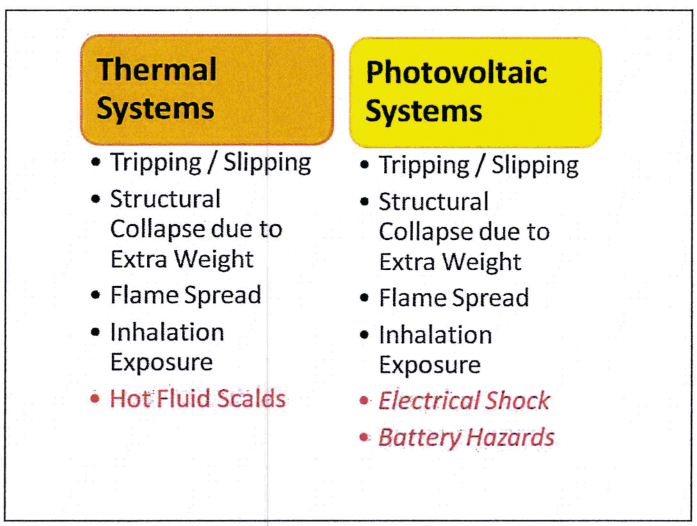

Figure 5-1: Primary Hazards of Solar Power Systems for Emergency Responders.[123]

As with any structural fire attack, size-up is a key step. The knowledge that the building has a solar power system should be immediately conveyed to the incident commander (IC), and the type of system should be immediately identified, that is, whether it is a solar thermal system or photovoltaic system. This will determine subsequent steps to minimize the hazards unique to both types of systems. Sometimes this is not readily obvious, such as with solar components that are blended in with the building construction. Figure 5-2 provides an example of a residential occupancy with a PV system that is an integral part of the roof assembly.

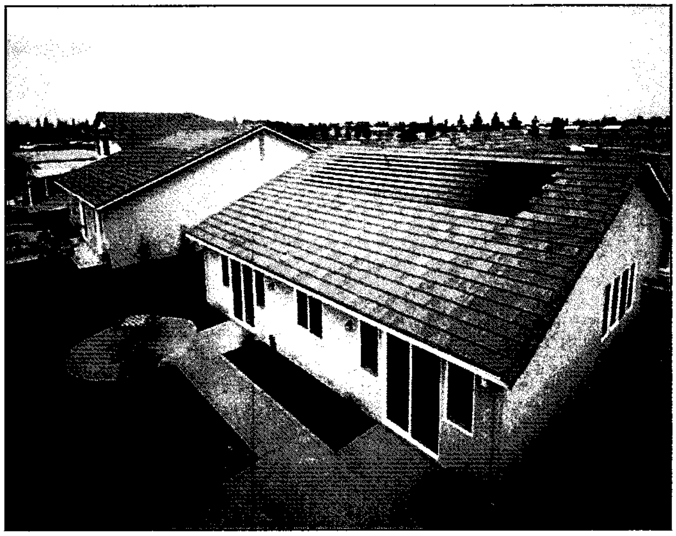

Figure 5-2: Residential Occupancy with a PV System Integral to the Roof Assembly
(Photo courtesy of NREL Photographic Information Exchange)

Arguably, the additional hazard characteristic of electric shock of a photovoltaic system makes it a greater concern than a solar thermal system, since it can remain energized and not be readily apparent during fireground operations. Thus, identifying and clarifying the type of solar power system is a critical first step for fire fighters and the IC on the fireground.

One concept for quickly identifying a solar power system and its specific components is the development and implementation of an equipment identification system, to assist with pre-planning and rapid identification on response. This would require clarifying the information critical to emergency responders, working with industry to incorporate this information, and enabling access to it by emergency first responders during an emergency.

This approach already exists in a general sense, such as, for example, through the "Fire Fighter Safety Building Marking System" (FFSBMS) described in Annex Q of NFPA 1, *Fire Code*, 2009 edition.[124] The FFSBMS provides a fire fighter safety building marking system with basic building information for fire fighters responding to the building or structure. Figure 5-3 illustrates a sample sign for the FFSBMS, which reserves the center of the Maltese cross for indication of special hazards, and could be used to indicate special concerns associated with the building's utilities.

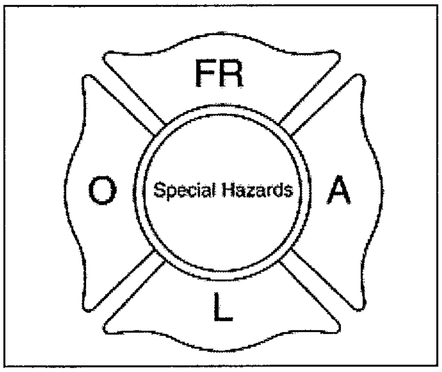

Figure 5-3: Sample Sign for Fire Fighter Safety Building Marking System.[125]

Rooftop Fire Fighting Operations

Several hazard concerns are common to either type of solar power system. Perhaps most obvious is tripping or slipping that may occur on a rooftop in dark or smoky conditions. Certain types of solar power systems that are integral with the roof structure and membrane might minimize tripping hazards, but not necessarily slipping. However, the inherent dangers to fire fighters on the roof of a burning structure, with or without a solar power system, are appreciable and always deserve special attention. Figure 5-4 illustrates townhouses in Bowie, MD, equipped with a PV system based on a standing seam roof design, and this demonstrates the challenges of roof operations confronting fire fighters in certain cases.


Figure 5-4: Townhouse with PV Systems in Maryland
(Photo courtesy of NREL Photographic Information Exchange)

During roof operations fire fighters will need to consider the additional weight of the PV array on a roof structure that may be weakened by the fire. A rooftop solar array may also prevent direct access to the section of roof providing the optimum point of ventilation. Under no circumstances should solar panels be damaged or compromised to perform vertical ventilation. To do so introduces serious potential risk to the fire fighters performing the task.

Solar power adds another component to possible rooftop dangers already faced by fire fighters. Multiple research initiatives are under way exploring the use of positive pressure ventilation (PPV) as a more integrated tool in the fire fighters tactical arsenal.[126,127] Approaches to better controlling the products of combustion in a building fire are being examined that will hopefully provide some relief from the need for fire fighter rooftop exposure. This would be additionally advantageous as solar power systems proliferate and appear on more and more rooftops.

Other Rooftop Concerns

Another common hazard regardless of the type of solar power system is the potential flame spread characteristics of the modules, such as from an adjacent exposing building fire or an approaching wildland fire. The components exposed to sunshine and other exterior elements of weather need to have highly durable characteristics, and certain materials that have traditionally performed well in this regard (i.e., certain types of plastics), do not necessarily have good fire-resistant characteristics. Further work is needed to clarify the fire resistance and fire spread characteristics of these panels.

If a photovoltaic solar array becomes engulfed in fire, care should be exercised in fighting the fire, and it should be attacked similarly to any piece of electrically energized equipment. Normally this would involve shutting down the power and applying water in a fog pattern on the photovoltaic array, but it is critical to be aware that a solar panel exposed to sunlight is always "on" and energized. Further, the electrical energy produced by multiple series connected panels or large solar systems are normally very dangerous.

One additional secondary concern that should always be considered when approaching rooftop solar power systems is that the module frame and junction boxes provide ideal nesting locations for biting and stinging insects. This could introduce an additional layer of difficulty for on scene fire fighters, enhancing other hazard concerns such as tripping or slipping.

The added rooftop weight may be a concern in some cases, although most of today's modern solar panel modules do not contribute an appreciable additional dead load on the roof. For a photovoltaic system, a typical panel weighs less than 50 pounds, and this is distributed over a relatively wide surface area that results in a cumulatively low additional roof load. A noteworthy exception, however, is when a solar thermal system includes a roof-mounted fluid storage unit. This could add a significant load at a specific localized position.

Electrical Shock Considerations

For solar thermal systems, the hazards facing fire fighters during fireground operations are not usually considered a serious additional concern, and they can be readily addressed in their normal tactical and strategic approaches. In contrast, however, the electrical shock hazard of photovoltaic systems presents an additional challenge, although it is one that fire fighters can readily handle once equipped with the proper operational knowledge. Thus, the need to identify and determine the type of solar power system is a critical step for emergency responders.

A photovoltaic system generates electricity when the sun is shining, and when it is receiving sunlight it is operational and generating electricity. This creates additional challenges for the fireground task of shutting off the utilities and the electrical power in the structure that could be a dangerous source of electric shock. Even with known shutdown steps taken to isolate electrical current, fire fighters should always treat all wiring and solar power components as if they are electrically energized.[128]

The inability to de-energize individual photovoltaic panels exposed to sunlight cannot be overemphasized. It is absolutely imperative that emergency responders always treat the systems and all its components as energized. This includes after the emergency event is stabilized, as the system will continue to be energized while exposed to sunlight, possibly with damaged system components that could present serious shock hazards or even cause a rekindling of a fire. Operational approaches for fire fighters in situations involving live electrical systems is well established, and constant attention needs to be given to the threat of live electrical wiring and components.[129]

Because a photovoltaic module and their respective solar cells within the modules will continue to generate electricity when exposed to light, any conduit or components between the modules and disconnect/isolation switches remain energized. Care should be taken throughout fireground operations never to cut or damage any conduit or any electrical equipment, and they should be treated as energized at all times. One tactic for minimizing or eliminating the electrical output from a solar module is to cover it with a 100% light-blocking material such as certain types of tarpaulin. However, this is a difficult tactic to implement, since many tarpaulins are not 100% light-blocking, often the solar system is too large for this to be realistically applied, and wind or other external influences (e.g., hose streams) make it difficult to maintain coverage.

The number of photovoltaic panels in the solar power system provides an indication of the magnitude of the electrical energy being generated. A smaller system such as on a residential occupancy might include only a few modules; however, the electricity generated is still appreciable and can be lethal. In contrast, large systems that are now being installed on roofs of commercial buildings (e.g., department stores) sometimes have hundreds of panels, and the electrical current they generate is very significant.

The inability to shut down the power on these large systems exemplifies the challenge facing fire fighters, since every panel is still generating electricity and thus the wiring and components are always "live" when the sun is shining. The presence of rooftop disconnects are primarily for maintenance of the system. Fire fighters should be wary of utilizing these as a secure method of power isolation. If not all disconnects to an inverter are opened, there still exists the possibility of voltage throughout the system. Additionally, large capacitors in the inverters will provide voltage in daylight hours for several minutes on both sides of the disconnect even when opened. Figure 5-5 illustrates a typical large PV installation on a commercial building located in Chicago, Illinois.

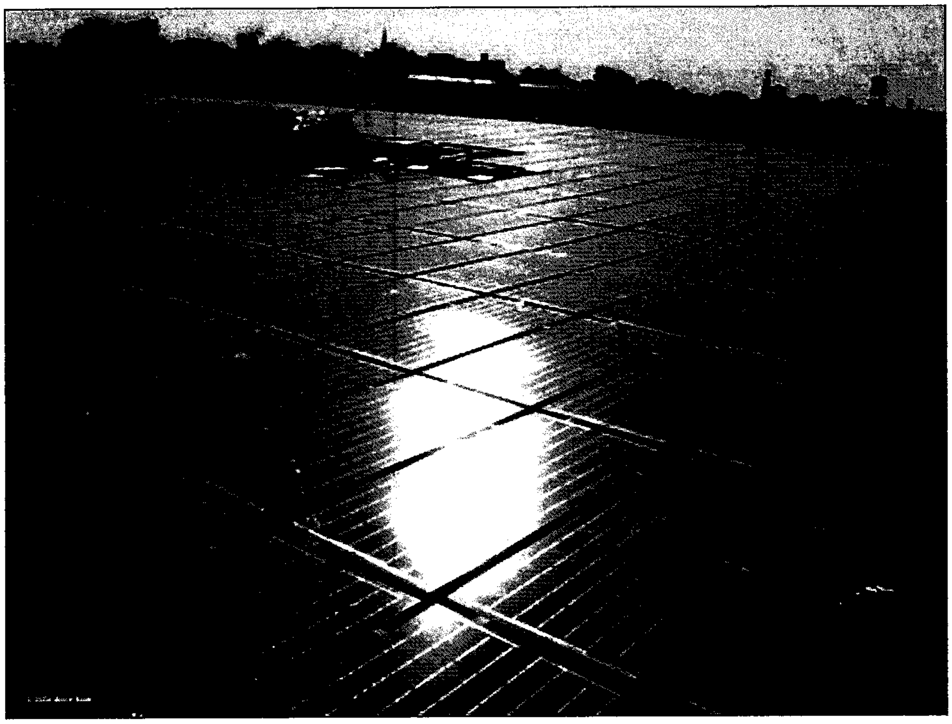

Figure 5-5: Example of a Large Photovoltaic Solar Power System on a Commercial Building
(Photo courtesy of NREL Photographic Information Exchange)

Battery Storage Components

An additional electrical concern exists for systems that have an optional battery storage arrangement as part of the PV system. The batteries can maintain electrical current at nighttime and when the rest of the system has been isolated, thus presenting an additional electric shock hazard. Further, depending on the types of batteries, they can present leakage and hazardous materials concerns, and special attention is required for any battery storage systems that have been damaged in a fire. Figure 5-6 illustrates a typical battery installation for a large commercial PV system.

Design requirements for batteries are already established and can be extrapolated to the battery systems used in a photovoltaic system, such the requirements for stationary storage battery systems addressed by Chapter 52 of NFPA 1, *Fire Code*, and Section 608 of the *International Fire Code*.[130,131] Technology commonly used for stationary storage batteries include: flooded lead-acid, flooded nickel cadmium (NI-CD); valve-regulated lead-acid; lithium-ion; and lithium metal polymer.[132]

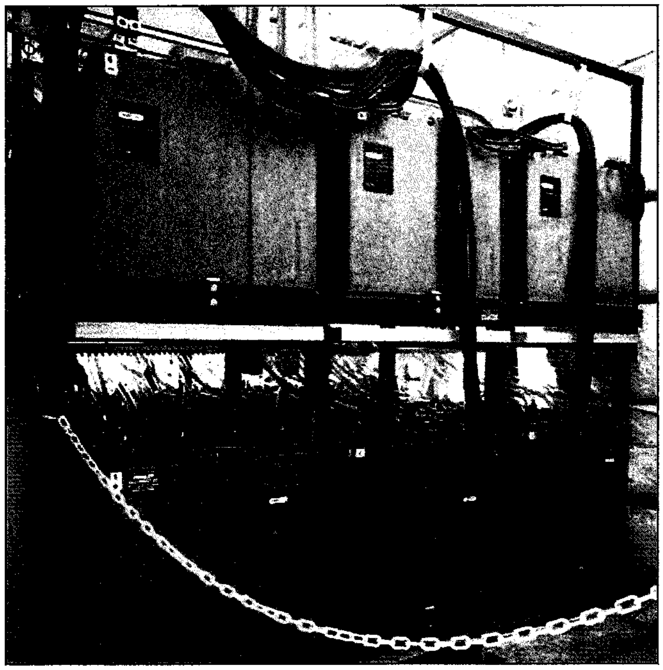

Figure 5-6: Typical Battery Installation for a Photovoltaic Solar Power System
(Photo courtesy of NREL Photographic Information Exchange)

Batteries generally burn with difficulty, although plastic battery casings provide a limited contribution to the combustion process. However, batteries that do burn or are damaged in a fire generate fumes and gases that are extremely corrosive. Spilled electrolyte can react with other metals and produce toxic fumes, as well as potentially flammable or explosive gases. Full protective clothing and respiratory protection is imperative in such incidents, and special care and maintenance may be required during cleanup. Dry chemical, CO_2, and foam are the preferred methods for extinguishing a fire involving batteries, and water is normally not the extinguishing agent of choice.[133]

Overhaul and Post Fire Concerns

Proper respiratory protection should be used during all fireground operations that involve a potentially hazardous atmosphere. Similarly, these protective measures apply during post-fire activities such as overhaul or fire investigations. Care should be taken during all fireground operations to protect against respiratory exposure from products of combustion involving PV systems. Under normal conditions the materials used for solar cells and modules are relatively inert and safe, but they can become dangerous when exposed to fire.

If solar power components are involved in a fire, care should be taken to avoid exposure to the products of combustion due to the somewhat unusual materials involved. In addition to inhalation concerns, dermal exposure from solar power system materials damaged by fire should also be handled with caution regardless of the type of solar power system. For large solar systems involved in a fire, additional precautions should be considered to protect downwind populations from respiratory exposure.

Some of the materials used in solar power components are known to be a problem when they decompose in a fire, and although stable under normal conditions, they exhibit adverse effects if released as a vapor of fluid. For example, cadmium telluride is among the most promising photovoltaic technologies, but when damaged by fire it introduces potentially dangerous levels of materials such as cadmium, a known carcinogen.[134] Some solar power systems are integral to other building components and may not be immediately obvious in a post-fire situation. Figure 5-7 illustrates the installation of PV shingle design whose presence may be difficult to detect by emergency first responders following a fire event.

Figure 5-7: An Example of PV System Integral with Building Components
(Photo courtesy of NREL Photographic Information Exchange)

Examples of other materials of concern that may be involved in solar power components include gallium arsenide and phosphorous.[135] Emergency responders are required to wear full respiratory protection (e.g., self-contained breathing apparatus) for any atmosphere that is possibly IDLH (immediately dangerous to life or health), and this should be the case when handling damaged solar modules involved in fire unless proven otherwise.[136]

An important delayed hazard occurs when a nighttime building fire damages a photovoltaic system and compromises system integrity at a time when no energy is being generated by the system. If the system wiring sustains short circuits and damaged components, exposed live wiring and components may suddenly appear once the sunlight returns. Solar arrays will resume generating electrical power through circuitry that was unpowered during the fire event, but becomes energized during the post-fire event when exposed to sunlight.

General Safety Precautions

Certain basic safety precautions should be taken into account by all fire fighters on the fireground. Determining the presence of a PV system is key to preventing fireground injuries. The following six points of safe operation are offered for fire fighters:[137]

- Daytime = Danger; Nighttime = Less Hazard
- Inform the IC that a PV system is present
- Securing the main electrical does not shut down the PV modules
- At night apparatus-mounted scene lighting may produce enough light to generate an electrical hazard in the PV system
- Cover all PV modules with 100 percent light-blocking materials to stop electrical generation
- Do not break, remove, or walk on PV modules, and stay away from modules, components, and conduit

A photovoltaic array will always generate electricity when the sun shines. These units do not turn "off" like conventional electrical equipment. Fire fighters on the fireground should always treat all wiring and components as energized. Breaking or compromising a photovoltaic module is extremely dangerous and could immediately release all the electrical energy in the system.

Without light, photovoltaic panels do not generate electricity, and thus nighttime operations provide less of a hazard. Emergency scene lighting during a nighttime fireground operation, such as from a mobile lighting plant unit, or sources other than direct sunlight, may be bright enough for the photovoltaic system to generate a dangerous level of electricity.

In summary, there are several fundamental points of consideration for fire fighters and incident commanders when handling any building fire equipped with a solar power system:[138]

- Identify the existence of a solar power system
  - locate rooftop panels
  - clarify electrical disconnects
  - obtain system information
- Identify the type of solar power system
  - Solar Thermal System
  - Photovoltaic System
- Isolate and shutdown as much of the system as possible
  - Lock-out and tag-out all electrical disconnects
  - Isolate the photovoltaic system at the inverter using reliable methods
- Work around all solar power system components

For an overview of revisions to this page, see the NOTE at the end of the report foreword.

While salvage covers can be used to block sunlight, some electricity will still be generated unless they are made of material that is 100 percent light blocking. Care is needed to make sure that wind does not suddenly blow off any salvage covers covering panels. Foam is not effective in blocking sunlight, and will slide off the solar array.

Target Applications Workshops

Solar power systems are experiencing widespread popularity in recent years, and they are one of the new challenges facing the U.S. fire service. Some fire service organizations are in the process of developing recommended emergency response procedures and best practices on a local or regional basis; in other jurisdictions, basic information on the hazard and appropriate response is lacking or not readily available.

One of the ways this project addresses these concerns is to collect and analyze all applicable scientific studies, training guidance, case study reports and loss data, and available emergency response guidance relating to solar power systems. To assist in accomplishing this task, an interactive one-day workshop was held, "Fire Service Workshop on Solar Power Systems." This workshop involved experts on the fire service and other subject matter and took place on Wednesday, 17 March 2010 at the Next Energy facility in Detroit, Michigan. The workshop was attended by approximately two dozen subject matter experts knowledgeable on fire service issues relating to solar power systems, and a summary of workshop attendance is included in Annex D, Attendees at Fire Service Workshop on Solar Power Systems.

The goal of the workshop was to identify, review, and assemble best practice information for tactical and strategic decision making by fire fighters and fireground incident commanders, to assist in their decision making process when responding to fire and/or rescue emergency events involving solar power systems. This goal was accomplished using an interactive approach involving subject matter experts that focused on the following workshop objectives:

- Collectively review the available baseline information (provided to participants prior to the workshop);
- Identify the fundamental principles and key details involving fire/rescue tactics and strategy, and provide a summary of core basics; and
- Address and clarify related issues such as training needs, areas needing further research, revisions to codes/standards, and other topics applicable to the overall workshop goal.

Final Evaluation of Best Practice Guidance

The workshop included a detailed review of the baseline information represented by the balance of content contained within this report. Two working groups were established among the attendees who, as part of the workshop, separately addressed a set of ten similar questions.

These ten questions were grouped into three sets according to: (1) current practice, (2) future trends and (3) other issues. Each working group reported their individual results to the entire workshop to support a collective discussion among all attendees. Based on the collective discussion of all attendees, the responses from each working group were subsequently consolidated and harmonized into a single set of responses for each question. This consolidated response is summarized in Figure 5-8, Workshop Working Group Summary.

FIRE SERVICE WORKSHOP ON SOLAR POWER SYSTEMS

Detroit, MI
17 March 2010

Working Group Summary

The following set of ten questions was addressed independently by two separate working groups at this workshop. This consolidated "Working Group Summary" provides their collective responses, and for each question is provided in a non-prioritized, harmonized summary-format.

I. CURRENT PRACTICE

A. In terms of prioritized hazards, how should this topic be scoped?

1. Solar Thermal vs. Photovoltaic
2. Solar Power System Types
   - 2.1. Residential (small in-grid systems, numerous)
   - 2.2. Commercial (large in-grid systems, less common)
   - 2.3. Utility scale power generation sites (very large systems, rare)
   - 2.4. Standalone off-grid systems
   - 2.5. Existing systems vs. new systems (for regulatory oversight)
3. Solar Power System Characteristics
   - 3.1. Hazard identification and labeling
   - 3.2. High voltage hazards (arcing, shock)
     - 3.2.1. Electrical component isolation (disconnects, how many?)
     - 3.2.2. Electrical conduit routing and location
     - 3.2.3. Batteries (integration, containment, isolation, etc.)
   - 3.3. System Responsibility/Accountability (installation, maintenance, etc.)
   - 3.4. Separate panels vs. integrated solar components (with structure)
4. Building Attributes
   - 4.1. Flammability hazard concerns
     - 4.1.1. Ignition
     - 4.1.2. Flame spread
     - 4.1.3. Products of combustion
   - 4.2. Building and roof assembly construction types
   - 4.3. Structural loads and related concerns (dead load, snow, wind, etc.)
   - 4.4. Integration with building electrical system
   - 4.5. Personnel access

5. Event Characteristics
    5.1. Fire in solar array vs. structure fire not yet involving array
    5.2. Support of site personnel not fully trained on system
    5.3. Hazards related to configuration (trip, slip, fall, etc.)
    5.4. Fire fighting ventilation tactics
    5.5. Products of combustion exposure (inhalation, air quality, etc.)
    5.6. Older systems vs. newer systems
    5.7. Low frequency occurrence, but with potential high severity

B. What are the prioritized core basics for emergency responders to address the topic?

1. Identification
    1.1. Common identification and labeling format (solar panel, rooftop conduits, disconnects, etc.)
    1.2. Common location of control panels and disconnects
    1.3. Establish and coordinate interface with local AHJ and fire department
2. Responder Guidance and Pre-Planning
    2.1. Provide universal fundamental set of tactics
    2.2. Develop emergency response plan
    2.3. Prepare to handle without outside support (e.g., utilities for shutdown)
3. Training
    3.1. Avoid complex training programs (instead promote inherent system design corrections)
    3.2. Concisely clarify what fire fighters can and can't do
4. Regulatory
    4.1. Establish an ongoing operation and maintenance process
    4.2. Consider regulatory oversight comparable with equivalent building systems (e.g., sprinklers, fire alarms, electrical, mechanical)

C. What is specifically needed for operational procedures and training materials?

1. Operational Materials
    1.1. Need standardization to set baseline requirements for operational materials
    1.2. Clarify offensive vs. defensive tactics
    1.3. Clearly indicate what can and can't be done
    1.4. Stress need for awareness and identification
    1.5. Indicate personnel access requirements to components (e.g., PPE)
    1.6. Identify options when in trouble (e.g., Rapid Intervention Teams)
2. Training Materials
    2.1. Need standardization to set baseline requirements for training materials
    2.2. Focus on state fire training academies
    2.3. Develop audience specific materials (e.g., fire personnel, incident commanders, fire instructors, investigators, etc)
    2.4. Include non-fire service groups in developing training materials
        2.4.1. Building owners and occupants
        2.4.2. Industry

D. What are the known or potential topics of technical debate?

1. NEC Related

1.1. Controllers and disconnects
1.1.1. String level disconnects
1.1.2. Module level controllers
1.2. Electrical conductor features and location
1.2.1. Wiring that is grounded vs. ungrounded
1.2.2. Ground indicators
1.3. Allowing DC power into building envelope
1.4. Number and size of access points
1.5. Effect of exterior conditions on system and components (e.g., contraction and expansion due to ambient roof temperatures, etc)

2. Fire Fighting Tactics
2.1. Tactics for large commercial systems
2.2. Firefighting with water vs. other agents
2.3. Products of combustion and implications of letting it burn during daytime fire
2.4. Support and response of system installer
2.5. Overhaul and post-fire situation
2.6. Myth vs. reality (inherent dangerous characteristics)

3. Regulatory
3.1. Flammability (as well as electrical) (e.g., fire resistance ratings)
3.2. Building construction and roof classifications
3.3. Non-OEM installations (e.g., non-listed products)

I. FUTURE TRENDS

A. Based on current technological trends, what are the greatest anticipated future hazards?

1. System Operating Features
1.1. Inability to power down system
1.2. Securing the system in post-fire
1.3. Micro-inverters and AC panels
1.4. Systems with integrated components, or integrated with building
1.5. Module level control (mitigation)
1.6. Issues involving arc fault

2. Material Properties and Configurations
2.1. Solar panels installed vertically
2.2. Solar powered shingles
2.3. Vertical surfaces (e.g., curtain walls, thin films)
2.4. Tempered vs. non-tempered glass
2.5. Solar concentrators and hot thermal fluids

3. Other System Concerns
3.1. After-market and non-OEM installations
3.2. Maintenance and upkeep requirements
3.3. Solar power use with vehicle
3.4. Mobile or portable equipment used to back feed building
3.5. Roof configurations with "green" buildings

B. How should fire service be addressing this topic in 5 years? 10 years?

1. Standardization
1.1. Isolate systems through module level controllers
1.2. Ventilation tactics (horizontal vs. vertical)

        1.3. Building and system labeling
    2. Data Collection
        2.1. Establish better data collection process
    3. Other Issues
        3.1. Sharp increase in solar
        3.2. Increase in distributed power supply

C. What constituent groups and/or organizations need to be involved?

1. Public Organizations
    - 1.1. Emergency responder representatives
        - 1.1.1. Fire service
            - 1.1.1.1. Membership organizations (e.g., IAFC, IAFF, NVFC, etc.)
            - 1.1.1.2. Training organizations (e.g., NAFTD, NFA, etc.)
        - 1.1.2. EMS and law enforcement
    - 1.2. Federal government
        - 1.2.1. DOE and NREL (and other DOE related organizations)
        - 1.2.2. OSHA
    - 1.3. Authorities Having Jurisdiction (AHJs)
        - 1.3.1. Building officials
        - 1.3.2. Electrical inspectors (e.g., IAEI, etc.)
        - 1.3.3. Fire Marshals (IFAM, NASFM, etc)
2. Private Organizations
    - 2.1. Conformity assessment and product approval organizations (e.g., UL, etc.)
    - 2.2. Industry
        - 2.2.1. Associations and membership organizations (e.g., Solar ABCs, etc.)
        - 2.2.2. Manufacturer representatives (e.g., NEMA)
        - 2.2.3. Integrator representatives (e.g., NEMA, IECI, etc.)
    - 2.3. Building users/owners
    - 2.4. Insurance
    - 2.5. Architects
3. Others
    - 3.1. Utility representation (e.g., EEI, etc.)
    - 3.2. Labor union groups (e.g., IBEW, etc.)
    - 3.3. International representation
    - 3.4. Codes and standard developing organizations (NFPA, ICC, ISO, IEC, etc.)

I. OTHER ISSUES

A. What other case study events have not already mentioned, and what are lessons learned?

1. Investigation process
    - 1.1. Clarify cause and origin information for investigators
    - 1.2. Establish investigation team process (for noteworthy incidents)
2. Data Collection Methods
    - 2.1. Better utilize industry organizations (e.g., Solar ABCs, etc.)
    - 2.2. Better define data elements with existing data collections (e.g., NFIRS, FIDO, etc)
3. Other Issues
    - 3.1. Clarify possible approaches with non disclosure agreements

B. What specific updates/additions/changes need to be addressed in codes and standards?

1. Electrical Codes
    1.1. String level disconnects
    1.2. Module level controllers
    1.3. Electrical conductor location
    1.4. Ground fault indicators
    1.5. Non grounded system
2. Building and Fire Prevention Codes
    2.1. Building markings and pre-incident planning info (in standardized format)
    2.2. Operation and maintenance for the upkeep of building marking
    2.3. Address flammability characteristics for exposure fires (e.g., NFPA 1144 Reducing Structure Ignition Hazards from Wildland Fire, etc.)
    2.4. System commissioning (NFPA 3, etc.)
3. Fire Service Standards
    3.1. Fireground tactics and strategy
        3.1.1. Residential
        3.1.2. Commercial and other large systems
    3.2. Overhaul and post-fire situations
    3.3. Update emergency responder professional qualification standards
4. Other Codes and Standards
    4.1. Data collection systems (e.g., NFIRS, FIDO, etc.)
    4.2. Fire investigations (e.g., NFPA 921, etc.)
5. Other Issues
    5.1. Aging and weathering
    5.2. Non-OEM installations (e.g., non-listed products)
    5.3. Proliferating use of applicable model code (e.g., Oregon, Cal Fire Guidelines, etc.)

C. What single message should the fire service express on this topic?

1. Fireground Tactics
    1.1. "Components are always hot!" (in daytime)
    1.2. Operate normally, but don't touch
    1.3. Size-up, identify and validate hazard
    1.4. Stress key message for tactical approach (especially large commercial systems)
    1.5. Leave the scene in a safe condition
2. Code Development
    2.1. Provide ability for electrical system isolation for emergency responders
    2.2. Create consistent placarding and labeling for emergency responders
    2.3. Address on-going maintenance oversight of installed systems (especially commercial)
    2.4. Require system contact information for emergencies
3. Education and Training
    3.1. This is energized electrical equipment like other equipment, but with inability to power down. Otherwise not much different.
    3.2. Systems are widespread: You probably have these systems in your 1st due jurisdiction
    3.3. Don't underestimate electrical hazard; don't be complacent

Figure 5-8: Workshop Working Group Summary

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6. Summary Observations

This report assembles best practice information for fire fighters and fireground incident commanders to assist in their decision making process with emergency events involving solar power systems. This is focused on structural fire fighting in buildings and structures having solar power systems that generate thermal and/or electrical energy, with a particular focus on solar photovoltaic panels used for electric power generation

This report collects and analyzes applicable scientific studies, training guidance, case study reports and loss data, and available emergency response guidance relating to solar power systems. The project deliverables are intended to serve as the basis for training program development by others.

A critical task in this project was the interactive one-day workshop involving fire service and other subject matter experts. This provided a detailed review and assessment of the information collected and generated a summary of the fundamental principles and key details relating to issues such as training needs, areas needing further research, revisions to codes and standards, and other applicable topics. The complete results are summarized in Figure 5-8 shown in the previous section.

The workshop review was coordinated around ten basic questions, and the collective response to these ten questions focuses on the core basics of this issue. Of particular interest is the tenth and final question that asked each break-out session: "What single message should the fire service express on this topic?" This question helped to clarify and highlight the most important issues arising throughout the entire project (as well as during the workshop review).

The following is a summary of the most important issues for emergency responders that need to considered and/or addressed for emergency events involving solar power systems:

Fireground Tactics

- "Components are always hot!" The single most critical message of emergency response personnel is to always consider photovoltaic systems and all their components as electrically energized. The inability to power-down photovoltaic panels exposed to sunlight makes this an obvious hazard during the daytime, but it is also a potential concern at nighttime for systems equipped with battery storage.

- Operate normally, but don't touch. Fire service personnel should follow their normal tactics and strategies at structure fires involving solar power systems, but do so with awareness and understanding of exposure to energized electrical equipment. Emergency response personnel should operate normally, and approach this subject area with awareness, caution, and understanding to assure that conditions are maintained as safely as possible.

- Size-up, identify and validate hazard. Accurate knowledge of the hazards present on the fireground is essential for minimizing personnel injuries. Identifying the type and extent of a solar power system during the emergency event size-up is critical to properly addressing the hazards they present. In particular, it is important to distinguish between a solar thermal system and a photovoltaic system, and the hazards presented by each type of system.

- Stress key message for tactical approach (especially large commercial systems). The tactical approach to solar power equipment in a building with a structure fire needs to be stressed with all fireground personnel (i.e., stay clear). Serious injury can occur with equipment such as photovoltaics on a sunny day, and the danger to fire service personnel is real and deserves attention. Of paramount concern are large commercial photovoltaic systems that generate significant levels of electricity and can create daunting strategic challenges for fire fighters as they are trying to address a building fire.

- Leave the scene in a safe condition. Emergency response personnel address and mitigate hazards, and turn the scene back over the owners and/or occupants after the scene is stabilized. They need to be aware of unanticipated dangers and leave the scene in a safe condition. An example would be a photovoltaic solar power system damaged during a nighttime fire, which once exposed to sunlight, begins to generate electricity and creates a shock hazard or re-kindling of the fire.

Code Development

- Provide ability for electrical system isolation for emergency responders. A key task handled by emergency response personnel at a building fire is the isolation or shutdown of the building's electrical power. For current photovoltaic solar power systems this may be difficult and/or impossible. Without delay code-making bodies need to explicitly address this problem, and provide adequate methods for emergency shutdown of this electrical equipment. This is especially important for large commercial systems that generate high levels of electricity and pose significant fire fighting challenges.

- Create consistent placarding and labeling for emergency responders. Standardized approaches to provide consistent identification of solar power systems and their components would greatly assist emergency responders in safely completing their job performance tasks. In particular, clearly and consistently identify system components that require special attention during an emergency, such as the color-coding of electrical conduit that is normally energized for a PV system. The more universal the identification protocol, the more likely for it to be embraced by the mainstream fire service.

- Address on-going maintenance oversight of installed systems (especially commercial). On-going operation and maintenance concerns for solar power systems must be addressed. These systems are normally exposed to outdoor weather conditions that enhance the aging process, and the infrastructure needs to be in place for the on-going maintenance of these systems to assure their safe operation.

- Require system contact information for emergencies. Consideration needs to be given to establishing responsible points of contacts that emergency responders can reliably depend on during an emergency situation. They currently have such contacts for other building systems they must handle, such as a building's electrical connection from the local power grid, or an automatic sprinkler system. In similar fashion, they should know who they can reliably use as an additional resource during an emergency, and who can readily assist with stabilizing the system. This is especially important for large commercial photovoltaic systems.

Education and Training

- This is energized electrical equipment like other equipment, but with an inability to power down; otherwise it's not much different. This topic is yet another new and evolving safety-related issue that requires attention from the emergency response community, and while it is important and deserves attention, there is no reason to create a sense of unfounded fear. While recognizing the key concern of not being able to power down energized electrical equipment, emergency response personnel should approach this overall subject area as yet another topic that they need to address with awareness, caution, and understanding to assure that conditions are maintained as safely as possible for all involved.

- Systems are widespread: You probably have these systems in your first due jurisdiction. Solar power systems represent a technology whose time has come. They are proliferating and it is likely that the first due response area for any particular emergency response unit includes this technology. It is also being utilized for direct use by the fire service on fire station facilities as well as fire apparatus.

- Don't underestimate electrical hazard; don't be complacent. Education and training materials needs to be clear on the hazards of solar power systems, and emphasize the importance of fire service personnel not becoming complacent about these hazards.
  The single most critical message of emergency response personnel is to always consider photovoltaic systems and all their components as electrically energized when exposed to sunlight.

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Annex A: Solar Power–Related Definitions

The following are terms relating to solar power that are used throughout this report and/or are commonly used relative to the subject matter applicable to this report.

In some cases multiple definitions are found in the common literature. Where multiple defined terms exist, preference is given to federal or state publications and widely recognized consensus-developed codes and standards. In some cases multiple definitions of the same term are provided.

Absorber. Component of a solar collector for absorbing radiant energy and transferring this energy as heat into a fluid.[139]

Aperture. Solar collector opening through which unconcentrated solar radiation is admitted.[140]

Array. A mechanically integrated assembly of modules or panels with a support structure and foundation, tracker, and other components, as required, to form a direct-current power-producing unit. See also "Photovoltaic Array".[141]

Building Integrated Photovoltaics. Photovoltaic cells, devices, modules, or modular materials that are integrated into the outer surface or structure of a building and serve as the outer protective surface of that building.[142]

Charge Controller. Equipment that controls dc voltage or dc current, or both, used to charge a battery.[143]

Concentrating Collector. Solar collector that uses reflectors, lenses or other optical elements to redirect and concentrate the solar radiation passing through the aperture onto an absorber. See also "Solar Collector".[144]

Electrical Production and Distribution Network. A power production, distribution, and utilization system, such as a utility system and connected loads, that is external to and not controlled by the photovoltaic power system.[145]

Heat Transfer Fluid. Fluid that is used to transfer thermal energy between components in a system.[146]

Hybrid System. A system comprised of multiple power sources. These power sources may include photovoltaic, wind, micro-hydro generators, engine-driven generators, and others, but do not include electrical production and distribution network systems. Energy storage systems, such as batteries, do not constitute a power source for the purpose of this definition.[147]

Interactive System. A solar photovoltaic system that operates in parallel with and may deliver power to an electrical production and distribution network. For the purpose of this definition, an energy storage subsystem of a solar photovoltaic system, such as a battery, is not another electrical production source.[148]

Inverter. Equipment that is used to change voltage level or waveform, or both, of electrical energy. Commonly, an inverter [also known as a power conditioning unit (PCU) or power conversion system (PCS)] is a device that changes dc input to an ac output. Inverters may also function as battery chargers that use alternating current from another source and convert it into direct current for charging batteries.[149]

Inverter. Electric energy converter that changes direct electric current to single-phase or polyphase alternating currents.[150]

Module. A complete, environmentally protected unit consisting of solar cells, optics, and other components, exclusive of tracker, designed to generate dc power when exposed to sunlight. See also "Photovoltaic Module" .[151]

Panel. A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit. See also "Photovoltaic Panel".[152]

Photovoltaic Array. Assembly of mechanically integrated and electrically interconnected PV modules, PV panels or PV sub-arrays and its support structure. Note: a PV array does not include its foundation, tracking apparatus, thermal control, and other such components. See also "Array" .[153]

Photovoltaic Assembly. PV components that are installed outdoors and remote from its loads, including modules, support structures, foundation, wiring, tracking apparatus, and thermal control (where specified), and including junction boxes, charge controllers and inverters depending on the assembly's installed configuration.[154]

Photovoltaic Cell. Most elementary photovoltaic device. See also "Solar Cell".[155]

Photovoltaic Module. Complete and environmentally protected assembly of interconnected photovoltaic cells. See also "Module".[156]

Photovoltaic Panel. PV modules mechanically integrated, pre-assembled and electrically interconnected. See also "Panel".[157]

Photovoltaic System. Assembly of components that produce and supply electricity by the conversion of solar energy.[158]

Photovoltaic System Voltage. The direct current (dc) voltage of any photovoltaic source or photovoltaic output circuit. For multiwire installations, the photovoltaic system voltage is the highest voltage between any two dc conductors.[159]

Solar Cell. The basic photovoltaic device that generates electricity when exposed to light. See also "Photovoltaic Cell".[160]

Solar Collector. Device designed to absorb solar radiation and to transfer the thermal energy so produced to a fluid passing through it. See also "Concentrating Collector".[161]

Solar Energy. Energy emitted by the sun in the form of electromagnetic energy. Note: solar energy is generally understood to mean any energy made available by the capture and conversion of solar radiation.[162]

Solar Heating System. System composed of solar collectors and other components for the delivery of thermal energy.[163]

Solar Photovoltaics. Pertaining to PV devices under the influence of sunlight.[164]

Solar Photovoltaic System. The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to a utilization load.[165]

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Annex B:
Example of Fire Service Training Program on Solar Power Systems

This annex provides a specific example of a fire service training program addressing solar power systems, and in particular photovoltaics. While multiple programs are available from various qualified sources, the following summarizes one comprehensive program as an example. This is posted on the website of the California State Fire Marshal's Office, and is available at the following URL: www.osfm.fire.ca.gov/training/photovoltaics.php

The information contained on their website includes student manuals, lesson plans, student handouts, and instructor information. Interested parties should directly access their website and download the applicable materials of interest. This following is the outline of this particular program:

I. Introduction
II. Cells and Components
III. PV Performance
IV. PV Applications
V. PV Codes
VI. Emergency Response

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Annex C: Overview of Fire Service Training and Education

There are an estimated 1.1 million fire fighters in the United States today.[166] This estimate is based on a sample survey with a confidence level associated with each estimate, and does not include certain fire fighter constituency groups such as industrial fire departments and federal fire departments.

Approximately 75 percent of these fire fighters serve as volunteers with the remainder serving as career fire fighters. As expected, the more populated jurisdictions are protected primarily by career fire fighters while rural areas are protected primarily by volunteer fire fighters. Some fire departments are a mix of career and volunteer fire fighters in what are considered combination fire departments.

This section covers the preparation and process infrastructure utilized by fire fighters to perform their duties. A review is provided on what is typically included in fire service training and education programs, as well as an overview of fire service standard operating procedures and guidelines commonly used by fire fighters.

Defining the Profession of Fire Fighting

Fire fighters face a bewildering spectrum of possible emergency events. As a result they are generalists in their core knowledge and acquire specialized additional skills to handle certain duties.

Fire service personnel require skills that are already adequately learned and ready to be used before an emergency occurs. Beyond the obvious hazards associated with fireground operations, the duties of a fire fighter include the need for training on additional topics commonly shared with other professions. Examples include biohazards associated with handling of victims requiring emergency medical services, and transportation safety relating to the hazards of large mobile fire apparatus.

Fire service training and education is a critical part of the activities addressed by fire fighters. It is not uncommon for fire fighters to be in a situation where their own personal survival depends on this training and education, and they are continually subjected to learning on a wide range of important topics. For all topics of interest to fire service emergency responders, an on-going need exists for updated, accurate, consistent, readily understandable training information.

What distinguishes a fire fighter from someone who is not a fire fighter? Most obvious is an individual's formal relationship (e.g., employment or membership) with a recognized fire service organization. Equally important, however, is the individual's training and education that qualifies them to adequately perform the tasks expected of a fire fighter.

To be *"qualified by training and examination"* are critical defining characteristics for today's fire service. Among the various definitions of "fire fighter" in the common literature, the following reflects the baseline importance of qualification by training and examination:

> *"<u>Fire Fighter</u>: An individual qualified by training and examination to perform activities for the control and suppression of unwanted fires and related events"*[167]

Fire fighter professional qualifications are key to defining the profession of fire fighting. Standards that set baseline requirements have been subject to ongoing enhancements for decades (as exemplified by documents such as NFPA 1961, *Standard on Fire Hose*, which was first issued in 1898, or NFPA 1410, *Standard on Training for Initial Emergency Scene Operations*, first issued in 1966).[168,169]

NFPA 1001	• **Fire Fighter 2008 Edition**
NFPA 1002	• **Fire Apparatus Driver/Operator 2009 Edition**
NFPA 1003	• **Airport Fire Fighter 2005 Edition**
NFPA 1005	• **Marine Fire Fighting for Land-Based Fire Fighters 2007 Edition**
NFPA 1006	• **Technical Rescuer 2008 Edition**
NFPA 1021	• **Fire Officer 2009 Edition**
NFPA 1026	• **Incident Management Personnel 2009 Edition**
NFPA 1031	• **Fire Inspector and Plan Examiner 2009 Edition**
NFPA 1033	• **Fire Investigator 2009 Edition**
NFPA 1035	• **Public Fire and Life Safety Educator 2005 Edition**
NFPA 1037	• **Fire Marshal 2007 Edition**
NFPA 1041	• **Fire Service Instructor 2007 Edition**
NFPA 1051	• **Wildland Fire Fighter 2007 Edition**
NFPA 1061	• **Public Safety Telecommunicator 2007 Edition**
NFPA 1071	• **Emergency Vehicle Technician 2006 Edition**
NFPA 1081	• **Industrial Fire Brigade Member 2007 Edition**

Figure C-1: Types of Fire Fighters, according to NFPA Professional Qualification Standards.

Of particular interest for addressing fire fighter performance is the set of 16 NFPA standards addressing fire fighter professional qualifications. These documents are summarized in Figure C-1, and they clarify fire fighting disciplines and establish required levels of knowledge that can be used for training and other purposes.

The fire service operates as a quasi-military type organization, with the need for potentially large numbers of fire service members to be quickly deployed to handle complicated emergencies. Further, efficient and effective handling of the event is necessary to minimize danger to life and property, which means that there is normally very little time to implement mitigating action.

Table C-1: Examples of Fire Fighting Disciplines and Training Levels.[170]

FIRE FIGHTING DISCIPLINE	EXAMPLES OF LEVELS	NFPA STANDARD
Airport Fire Fighter		1003
Driver/Operator	Pumper; Aerial, Tiller; ARFF; Mobile Water Supply; Wildland	1002
EMS HazMat	I, II	473
Fire Department Safety Officer	Health/Safety Officer; Incident Safety Officer; ISO-Fire Suppression; ISO – EMS Operations; ISO – HazMat Operations; ISO – Special Operations	1521
Fire Fighter	I; II	1001
Fire Inspector	I; II; III; Plans Examiner	1031
Fire Investigator		1033
Fire Officer	I; II; III; IV	1021
Fire Service Instructor	I; II; III	1041
Hazardous Materials	Awareness; Operations; Technician; Incident Commander; Branch Safety Officer; Private Sector Specialist A, B, C; Tech w/Tank Car Specialty, Tech w/Cargo Tank Specialty; Tech w/Intermodal Tank Specialty; Tech w/ Flammable Gases Bulk Storage Specialty; Tech w/ Flammable Liquids Bulk Storage Specialty	472
Industrial Fire Brigade	Incipient; Advanced Exterior; Interior Structural; Advanced Structural; Leader	1081
Marine Fire Fighter	I, II	1005
Public Fire & Life Safety Educator	I; II; III; Public Information Officer; Juvenile Firesetter Intervention Specialist	1035
Public Safety Telecommunicator	I; II	1061
Rescue Technician	Rope; Confined Space; Trench; Structural Collapse; Surface Water; Vehicle & Machinery	1006
Wildland Fire Fighter	I, II	1051

As a result, multiple specialized fire fighting disciplines have evolved to address certain tasks and duties as defined by the level of training and education they receive. Table C-1 summarizes examples of fire fighting disciplines and the standardized levels to which fire fighters can be qualified.

The last several years has seen a more widespread use of these standards, partly because five (NFPA 1000, 1001, 1002, 1006, and 1021) are among the 27 NFPA standards adopted as national preparedness standards by the U.S. Department of Homeland Security.[171] Each year DHS distributes millions of dollars in aid through their "Assistance to Firefighters Grant" (AFG) to U.S. fire departments, which is administered by the U.S. Federal Emergency Management Agency (FEMA). A prerequisite for applying for this support is conformance to these DHS national preparedness standards. The 19,791 applications requesting more than $3.1 billion in AFG grants in 2009 indicate the level of activity in this DHS/FEMA program.[172]

Training versus Education

In today's fire service the terms training and education are sometime used synonymously; however, they have different meanings.[173] While both refer to the transfer of information from a body of knowledge to a recipient, each has a different focus on the purpose and details of the information transfer methodology.

Training is an exercise in focused learning, and refers to the exchange of specific information intended to enhance the proficiency of a particular skill. An example of training is a fire fighter class that teaches the skills necessary for certification at the "Awareness Level" for a hazardous materials incident. Training is more applicable to specific emergency events such as handling a motor vehicle accident.

In contrast, education refers to broad-based learning, with the intent of providing a foundation of general knowledge that supports efficient analytical techniques for effective problem solving. An example is a college degree in business administration, which will provide a fire service officer with the skill set needed to manage a large city fire department.

In general, the technical content for fire service training is well-established and addresses a wide range of topics faced by fire fighters. Much of this is captured in the mainstream literature and national standards (e.g., NFPA standards) addressing a wide range of fire fighting tasks, equipment, and other fire service detail. Some of this information has been developed and refined in various arenas for decades.

Specifically, multiple sources of training materials are available that extensively address useful content on the topic of interest. These training materials can be readily adapted and used directly by members of the fire service and other emergency responders. A wide assortment of broadly developed training materials and guidance materials are available that provide support. This includes, for example, the training manuals provided by the International Fire Service Training Association (since 1932), fire service training materials provided by Jones and Bartlett Publishers, and various books and publications provided through Delmar Learning.[174,175,176]

The Fire Service Training Infrastructure

Fire departments are the basic organizations used by fire fighters to deliver their services. These can range from a small volunteer fire department in rural areas, to large fire departments with all career personnel protecting a major metropolitan city. Training will also depend on the specific hazards within the protected jurisdiction, such as the difference between an industrial district and a bedroom community.

Fire departments, regardless of their size or type, have two distinct sources for their training needs: (1) training programs that originate and operate internally within the organization, and (2) those that originate and operate externally. Figure C-2 illustrates the two basic sources of training information and materials for the fire service.

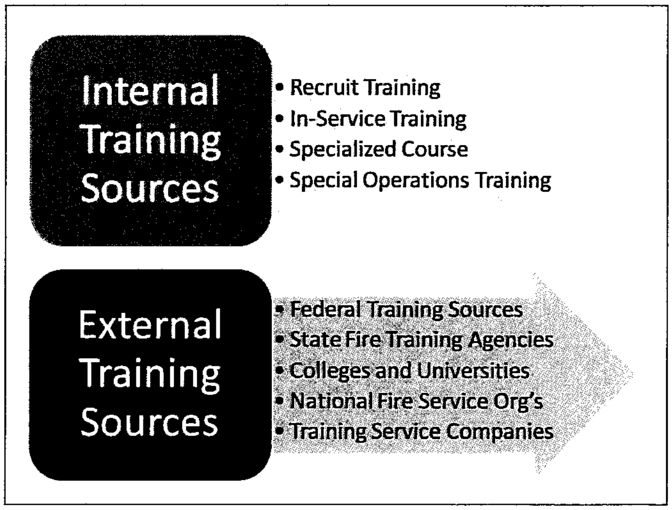


Figure C-2: Types of Training Sources

The extent of internal training sources depends on the available resources of the particular fire department, and as a result, these internal sources tend to be more extensive and sophisticated for larger fire departments (e.g., large city or county fire departments). These larger fire departments generally have their own dedicated training divisions as well as training facilities (i.e., training academy), and are able to effectively handle recruit training and in-service training. Specialized training may be offered for specific duties such as fire apparatus operators, incident commanders, or safety officers. They may also offer specialized courses for duties beyond those of front-line emergency responders, such as fire investigators, fire prevention and inspection personnel (i.e., permitting officials), and public fire and life safety educators.

Multiple external sources of training information and materials are available from a number of sources. These are available to directly support the many fire departments (and especially smaller departments) with limited resources for training. In addition, they also help to supplement and support larger fire departments with their own training departments, and while doing so promote general consistency throughout the fire service. In some cases, regional training centers fulfill internal training needs despite their external characteristics, and these may be operated at the county or state level, or simply by multiple fire service organizations joining together for this purpose. Figure C-3 provides an overview of fire service training, from the perspective of the external sources that directly influence today's fire service training.

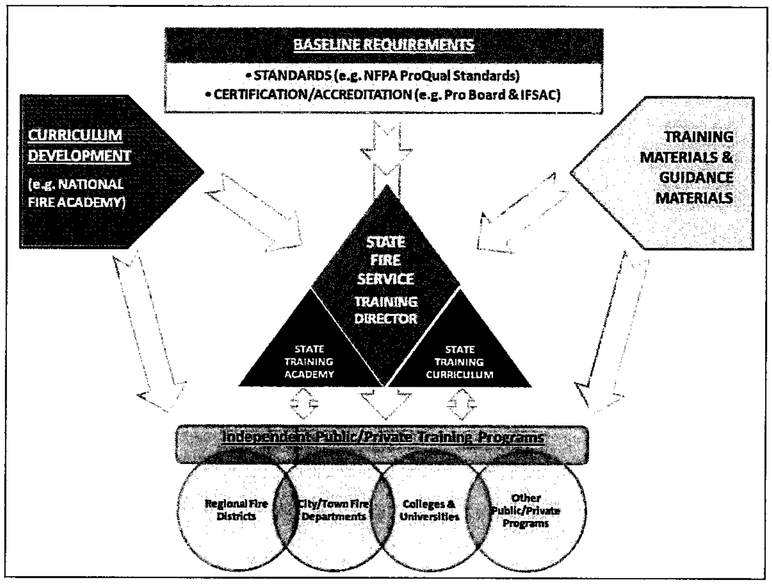


Figure C-3: Overview of the External Sources of Fire Service Training

State governments are a key external resource for fire departments, and many states have designated an official agency to provide state-wide training for fire and emergency personnel. Similarly but at a higher level, the federal government provides important support through the National Fire Academy and other resources. Depending on the legislative and funding arrangements in a particular state or region, certain colleges and universities may serve as centers for fire service training, with or without the involvement of their respective state agency. Supporting these training programs is a group of national fire service organizations and private training service organizations that provide valuable components for the fire service training infrastructure.

State training agencies and state training directors are central players in the fire service training infrastructure. Training directors sometimes report to the state fire marshal in each state, and many states operate a state-wide training academy. In addition, many also coordinate the training materials and curriculums used throughout the state. In some states, fire departments within the state are required to mandatorily use this information and material, and in others they can voluntarily utilize it as they deem appropriate.

Independent public and private training programs that exist within the state often work in coordination with state training programs. These may include the fire service training activities of regional fire districts, large city fire departments, colleges and universities, and other public or private fire service training programs. The relationships among these entities vary significantly from state to state. For example, one state may not have a dedicated state fire training academy and instead have multiple separate but similar training programs throughout the state in conjunction with the state community college system. Elsewhere there may be a state training academy, but the large city fire departments use their own training resources and do not participate in the state programs.

On a national level, several key programs, activities and initiatives feed into the multitude of fire service training activities found at the local and state levels. An example is the National Fire Academy that assists state and local organizations with curriculum development and the national promotion of technical training content. Important baseline requirements are set by the applicable standards that manage the training content and provide a level of agreement on the applicable professional qualifications. These baseline requirements are effectively implemented through accreditation and certification processes.

Administering Qualifications for the Fire Service

Fire fighting as a profession has been recognized for centuries among various civilizations. It was not until more recently, however, that its professional status has become more distinctly defined, with the development of standardized baseline requirements and the implementation and quality assurance process that supports the use of these requirements.

Starting in 1974, NFPA's professional qualifications standards began to appear, becoming increasingly used by state agencies responsible for fire service training in the years since. The use of national standards for fire fighter professional qualifications is a concept that political leaders have been able to widely support, and the appearance of these documents has independently coincided with a general rise in funding and recognition for state fire service training programs.[177]

As a result, most states utilize these standards as the defining measure of professional qualifications for fire fighters. However, certification programs in many states are voluntary, and states often do not have mandatory minimum qualifications requirements for fire service personnel.

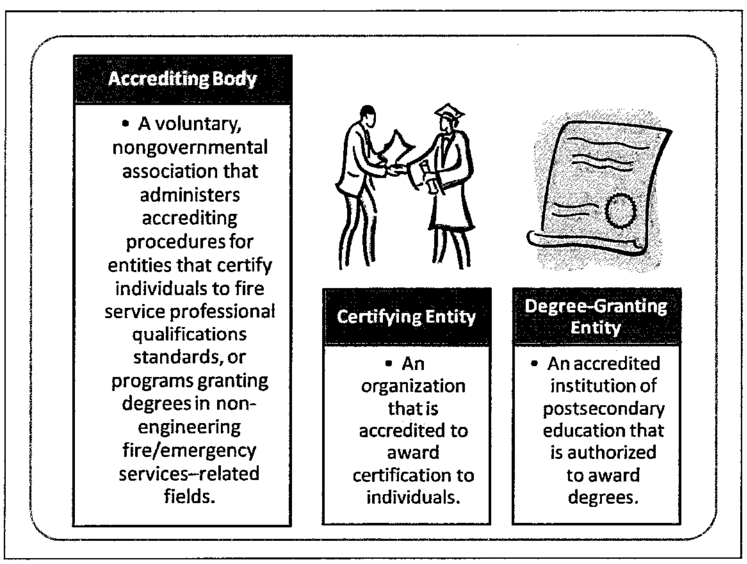


Figure C-4: Overview of Entities that Accredit, Certify, and Grant Degrees.[178]

The baseline requirements included in national standards provide a foundation for fire fighter professional qualifications, but how these are applied is equally important. To achieve consistent implementation, the processes of accreditation, certification, and degree-granting have evolved. The organizations that administer these training programs are known as accrediting bodies, certifying entities, and degree-granting entities, respectively. These are summarized in Figure C-4, which provides an overview of the entities that accredit, certify, and grant degrees.

As further explanation, accreditation refers to enabling oversight (within a recognized framework that measures and ensures quality implementation), bestowed upon another organization. Once accredited, that organization will in turn provide certifications and/or grants degrees to individuals. The following are definitions for accredit, certification, and degree:[179]

> *"Accredit. To give official authorization to or to approve a process or procedure to recognize as conforming to specific criteria, and to recognize an entity as maintaining standards appropriate to the provision of its services."*[180]

> *"Certification. An authoritative attestment; specifically, the issuance of a document that states that an individual has demonstrated the knowledge and skills necessary to function in a particular fire service professional field."*[181]

> *"Degree. A formal recognition of completion of a prescribed program of study at the postsecondary level."*[182]

Annex D: Attendees at Fire Service Workshop on Solar Power Systems

The following is a summary of the subject matter experts that attended and participated in the "Fire Service Workshop on Solar Power Systems", held in Detroit, Michigan on 17 March 2010.

Table D-1: Attendees at Fire Service Workshop on Solar Power Systems

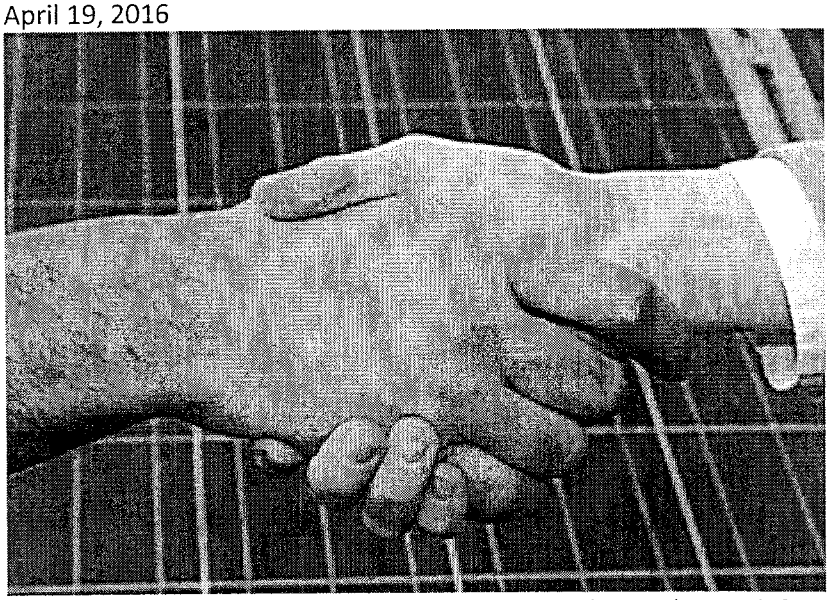
Last Name	First Name	Organization	City, State	
Brooks	Bill	Brooks Engineering (SEIA, CMP-04)	Vacaville, CA	1
Croushore	Tim	Allegany Power (CMP-12 Chair)	Greensburg, PA	2
Dalton	James	Chicago Fire Dept.	Chicago, IL	3
Earley	Mark	NFPA	Quincy, MA	4
Frable	Dave	U.S. General Services Administration	Genera, IL	5
Grant	Casey	FPRF/NFPA	Quincy, MA	6
Groden	Walter	Chartis Insurance	New York, NY	7
Hollenstain	Tom	State Farm, ATR - Vehicle Research Facility	Bloomington, IL	8
Kerber	Stephen	Underwriters Laboratories	Northbrook, IL	9
Kreis	Timothy	Phoenix Fire Dept.	Phoenix, AZ	10
Layman	Jeff	BP Solar International	TN	11
Lindsey	Travis	Travis Lindsey Consulting Services	Las Vegas, NV	12
McCall	George	McCall & Son	Greenville, SC	13
Murchie	Colin	Solarcity	Washington, DC	14
Paiss	Matt	San Jose Fire Dept. (NGLB Training Group)	San Jose, CA	15
Peterson	Eric	FPRF/NFPA	Quincy, MA	16
Roper	Ed	SC State Training Academy, (NAFTD)	Columbia, SC	17
Sanfilippo	Tony	MI State Fire Marshal's Office	Lansing, MI	18
Sawyer	Steve	NFPA	Quincy, MA	19
Shaw	Ron	Extrication.Com	Plymouth MA	20
Stroud	Matt	MGS Tech	Shoreline, WA	21
Van de Velde	Marc	Global Asset Protection Services LLC	Frankfurt, Germany	22
Varone	Curt	NFPA	Quincy, MA	23
Willse	Pete	XL Global Asset Protection Services	Hartford, CT	24

EXHIBIT
RUCO-1
ADMITTED

From: Jeffrey Michlik
Sent: Wednesday, April 20, 2016 8:16 AM
To: Robert Mease; Dan Pozefsky; David Tenney; Jordy Fuentes; Tim Coley; John Cassidy
Subject: Solar Article

Net Metering Fights Are Bad for Business. Here's How Utilities and Solar Advocates Can Avoid Them

Collaboration and compromise are the key to making solar work for everyone.
by Silvio Marcacci
April 19, 2016



Collaboration and compromise are the key to making solar work for everyone.
by Silvio Marcacci
April 19, 2016

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Last year, 46 states considered changes to compensation for rooftop solar systems. Some of those proposed changes resulted in a contentious war of words between solar advocates and utilities.

Utilities are in a tough spot. They must now balance what their customers want -- which, increasingly, is solar -- with the cost of maintaining the grid.

While utilities need to ensure that customers are paying their share of the costs to access the grid, they also run the risk of angering customers if changes to net metering are too onerous. This can be bad for business.

So what's the best course of action?

Net metering pays owners of residential and small commercial rooftop systems the retail rate for every kilowatt-hour of electricity fed back into the grid. It's been a successful tool -- but it's a very blunt one.

In several states, compromise approaches to accurately valuing solar and managing higher penetration levels are becoming more common, creating a model for successfully dealing with the growth of PV.

Quick action may not be best

When -- and how -- utilities get involved in a solar valuation process is inherently a business-model decision.

Rising rooftop-solar penetration levels have spurred utilities to reconsider how they compensate customer-sited generation in order to mitigate revenue loss and avoid undue cost-shifting. But sudden revisions to incentives that solar owners rely on for financing creates backlash. That's what happened in Nevada when solar customers filed a class-action lawsuit against NV Energy after the state slashed its net metering program for all customers.

However, the stakeholders on different sides of the issue aren't necessarily that far apart. A GTM Research survey found that 67 percent of regulators, utilities and solar industry respondents felt customer-sited solar should be compensated using value-of-solar tariffs that more accurately reflect grid costs and the avoided cost of building new infrastructure by 2020.

Decision time is fast approaching. Senators Harry Reid and Angus King proposed legislation to preserve net metering nationwide, and the National Association of Regulatory Utility Commissioners is drafting a manual based on existing approaches and court decisions to guide future rate designs for rooftop solar.

"Utilities are taking a long-term view of how to participate in policy creation that's sustainable, where customers don't feel there's a bait-and-switch," said Jim Heidell, a utilities expert at PA Consulting.

"A litigated process is not necessarily the best way to come to a conclusion. The collaborative process often works and can lead to better solutions where all parties are in agreement," said Heidell.

Maine meets all sides in the middle

Ironically, the most innovative collaborative approach to solar valuation is found in one of America's smallest solar markets: Maine.

Earlier this year, Maine legislators introduced a bill to replace net metering in 2017 with a system where regulators periodically reset compensation levels applied to aggregated solar power sold into the wholesale market.

Solar owners would get market-based compensation. They'd also have an option to get grandfathered into the old net-metering system, while paying a larger share of transmission and distribution costs.

Utilities would benefit from wholesale market and renewable energy credit revenue while managing intermittency through project aggregation and targeting installations to the most valuable locations for each market segment. Transparent pricing is key here, for solar owner and utility alike.

"The utility compact is providing reliable, affordable, safe, and more recently, clean electricity," said Zach Pollock, an energy and utilities expert at PA Consulting. "By aggregating individual projects, they're able to more accurately value those resources in terms of system planning while bringing in benefits and addressing environmental externalities."

Maine's compromise approach hasn't convinced everyone, however. Even though all sides agree with the middle-ground proposal, Governor Paul LePage says he'll veto the bill. If the legislation does fail, Maine's Public Utilities Commission would decide future net-metering policy -- and a ruling made there could be less collaborative.

The Midwest's move toward accurate solar valuation

Maine is not alone in the shift toward accurate solar valuation based on environmental and system benefits. Minnesota was the first state to set a value-of-solar (VOS) tariff including the value of delivered energy, generation and transmission capacity, line losses, and external environmental benefits -- many of distributed solar's most important attributes.

"The long-term value of solar is a complicated calculation, but it needs to include all the values like energy generation, transmission and distribution capacity, the way solar offsets utility line losses, and internalizing various externalities like the social cost of carbon," said Briana Kobor, program director of DG regulatory policy at Vote Solar.

The process included all relevant parties and granted investor-owned utilities the option of applying the VOS formula to customers instead of imposing retail-rate net metering. While the price may not have been ideal for any one side, regulators engaged all stakeholders and determined compensation in the fairest way possible.

Minnesota's e21 Initiative is also bringing utilities and renewable energy advocates together to determine fair solar valuation and consider proposals for remaking utility business models.

"The regulatory process has historically been pretty cumbersome and asymmetrical. That's what e21 is trying to target -- the undue burden and regulatory constraints created with the traditional rate-case process," said Pollock.

A big proposal in America's smallest solar state

The Midwest's move toward greater transparency in solar valuation is spreading. Proposed legislation in South Dakota -- which ranks last in the U.S. with just 2.4 megawatts of installed solar capacity -- could avoid future regulatory fights by better defining solar's value to include all of the technology's benefits and costs.

South Dakota currently reimburses solar owners at an avoided cost rate of 2.78 cents to 4.33 cents per kilowatt-hour, depending on the utility. Several additional values would be included under the new system, including unused energy, avoided transmission capacity, reduced line losses, and the value of generation added to high-demand locations on the grid.

This process would seek input from all stakeholders -- utilities, customers, and solar advocates alike -- and establish an acceptable value for solar generation ahead of rising demand. Unfortunately, South Dakota's solar future will have to wait a bit longer, as the proposed bill was recently tabled until the next legislative session.

Collaboration is key, but it takes time

These examples show a collaborative path forward, but one problem remains -- they're all in nascent markets with low penetration levels.

Similar compromise efforts have emerged in other small-scale markets like Louisiana and Montana. And New Hampshire's recent net-metering expansion directs regulators to develop new compensation guidelines after the new cap is reached.

But developed markets like California and Hawaii have made contentious net-metering changes without a VOS process that riled utility stakeholders. And while Massachusetts' recent net-metering compromise expanded cap limits, it also cut compensation levels without a new valuation process.

As utilities start thinking more seriously about how to properly value solar, the best course of action is likely one that meets customers halfway.

"Customers should have the choice to consume as much or as little energy as they want from their utility," said Kobor, pointing to Vote Solar's "Guiding Principals" policy guide, developed with partners across the energy and consumer spectrum. "If you move beyond retail-rate net metering, the discussion should focus on energy exports."

This approach has worked in Minnesota and would likely work in Maine, if approved. A collaborative approach to accurately valuing solar could even help re-establish a market in Arizona, where regulators are developing a standardized cost of service and a value-of-solar methodology to apply to future cases.

Ultimately, a successful approach to net-metering policy will likely require patience and collaboration.

"You have less resistance to change if change comes slowly without suddenly taking rights away from people," said Heidell. "It's got to be gradual, and it takes a long time."

This article is part of a Next Generation Utility series from PA Consulting. Find more news and analysis on the subject here.

MARKETS & POLICY

Minnesota Becomes First State to Set 'Value of Solar' Tariff

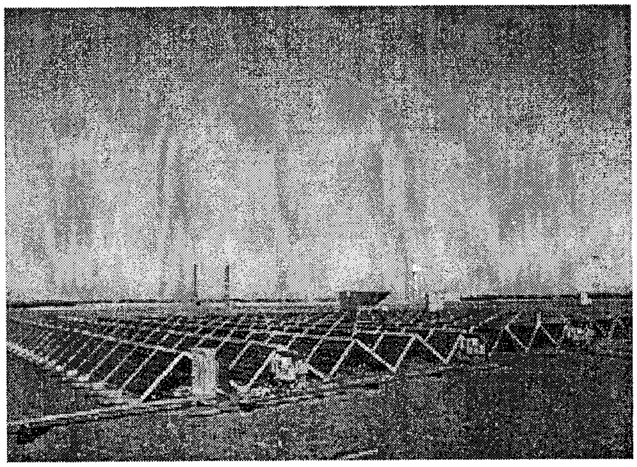

Photo Credit: Sundial Solar/Minnesota Solar Challenge, Creative Commons

As some states attempt to weaken solar crediting policies, Minnesota looks to make them more effective and fair.

by Midwest Energy News, Dan Haugen
March 14, 2014

Minnesota utility regulators on Wednesday approved the nation's first statewide formula for calculating the value of customer-generated solar power.

The Minnesota Public Utilities Commission voted 3-2 in favor of a proposal aimed at settling the perennial debate (http://www.midwestenergynews.com/2013/06/10/minnesota-to-ask-what-is-the-value-of-solar-power/) over how much solar power is worth to a utility and its ratepayers, as well as to society and the environment.

"I think that consensus is really beginning to emerge," said Lynn Hinkle, policy director for the Minnesota Solar Energy Industries Association. "There's no doubt what happened today was a step forward."

Investor-owned utilities will now have the voluntary option of applying to use the value-of-solar formula instead of the retail electricity rate when crediting customers for unused electricity they generate from solar panels.

Utilities have complained that paying the retail rate, under a policy known as net metering, amounts to an unfair subsidy for customers that own solar panels at the expense of those who don't. Meanwhile, solar advocates say the retail rate underestimates the value of solar panels to the grid and to society.

Minnesota Gov. Mark Dayton signed a bill last year requiring the state's energy office to develop a formula that utilities may use to determine how it should compensate customers who generate electricity from solar panels.

'This isn't an incentive'

Wednesday's debate, which follows nearly two years of discussions (http://www.midwestenergynews.com/2013/10/28/minnesotas-day-in-the-sun-for-determining-the-value-of-solar/) among state officials, utility representatives and solar advocates, focused largely on the cost of carbon emissions, of which there were three main options.

One was referred to as the "established externality value" and was created by Minnesota utility regulators two decades ago as a tool to help the commission evaluate resource options.

The value has been updated for inflation but never fully reevaluated, and the commission recently agreed with environmental groups that the numbers are "outdated and no longer scientifically defensible (http://www.midwestenergynews.com/2014/02/20/coal-giant-peabody-energy-enters-minnesota-pollution-debate/)."

Another was referred to as the "planning value" and was created in recent years to help Minnesota utilities and regulators estimate the likely cost of complying with future carbon regulations. That number doesn't reflect the cost to society in health or environmental damages from carbon, something the Minnesota law requires to be included in the formula.

Instead, the commission voted to adopt the federal government's social cost of carbon (http://www.epa.gov/climatechange/EPAactivities/economics/scc.html) figure, which environmental groups and the state's Department of Commerce argued was the best fit for a value-of-solar formula.

"The social cost of carbon is specifically focused on measuring what is the economic and health damage of emitting one more ton of carbon," said Erin Stojan Ruccolo, director of electricity markets for Fresh Energy.

Commissioner David Boyd, one of the two dissenters, said he objected because the social cost of carbon hasn't been thoroughly vetted by the utilities commission. He preferred one of the state-studied numbers.

"For me, this is a deal-breaker. I won't vote for this methodology with that in there." Boyd said. "It's not the number. It's the process."

Commission Chair Beverly Jones Heydinger, however, countered that it isn't fair to describe the social cost of carbon as unvetted, noting the extensive and open federal process that was involved in developing it.

"It's hardly a number that was picked out of thin air," Jones Heydinger said.

Another "no" vote came from Commissioner Betsy Wergin, who said that other than "a pretty miniscule number" of residents who own or plan to own solar panels, "the rest of ratepayers were really not at the table." She also said she was unconvinced that the formula wouldn't amount to a subsidy for solar.

Commissioner Nancy Lange restated the state energy office's position: "This isn't an incentive. This isn't designed to be a prop-up for the solar industry."

How the formula works

Bill Grant, Minnesota's deputy commissioner for energy, said the objective was to find a formula that accurately reflected all of the costs and benefits to all parties involved, including utilities, solar owners and other ratepayers.

"The goal as I see it with the value of solar is to find that point...at which everyone should be indifferent about whether this rate is imposed or not," Grant said.

The methodology for calculating a value-of-solar tariff will be the same for any utility that wishes to propose one, but the end rate will vary depending on circumstances specific to each utility's load and generation mix.

Grant said it isn't a "foregone conclusion" that the value-of-solar rate will be higher than the retail or avoided cost rates. It might, but it might not, he stressed.

The state law tasked the Commerce Department with proposing a tariff design to the utilities commission earlier this year, after which the board had 60 days to approve it or not.

"We believe that the methodology we've put in front of you really is plug-and-play." Grant said, adding that there shouldn't be need for utilities or the department to develop additional formulas or spreadsheets when a utility applies to create a value-of-solar tariff.

Utilities' testimony over the last two months has been skeptical and questioned the department's methodology in some areas, including the cost of carbon.

Minnesota's community solar gardens (http://www.midwestenergynews.com/2014/02/21/minnesota-closer-to-terms-on-community-solar-gardens/) law says that participants in those shared solar projects should be reimbursed at the value-of-solar rate. Beyond that, the tariff's adoption is voluntary.

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Editor's note: This article is reposted (http://www.midwestenergynews.com/2014/03/12/minnesota-becomes-first-state-to-set-value-of-solar-tariff/) from Midwest Energy News (http://www.midwestenergynews.com/). Author credit goes to Dan Haugen.

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Midwest Energy News

VALUE AND COST OF DISTRIBUTED GENERATION
(INCLUDING NET METERING)
DOCKET NO. E-00000J-14-0023

EXHIBIT
RUCO-2
ADMITTED

DIRECT TESTIMONY
OF
LON HUBER

ON BEHALF OF THE
RESIDENTIAL UTILITY CONSUMER OFFICE

FEBRUARY 25, 2016

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EXECUTIVE SUMMARY

RUCO believes that this proceeding should develop a methodology for measuring the benefits and costs of DG that can be applied in a customized manner for each Arizona utility. This would be similar in some ways to the cost effectiveness tests currently used for energy efficiency programs. As part of this methodology, RUCO supports measuring benefits and costs over a 20-year time horizon. To balance against any uncertainty this forward-looking assessment brings, the methodology and categories of values included should be approached conservatively and narrowly.

Ultimately, RUCO thinks the respective results from utilizing this methodology should inform rate design, including several upcoming rate proceedings. Over time, the method can also be used in other forums, discussions, and policy considerations. The natural evolution of how these results can be integrated into current and future proceedings, is yet to be determined, but RUCO envisions some steps happening in quick succession while others occurring over a longer time period. The first step of implementation after establishing a methodology should be to find the level of compensation needed to deliver a cost-neutral value proposition for non-solar ratepayers in each utility service territory. This should be quickly followed by an exploration into the ability for the market to handle moving beyond a breakeven transaction, thereby providing increased value to non-solar ratepayers. Next, the Commission could examine other possible compensation mechanisms for distributed solar that can maximize value to all ratepayers. Finally, the discussion could address distributed solar procurement targets and how to link these to the IRP process. In this setting, the relative costs and benefits of different renewable energy technologies can be compared and the most efficient path to reaching a specific policy goal can be determined. In fact, RUCO could envision adapting the framework accepted in this proceeding to a broader class of distributed energy resources like battery storage.

I. APPLICATION OF VALUE AND COST OF DG TO FUTURE RATEMAKING PROCEEDINGS

Q. This proceeding concerns the value and cost of distributed generation (DG). What is RUCO's understanding of the term "value" in this context?

A. Generally speaking, value describes the direct and indirect monetized benefits minus the monetized costs (or "net benefits") experienced by an individual or group of individuals (e.g. ratepayers). In this case, the value being considered is the value derived from the production of energy from DG resources. Nearly 97% of all residential ratepayers are non-DG customers, thus, RUCO is primarily concerned with the value these non-DG customers receive.

Q. What does "cost" mean from RUCO's perspective?

A. While there are many possible definitions of cost, RUCO is primarily concerned with the costs to serve DG customers that are paid by non-DG customers. This includes any compensation paid to DG customers through net metering, incentives or other mechanisms.

Q. What should the purpose of this proceeding be?

A. RUCO agrees with Commissioner Little's statement: "Any recommended order should focus on methods and process and should not be assigning costs or values to be used in future ratemaking proceedings."

Q. Does RUCO believe that future ratemaking proceedings should be informed by the methods and process established in this proceeding?

A. Yes.

Q. Is cost the only standard that should govern future ratemaking proceedings?

A. No. As Bonbright points out, many economists have argued that "a reasonable rate is one intermediate between cost of production as the lower limit and value of the service as the upper limit, the precise point being set by practical considerations rather than by any scientific rule of ratemaking."[1] RUCO agrees with this concept and believes the Commission should strive to find solutions that maximize value to all ratepayers.

Q. Do commissions generally consider value in ratemaking proceedings?

A. Yes. Bonbright goes on to say that "the examples of value-of-service pricing embedded in the structure of rates are numerous."[2] However, he also argues that "[value-of-service standards] play important though subordinate roles [to cost] in the modern theory and practice of rate regulation."[3] RUCO tends to agree. Value should be a consideration but the amount one pays should be as cost based as possible. However, RUCO recognizes that procurement and compensation of customer sited resources necessitates a hybrid approach due to administrative challenges among other things.

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[1] Bonbright, et al. *Principles of Public Utility Rates, 2nd Ed.*, page 125.
[2] *Ibid*, page 126.
[3] *Ibid*, page 137

Q. Has this Commission ever considered value in other proceedings related to ratemaking?

A. Yes. For example, in Decision No. 73130, the Commission concluded that APS demonstrated the "unique value" of its proposed purchase of Four Corners Units 4 and 5, which included "substantial economic benefits to the Navajo Nation and surrounding communities, the acceleration of lower emissions that will result in environmental improvements, and maintaining the balance of APS' diverse resource portfolio for the benefit of ratepayers."

Q. What then is the purpose of assigning costs or values to DG in future ratemaking proceedings?

A. The value (i.e. benefits minus costs) assigned to DG defines the range of possible compensation levels for DG (through a combination of rates, incentives, and/or other mechanisms) that can be assumed to be reasonable and in the public interest.

Q. Do future rates need to compensate DG at the assigned value?

A. Not necessarily. RUCO sees this as a policy decision for the Commission to consider. In RUCO's view, the ultimate goal should be to pay a rate that is closer to the initial installation cost while still maintaining a healthy DER market sector for Renewable Energy Standard compliance.

Q. Are there additional policy issues that might be considered when deciding the level of DG compensation?

A. Yes, there are several. Regulation of public utility rates is intended to be a substitute for competition. Thus, RUCO believes that the rates the Commission sets should be designed to help to maintain a highly competitive and innovative DG marketplace for the benefit of DG and non-DG customers alike. Additionally, RUCO believes that nearly all of the benefits that DG solar could provide to utility customers can also be provided by utility-scale or community solar. Recent reports indicate that utility scale solar can cost as little as 3.7 cents per kWh.[4]

Community scale solar projects connected within the distribution system can also be relatively inexpensive, with one recent example costing as little as 8 cents per kWh.[5] In contrast, solar energy from DG customers are paid at retail rates, which are typically 11-13 cents per kWh.

Q. Does this suggest that all investments made by utilities in solar should be utility-scale?

A. Not necessarily. Presuming that both DG solar, utility-scale solar, and community scale solar all provide net benefits to customers, then it would still make sense to invest in each of these options. However, RUCO believes there should be heavy consideration of how to optimally spend ratepayer money across the range of possible solar solutions. As a hypothetical example, one could assume that the ratio of benefits to cost for a typical community scale solar project is 3:1, while the ratio for a typical DG solar project is 2:1. In this case both are good investments that will yield net benefits for ratepayers. However, assuming a fixed budget, investing more heavily in community scale projects than DG projects will yield greater benefits to customers.

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[4] https://cleantechnica.com/2016/02/23/palo-alto-california-approves-solar-ppa-hecate-energy-36-76mwh-record-low/

[5] http://www.utilitydive.com/news/tesla-battery-storage-tapped-for-texas-first-community-solar-project/405690/

Q. To what extent should intangible benefits be considered?

A. DG can provide intangible benefits that may not be readily quantified and/or quantified with sufficient accuracy. Some of these include providing customers with additional energy choices, economic benefits and environmental benefits (e.g. lower water consumption by the power sector). The Commission could choose to support DG to provide these benefits as a policy matter but not in ratemaking.

Q. How then should any value assigned to DG via the methodology established in this proceeding be used to inform future rate proceedings?

A. The Commission should first consider the current level of compensation for DG. If the value ultimately assigned to DG is lower than the current level (i.e. DG is not cost-effective), then the Commission should develop a reasonable and gradual transition path towards that lower value. Even if the value the Commission ultimately assigns to DG is higher, the Commission should set rates that encourage increased cost effectiveness for DG installations (i.e. $/kWh of energy produced). In either case, the overarching goal is to apply some form competitive price pressure on DG compensation for the benefit of all ratepayers.

II. THE CHANGING VALUE PROPOSITION OF DG SOLAR

Q. How was the value and cost of solar considered in the development of the current net metering tariffs?

A. RUCO's understanding is that the original net metering tariffs were designed partly to encourage a new market for distributed generation which largely did not exist at the time. For example, Decision No. 69877, Finding of Fact 9 states "Net metering provides a financial incentive to encourage the installation of DG, especially renewable resources." Additionally, the costs to serve net metering customers were assumed to be roughly offset by the benefits they provided to the grid. For example, Decision No. 70567, Appendix C, Para. 2. states: "The public at large would benefit from Net Metering since it would encourage more of the electricity produced in Arizona to be generated from renewable resources and high-efficiency facilities."

Q. Over the past several years the cost of PV panels has declined significantly. Does the declining cost of panels affect the value proposition? If so, how?

A. Yes, however, the change in the value proposition depends on which perspective is assumed.

Q. How has the value proposition changed for customers that adopt PV?

A. For a customer purchasing PV panels, the value proposition would likely have improved due to the lower purchase price. For a customer leasing PV panels, the value depends upon the contract price offered by the leasing company, which may or may not reflect changes in panel prices.

Q. Do you have any examples of how contract prices have changed over time relative to installation costs?

A. Yes. In its most recent earnings report, SolarCity reported that installation costs for new system fell from $3.25 at the start of 2014 to $2.71 per watt at the end of 2015.[6] In contrast, first year contract prices were actually higher in 2015 than in 2014.

[6] http://investors.solarcity.com/common/download/download.cfm?companyid=AMDA-14LQRE&fileid=874112&filekey=0E1F3F06-1EE6-449C-A6D6-9B39E58FC62C&filename=SolarCity_4Q15_Earnings_Presentation_FINAL.pdf

Q. How has the value proposition changed for non-DG customers?

A. For all customers (including non-DG customer) the theoretical value proposition of solar PV has improved relative to other possible generation resources since procurement costs have declined along with panel prices. This is true for both distributed and utility-scale solar. However, the actual value to non-DG customers of "procuring" distributed PV as a resource depends upon the compensation being provided to DG customers by the utility. This in turn depends upon the underlying rate structure (through which compensation is currently provided via net metering), plus any incentives. In the previous era of incentives, the value of DG to non-DG customers gradually improved as incentive prices gradually declined to zero. Since then the value proposition has remained largely unchanged, except for the adoption of the Grid Access Fee.

Q. Is it appropriate to factor the cost of the panels into the reimbursement rate for net metering? If so, how?

A. Not necessarily. Panels are only one component of the overall cost to install distributed PV, which also includes customer acquisition, O&M, and tax credits.

Q. Would it be appropriate to consider the overall installation cost of distributed PV?

A. It may be appropriate, depending on the Commission's policy goals. If the Commission's goal is to improve the cost-effectiveness of DG (which RUCO supports), then one option might be to set a rate of DG compensation that somehow tracks changes in installation costs – ideally declining stepwise over time as installation costs decline. This in turn would help to minimize any non-DG ratepayer costs of distributed PV over time.

Q. Is there room for further declines in PV installation costs?

A. RUCO believes so. According to a recent study by Lawrence Berkeley National Lab, "U.S. installed prices are high compared to many other major markets, particularly with respect to Germany, China, and Australia."[7] This is attributed primarily to differences in soft costs of DG installation.

Q. What does RUCO conclude from this study?

A. RUCO concludes that there is still room for improvement in the U.S. to drive down installation costs. Ideally, lower installation costs would lead to lower DG prices for adopting customers as well as the possibility to step down DG compensation over time for the benefit of non-DG customers.

III. METHODOLOGY FOR DETERMINING VALUE AND COST

Q. What attributes should be considered when selecting a methodology to assign cost and value to DG?

A. RUCO believes that any methodology applied by the Commission to assign cost and value to DG should include the following attributes: 1) independence, 2) transparency, 3) accessibility, and 4) ability to change over time.

Q. Please explain what RUCO means by each of these attributes.

A. 1) Neutrality: the Commission's methodology should strive to be unbiased and not be unduly favorable to either utilities or DG providers.

2) Transparency: all inputs, assumptions, and calculations should be clearly described and explained.

[7] https://emp.lbl.gov/sites/all/files/lbnl-188238_2.pdf

3) Accessibility: the cost-benefit calculation should be made available to the public in the form of an electronic spreadsheet that is published on the Commission's website. RUCO suggests that this spreadsheet could be developed in this proceeding with generic, indicative values that are not related to any specific utility.

4) Ability to change: inputs and assumptions used in the calculation should change periodically over time as conditions change.

Q. Are there any threshold questions the Commission must answer before selecting a methodology to calculate cost and value?

A. Yes. The Commission must decide what perspective(s) should be included and prioritized when evaluating the overall costs and benefits of DG.

Q. What possible perspectives could be considered when evaluating the overall costs and benefits of DG?

A. Cost and benefits from DG can be considered from multiple perspectives, including 1) the DG-adopting customers, 2) non-DG customers, 3) the utility (i.e. all ratepayers), and 4) the total economy. These perspectives are similar to those established through the traditional Demand Side Management (DSM) cost-effectiveness tests.

Q. Does the Commission already use any of these cost-effectiveness tests?

A. Yes, the Commission uses the Societal Cost Test to evaluate the cost-effectiveness of utility DSM portfolio investments. This test takes the perspective of the total economy.

Q. Which perspective(s) does RUCO recommend that the Commission consider in the proceeding for evaluating costs and benefits of DG?

A. RUCO recommends that the Commission consider the cost and benefits of DG from each of these perspectives, however it should prioritize one perspective for ratemaking proceedings that relate to DG.

Q. Which perspective should be prioritized for ratemaking purposes?

A. RUCO believes the value assigned for ratemaking purposes should be limited to the costs and benefits from the perspective of non-DG customers, which make up the majority of residential ratepayers. It is also important to understand that this method assumes that utilities are entitled to recover fixed costs that have already been authorized by the Commission. Thus any reduction in utility revenues from DG are assumed to be made up through future price increases to non-participants (e.g. through adjustors such as the LFCR or in future rate increases approved by the Commission).

Q. Why not just use the Societal Cost test for DG like Energy efficiency?

A. DG, and rooftop solar in particular, has many attributes that differ from energy efficiency. RUCO believes these differences are substantial enough to warrant the use of a different evaluation approach. These differences are explained below:

1. **Less Accessibility** -- Generally speaking, DG solar is not accessible to customers that are renters, have structural impediments, or live on fixed incomes. Thus, not all customers have an equal opportunity to benefit from DG solar. In contrast, every customer has the opportunity to take part in some form of energy efficiency. Cost allocation tensions can arise between DG and non-DG

customers in a way that is not evident with energy efficiency. For this reason, RUCO believes that more attention must be paid to the possibility of cost-shifting than is necessary when considering efficiency programs. This suggests to RUCO that the evaluation approach for DG should have an increased emphasis on the perspective of non-DG customers.

2. **Less Diverse Grid Impacts** - Energy efficiency encompasses a large and diverse set of measures that have different attributes and impacts. Some measures can offset base load energy, some are just on-peak, and others provide a mix of load impacts depending on the customer's habits. In contrast, DG solar has only a handful of configurations and orientations such that each DG system impacts to the grid in a similar way. Solar PV systems, especially in localized areas can mimic each other in ways energy efficiency measure cannot. For instance, when a cloud front comes in all the areas, PV production will decrease. Energy efficiency measures, on the other hand, do not have that type of predictable and sequenced response.

3. **Masking not Reducing** – PV systems mask a customer's load, meaning that if the solar panels stop functioning, for whatever reason, the grid must be available to meet the customer's needs. In a sense, PV hides load from the utility. Energy efficiency measures on the other hand, reduce load, often times permanently. If an Energy efficiency measure fails (e.g. if an appliance malfunctions), the customer load is also reduced. This lack of dependability is important when one considers PV on an aggregated basis.

4. **Can Increase Utility System Cost -** The general production characteristic of solar, aggregated and at high penetrations, can change system wide load shapes to create new demands on the system. Large amounts of solar without batteries can create ramping needs and fast-start backup generation requirements. The diversity and inherent "on the margin savings" attribute of energy efficiency does not yield these effects. Meaning Energy efficiency does not radically reduce load to zero or get exported, rather it reduces load incrementally and broadly throughout the system.

5. **The Benefits are Concentrated** - Solar PV can deliver energy production (e.g. for one high usage customer with a large roof and PV system) that is equivalent to the amount of savings achieved from many households installing energy efficiency measures. In fact, participating solar customers can be net zero users during peak solar hours in a way energy efficiency adopters cannot match. As such, the benefits of DG solar are more concentrated among a smaller group of individuals, whereas for energy efficiency the benefits are spread among a very large and diverse group of participants.

For these reasons, RUCO believes it is more appropriate to evaluate impacts from the perspective of non-DG customers, rather than the total economy.

Q. How specifically should costs and benefits be calculated from the perspective of non-DG solar customers?

A. RUCO agrees with Commissioner Little's statement that the methodology should be "based on locational and production benefits associated with particular DG installations." Additionally, RUCO agrees with Commissioner Little that "The methodology should evaluate DG installations using a levelized cost of electricity calculation, calculated over the useful life of the system." That is, costs and benefits should be represented as the net present value (in dollars) per kWh produced. RUCO recommends levelizing the costs and benefits over twenty years, which is typical lifetime for a solar DG system.

Q. Please summarize the key details of RUCO's preferred analysis framework for determining cost and value of DG solar.

A. RUCO recommends that costs and benefits of DG solar be calculated as follows:

- All DG solar generation is included (both exports and self-consumption)
- Costs and benefits are considered primarily from the perspective of non-DG customers.
- Costs and benefits are calculated as levelized values over 20 years of DG energy production (i.e. LCOE is used).
- The methodology should only include costs and benefits that are easily quantified and focus on categories that are related to the energy system.
- Benefits or costs that are more indirect or speculative in nature (e.g. secondary economic impacts) should be considered qualitatively, but not be calculated in the value methodology.

Q. How should the Commission capture the details of its cost and value methodological framework?

A. The Commission should publish a technical reference manual that explains how costs and benefits are determined and the major assumptions included in each.

IV. COSTS OF DG SOLAR

Q. What cost categories should be included in the Commission's methodology?

A. RUCO recommends the following costs be considered:

- Utility revenues lost from DG solar customers due to DG adoption (with an anticipated annual escalator),
- Incremental utility system costs due to DG solar adoption (e.g. integration costs, administration costs, etc.).

RUCO believes it is important to differentiate between these two costs categories – the first representing sunk costs not caused by DG customers (but could be allocated to them) and the second representing marginal costs caused by DG customers.

Q. What are the most important inputs and assumptions for calculating costs?

A. The most important cost assumption is the change in revenue collected by the utility from the customer before and after the customer installs a DG system.

Q. How should this change in revenue be determined?

A. The change in revenue should be determined by looking at the average customer's contribution to fixed cost revenue compared to that of a DG adopter.

Q. How does the intermittent nature of DG solar affect its value and costs?

A. RUCO believes that variability and uncertainty in solar PV's output can lead to some incremental costs to operate the system. For example, utility system operators may need to hold additional operating reserves to account for unexpected changes in solar energy output. However, RUCO does not believe that these costs are likely to play a large role in the overall value and cost of DG. According to APS' 2012 Solar PV Integration Cost study, the incremental cost of operating reserves needed to maintain reliability with higher penetrations of solar was $0.002/kWh in 2020 and $0.003/kWh in 2030.[8] Only a fraction of this cost would be attributable to DG solar as opposed to utility-scale solar.

Q. Are there technologies that could reduce the intermittency of DG solar?

A. Yes. For example, a customer could install a battery energy storage system in conjunction with DG solar. Note, that such capabilities can be sited on the customer side of the meter, or on the utility side of the meter. It has been shown in other places that storage has the capability to not only reduce intermittency, but can be used to support the grid when not being used for local services.

Q. Should an "intermittency factor" be applied to more accurately determine cost and value?

A. Possibly. To the extent that a device such as a battery storage system could reduce DG output variability, it could lower the incremental integration costs attributable to that system. An "intermittency factor" might be one way to represent the lower integration costs attributable to a particular DG system that also has storage.

Q. Is it possible for DG solar to be more dispatchable?

A. Yes. This is possible through energy storage. It is also possible to some degree with smart inverters, but may require some amount of pre-curtailment.

[8] https://www.aps.com/library/renewables/PVReserveReport.pdf

Q. How does this ability to dispatch or the lack of ability to dispatch affect the value and cost of DG solar?

A. This could increase DG's value by providing additional ancillary services to the utility system.

Q. Will the bidirectional energy flow associated with DG solar require modifications or upgrades to the distribution system?

A. DG solar may reduce distribution system costs in certain circumstances. For example, geo-targeting high value sections of the distribution system with solar DG can yield locational higher than average locational benefits. However, RUCO is aware of some scenarios where costs could be increased. This might occur on circuits with high enough PV penetration that power flows in the reverse direction, leading to the need to upgrade certain protection equipment.

Q. How should the cost of these upgrades be considered when determining the cost and value of DG solar?

A. These costs should be treated similarly to integration costs described above.

Q. Would the required upgrades vary based on location and penetration of DG solar?

A. Yes.

Q. Should the costs for DG installations vary based on these factors?

A. Possibly. However, more information is needed about the frequency of these upgrades and the magnitude of their costs.

V. BENEFITS OF DG SOLAR

Q. To what degree is DG solar energy production coincident with peak demand?

A. DG solar resources can produce some energy during peak demand hours, at least for now. Thus, DG solar provides value in terms for reducing peak demand (i.e. "capacity value").

Q. Does the cost and value of DG solar vary depending on whether or not energy production is coincident with peak demand?

A. Yes. A major category of benefits that DG solar provides is avoided capacity costs. To the extent that DG production coincides with peak demand, it has the potential to defer investments in new capacity resources, thereby avoiding costs for all ratepayers.

Q. Are there policies that the Commission could consider that address this issue?

A. Yes. The Commission could assign a higher value to DG resources producing energy that better coincides with peak hours (i.e. resources that have a higher capacity value). The precise capacity value should be determined by calculating the Effective Load Carrying Capability (ELCC) of the DG resource. It should be noted that DG resources can be combined to increase the ELCC, such as combining storage with solar.

Q. How does the value and cost of DG solar change as penetration levels rise?

A. As the penetration of solar PV increases, peak demand is pushed further into the evening hours, thereby diminishing the capacity value of incremental DG solar (and other PV resources).

Q. How should this be considered in rate making and resource planning contexts?

A. The value of DG should reflect the capacity value as determined by the ELCC calculation. This will adequately incorporate the effect of diminishing capacity value as penetration increases. If capacity values are assigned to individual DG resources, this value should reflect the value at the time the resource was installed and should persist over the life of the asset.

Regarding resource planning, varying levels of DG deployment are typically not analyzed in the IRP process. RUCO believes that the Commission should encourage utilities to analyze differing levels of DG deployment as they develop their IRPs.

Q. Should the fuel cost savings to the utility associated with DG solar be considered in the value and cost determination?

A. Yes. Fuel cost savings are a major category of benefits that DG solar provides.

Q. How do we deal with uncertainty of future fuel prices?

A. Future fuel prices should be estimated based on a forward price curve, such as those used in utility IRPs. If there are additional fuel savings after the period of the forward price curve, a simple escalation rate can be applied.

Q. Does the deployment of DG solar result in changes in the need for transmission capacity? If so, how should those changes be included in the value and cost considerations?

A. Possibly. To the extent that DG solar reduces peak load on the transmission system, it may be able to defer the need to build additional transmission lines. Such deferrals should be considered as a benefit resulting from DG. However, due to the locational nature of this benefit, RUCO believes a conservative approach is needed unless the evidence is highly compelling. That said, transmission savings tied to new generation is more straightforward and should be treated accordingly.

Q. Does the deployment of DG solar result in changes in the need for distribution capacity? If so, how should those changes be included in the value and cost considerations?

A. Possibly. To the extent that DG solar reduces peak load on certain distribution circuits, it may be able to defer the need to perform distribution system upgrades. Such deferrals should be considered as a benefit resulting from DG. However, due to the locational nature of this benefit, RUCO believes a conservative approach is needed unless the evidence is highly compelling.

Q. Based on your testimony thus far, what benefit categories should be included in the Commission's methodology?

A. The primary benefits derived from DG are those related to the avoided costs associated with energy production and delivery. Thus the benefits of DG should mainly include the following categories in relative order of significance:

- Avoided energy costs (including line losses)
- Avoided generation capacity costs (including line losses)

- Avoided transmission system costs
- Avoided distribution system costs

Q. What are the key inputs and assumptions for calculating these benefits?

A. Some of the key assumptions for calculating benefits are as follows:

Benefit Category	Key Inputs and Assumptions
Avoided energy costs (including line losses)	• Fuel price forecast and/or escalation rate • Marginal production cost of energy during hours of DG production • Marginal line losses during hours of DG production • Societal discount rate
Avoided generation capacity costs (including line losses)	• Year in which the next marginal unit of generation capacity is needed • Cost of the next marginal unit of generation capacity • DG capacity value • Marginal capacity losses during hours of DG production • Planning reserve margins • Societal discount rate • Inflation rate • Weighted average cost of capital • Fixed O&M costs (projected in year of capacity need) • Variable O&M costs
Avoided transmission system costs	• Year in which transmission investment is needed • Cost of avoided transmission • DG capacity value

	• Societal discount rate • Inflation rate • Weighted average cost of capital • O&M costs
Avoided distribution system costs	• Year in which distribution investment is needed • DG capacity value • Societal discount rate • Inflation rate • Weighted average cost of capital • O&M costs

Q. What other benefits could be considered?

A. Another benefit that might be considered is off-system sales. To the extent that DG solar frees up utility-owned generation capacity, this capacity could be used to sell electricity to other utilities. These benefits should also be included as part of the value of DG solar. Finally, locational benefits and ancillary service benefits should be part of the framework and quantified when circumstances allow it. For example, future load additions like electric vehicles may bring congestion to certain portions of the distribution system that DG could relieve.

Q. Does RUCO recommend defining the inputs and assumptions in this proceeding?

A. Yes. While numerical values should not be assigned, the Commission should establish how numerical values will be determined for each input and assumption. For data gathering, RUCO suggests first starting in each utility's IRP plan. Any data voids should be estimated and studied as a follow up to this track but should not slow progress in this proceeding.

Q. How does cost and value of DG solar vary based on the orientation of the panels?

A. The orientation of distributed PV panels will affect the output at different times of day. Traditionally, rooftop PV has been oriented due south to maximize overall kWh energy output. Alternatively, solar PV could be oriented to increase output during hours of peak demand (e.g. west-facing). While this would slightly reduce the overall kWh produced, it would also have the effect of increasing the overall capacity value of solar PV.

Q. How would the installation of single or dual axis trackers change the output or efficiency of the DG solar system?

A. Implementing single or dual axis tracking would have a similar effect of increasing output during peak hours (and all other hours as well).

Q. Should this variability be reflected in rates?

A. Capacity value is a major value component when considering any resource addition, including DG. To the extent that westward orientation and tracking systems are able to increase the capacity value of distributed solar, these attributes should be included in the overall determination of a DG system's value. The Commission could then in turn use this information to develop rates that compensate DG systems accordingly.

Q. How is the value and cost of DG solar affected when coupled with some type of storage?

A. The incremental value that storage provides depends on how the stored energy is dispatched. Much like the orientation and tracking systems I described earlier, if storage is dispatched to increase output during the hours of system peak, then it could help to increase the value of DG by increasing the capacity benefit.

Q. Should deployment of storage technologies be encouraged? If so, how?

A. RUCO believes that any compensation scheme for DG resources should strive to be technology neutral and provide compensation based primarily on the value provided to the grid. An appropriate compensation scheme that adequately recognizes this value should, by extension, encourage storage.

VI. ADDITIONAL COST AND BENEFIT CONSIDERATIONS

Q. How does the value and cost of DG solar compare to the value and cost of community scale and utility scale solar?

A. Generally speaking, community and utility scale solar located within the distribution system have been shown to be more cost effective (lower $/W) than DG solar. DG solar may yield some additional benefits in terms of avoided line losses versus utility scale, however these are not anticipated to be large. Favorable costs of utility and community scale solar should not be used to determine that DG solar cannot be cost-effective, or should not be pursued. However, such findings do suggest that other forms of solar may offer some of the same benefits but at a much lower cost. This information should be used by the Commission to determine an overall portfolio strategy that maximizes benefits at the best price.

Q. How do the value and costs of DG solar compare to that of wind or other renewable resources?

A. Other renewable resources can produce similar environmental benefits to DG solar. However, these resources have very different operating profiles than DG solar. Thus, the benefits each resource type provides to the grid is likely to be very different than DG in terms of avoided costs. Moreover, wind and other non-DG renewables are most commonly deployed as utility scale resources. Thus, the costs for these resources would likely be recovered by all utility rate payers in an equal fashion.

Q. How does the value and cost of DG solar compare to that of energy efficiency?

A. As a demand-side resource, energy efficiency has some similarities to DG in that the cost and value can be evaluated from multiple perspectives. In Arizona, energy efficiency is evaluated from the perspective of the total economy through the Societal Cost Test. Energy efficiency programs implemented by utilities in Arizona have generally been very cost effective with benefit to cost ratios exceeding 1.0 in nearly all cases. RUCO is not aware of similar evaluations that have been performed for DG, making a direct comparison difficult to make. As mentioned, one notable difference between energy efficiency and DG is that utility energy efficiency portfolios are designed so that all customers can participate in some type of efficiency measure. In contrast, DG may not be available to all of a utility's customers, and thus the full value of DG may be inaccessible for certain customers. Moreover, the Commission has different policies for DG and energy efficiency which can distort the overall cost picture. The Commission mandates a 4.5% DG carve-out compared to a 20% energy efficiency standard with most measures taking place on the customer's premises just like DG. However, the energy efficiency portfolio requires that measures be tested for cost-effectiveness, while DG solar is not.

Q. Does the cost and value of DG solar vary based on the specific customer location?

A. Yes. However this value potential is highly location-specific and unique to each distribution circuit. For example, under some circumstances, DG solar may be able to defer investments in equipment upgrades on the distribution system that would otherwise be needed to accommodate load growth. In other cases, high penetration of DG solar may lead to reverse power flow conditions that necessitate upgrades to protection equipment. RUCO does not anticipate these costs to be very significant or very common at current DG penetration levels.

Q. Should this variability be reflected in rates?

A. To the extent that utilities are willing and able to share information about their distribution system planning activities, then it may be possible to consider the locational variability of DG's cost and value. In turn, the Commission could use this information to develop compensation mechanisms that reflect this locational variability. RUCO believes it will be important to gather information about these issues in the long run so that they can be reflected in the valuation. However, RUCO believes these factors are less likely to be significant drivers of costs or benefits in the near term compared to other components (e.g. avoided generation and fuel cost) and should not distract from other elements in the valuation process.

Q. How much should secondary economic impacts of DG solar deployment be considered in the value and cost considerations?

A. For the sake of simplicity and rate making, RUCO recommends against attempting to quantify benefits and/or costs related to larger macroeconomic impacts such as job losses or gains.

Q. Do investments in other types of generation technology have similar, greater or lesser secondary economic impacts? If so, how?

A. As with my previous answer, RUCO believes these considerations stretch beyond the scope of this proceeding and should only be considered qualitatively until further information is available.

Q. Does the deployment of DG solar result in a reduction in the use of water in electric generation? How should this be considered when determining DG solar value?

A. Yes. Traditional thermal generation requires significant amounts of water. The costs of this should be reflected in the variable energy costs avoided from DG. Concerns about future water shortages may also be another policy issue for the Commission to consider.

Q. Does this conclude your testimony?

A. Yes.

IN THE MATTER OF THE COMMISSION'S INVESTIGATON OF

VALUE AND COST OF DISTRIBUTED GENERATION

DOCKET NO. E-00000J-14-0023

REBUTTAL TESTIMONY

OF

LON HUBER

ON BEHALF OF THE

RESIDENTIAL UTILITY CONSUMER OFFICE

APRIL 7, 2016

Q. Do you have any major new issues to introduce in your Rebuttal Testimony?

A. No, however, there is one issue area I identified in the testimony of other intervenors that concerns RUCO and I would like to address in this response.

Q. What issue area is of concern to RUCO?

A. RUCO is concerned by the prospect of only examining the value of energy that distributed PV systems export to the grid. Certain parties to this proceeding have advocated that this docket should be limited solely to the value of exported energy, not the full output of the DG system.

Q. What are the implications of examining exports only?

A. Limiting the scope of this proceeding to exports would significantly reduce both the information collected by the Commission and the policy options that the Commission could consider. Moreover, limiting the scope to exports only increases the likelihood that there will ultimately be different compensation levels for energy consumed on site and energy exported to the grid. This is problematic for a variety of reasons.

Q. Please explain some of the reasons this would be problematic.

A. First, RUCO believes that the Commission should have all the data and policy options available to create sound solar policy. Second, by examining exports only, the Commission would be declaring, by implication, that the prevailing retail rate is an appropriate price for compensating a major portion of a PV system's output. In fact, on-site consumption often represents around 50% of a system's production on average. This means that any policy option adopted under an export-only framework will only address one half of a typical PV system's output. In order to address the second half (i.e. self-consumption) the Commission would have to undertake a general rate case. This would create a complex, bifurcated policy framework to address what RUCO believes is a singular policy issue. Furthermore, several stakeholders, including the ACC Staff, have recently taken the position that retail rate design changes, necessitated by a small subset of technology adopting residential customers, should be applied equally to every residential ratepayer (Docket No. E-04204A-15-0142 UNS Energy Rate Case, Direct Testimony of Thomas M. Broderick, Page 1 Line 20). This means that if the Commission seeks to address compensation for the other 50% of a PV system's output it would have to do so in a way that could have significant impacts on hundreds of thousands of ratepayers without solar. Finally, general rate design is a blunt policy instrument with a long timetable for change and is unable to respond quickly or precisely to the rapidly changing circumstances in the DG marketplace. Thus, relegating part of this proceeding to a general rate case thus would forgo the ability to capture additional value from DG that could arise due to near term price declines of DG technologies. Ultimately, this means higher costs for all ratepayers.

Q. Does RUCO believe that changing the rate design for every customer in order to address DG-related issues represents a sensible long-term approach?

A. No. In fact, if the Commission were to apply this approach in subsequent ratemaking decisions, it could undoubtedly lead to very harmful consequences for customers. For example, it is conceivable that within 10 years a solar "plus" storage technology product could become widely available and would be able to erase most of a customer's grid energy consumption except for a few peak summer hours when AC load is the highest. RUCO wonders what the Commission's policy response would be to such a development. For example, one possible outcome consistent with Staff's current approach would be to change every customer's rate plan to have near wholesale pricing for 98% of a year's hours and then charge around $100 per peak day during the summer. While this might work for some customers, this type of pricing would likely be strongly rejected by many customer segments and create financial problems for the Company. Instead, RUCO believes that Arizona should strive to create fair and transparent rate design changes that treat DG customers as a unique customer segment.

Q. Are there other issues with a pricing differential between self-consumption and exports?

A. Yes. First, there is no sound economic or technical justification (at this stage of solar penetration in Arizona) to value self-consumption substantially different than exports. For example, why would self-consumption be compensated at 10 cents/kWh and exports at 5 cents/kWh? While there may be policy reasons for this type of pricing discrepancy, especially when other DG rate options exists alongside it, the electrons are the same and the distances traveled are both likely very short.

Q. Would it generally be good for ratepayers to apply a different approach to valuing exports and on-site consumption?

A. It depends on the specifics; but in general, having a sizable differential in compensation for exports and on-site consumption will make a customer's decision to evaluate solar much more complicated and the saving projections more uncertain. The installer will also have many more hurdles to selling systems. Absent other policy options, this will likely increase the cost of rooftop solar in Arizona.

Q. Please explain the potential difficulties for prospective solar customers in more detail.

A. To begin, the exact timing of when exports occur would become a key consideration. If the compensation price for this energy approximates its value in real-time, then trying to understand the value proposition of solar would be extremely difficult. Long term metering would need to be put in place and if solar was to be installed, the customer would have to be careful in changing usage patterns even if it was a conservation related behavior change. On a monthly basis, it is still somewhat complicated but less so. Under both situations a significant portion of the value proposition of solar would be dependent on an ever changing unknown of customer load patterns.

Q. Are there rate designs that could send appropriate price signals for both on-site consumption and exports, but are easier to understand?

A. Yes. For example, one sensible option would be to use a DG specific seasonal on/off peak TOU rate design. This would send accurate price signals to both exports and self-consumption without being reliant on complicated load metering and export ratio calculations.

Q. If it is more complicated and lacks sound justification, why are some parties proposing to differentiate between self-consumption and exports?

A. Some parties have argued that DG solar is just like energy efficiency and therefore any self-consumption should be treated similarly to an energy efficiency measure.

Q. Is energy efficiency the same as self-consumed distributed generation?

A. Energy efficiency is not the same as distributed generation solar. There are similarities but as my direct testimony stated, starting on page 10, there are key differences. This can manifest both in technology impacts and intra class equities.

Q. Do you have an example to illustrate this difference?

A. Using the methodology published in APS' most recent Technical Reference Manual for Energy Efficiency Programs[1] I calculated that replacing a typical 60W lightbulb with an LED bulb yields approximately 41 kWh of energy savings over the course of a year. Thus, even if a homeowner were to replace <u>every single</u> light in his or her home with a cutting edge LED, it would only yield about 1,858 kWh in total energy savings.[2] This represents only a small fraction (<20%) of the annual energy produced from a typical 6.5 kW rooftop PV system, which I estimate to be about 11,700 kWh per year.[3] Most

[1] http://images.edocket.azcc.gov/docketpdf/0000162231.pdf
[2] Assumes replacement of 45 bulbs, which is the total number of lighting sockets in a typical home.
[3] Assumes a typical rooftop PV system produces 1800 kWh-ac/kW-dc, and is sized at 6.5kW-dc.

importantly, if one of the various 45 bulbs fails, customer load would decrease. In contrast, if a customer's PV system failed, it would cause load to increase substantially.

Q. Does that conclude your testimony?

A. Yes.

ATTACHMENT

Lon Huber
928-380-5540
lonmhuber@gmail.com

EDUCATION

January 2010 – May 2011
Eller College of Management - University of Arizona
Masters of Business Administration (MBA)

August 2005 – May 2009
School of Government & Public Policy - University of Arizona
Bachelor of Science - Public Policy and Management

RELEVANT WORK EXPERIENCE

Strategen Consulting
Director –March 2015 to present

Arizona's Residential Utility Consumer Office (RUCO)
Special Projects Advisor and former consultant – April 2013 to March 2015
- Responsibilities: policy analysis and design, advocacy, case testimony, constituent outreach, and financial analysis.
    - Team lead on net metering, utility-owned rooftop solar, and new resource procurement policies.

Suntech America
Manager, Regional Policy – September 2011 to December 2012
- Point person for the company in every key state solar market except California.
    - Worked to balance cost effective utility-scale solar with state distributed generation policy goals.
    - Elected by SEIA member companies to be the state lead in Arizona.

TFS Solar
Government Affairs – September 2010 to September 2011
- Created a solar financing program for faith based organizations in Tucson.
- Instrumental in forming the Southern Arizona Solar Standards Board.
- Advocated for polcies in front of ACC.

Arizona Research Institute for Solar Energy at the University of Arizona
"Founding employee" and Policy Program Associate – August 2007 to September 2010
- Helped build the institute while gaining experience with the technical attributes and challenges of various energy technologies.

Lon Huber
928-380-5540
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Congressional Fellow – D.C.

January 2009 to May 2009

- Responsibilities included weekly memos to the Congress member on energy issues, forming energy related legislation (Solar Schools Act - H.R. 4967), and creating educational presentations on energy.

COMMUNITY INVOLVEMENT

- Appointed to the Arizona Governor's Solar Task Force, 2013
- Chairman - Southern Arizona Regional Solar Partnership at the Pima Association of Governments, 2011
- Founding Chairman - University of Arizona Green Fund, 2010 to 2011
- Member of UA President's Campus Sustainability Advisory Board, 2008 to 2011
- Big Brother for a child in special needs program - Tucson Big Brothers Big Sisters, 2006 to 2008

AWARDS AND HONORS

- *Arizona Daily Star's* "40 Under 40" winner for leadership, community impact, and professional accomplishment, 2011
- University of Arizona Honors College Young Alumni Award Winner, 2011
- Outstanding Professional Staff Member – University of Arizona, 2010
- Arizona Foundation Outstanding Senior Award for the Eller College of Management, 2009
- Honors College Pillars of Excellence Award, March 2009
- Congressional Recognition Award, May 2008

BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS

DOUG LITTLE, Chairman
BOB STUMP
BOB BURNS
TOM FORESE
ANDY TOBIN

EXHIBIT
GCSECA-1
ADMITTED

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF VALUE AND COST OF DISTRIBUTED GENERATION	**DOCKET NO. E-00000J-14-0023**

DIRECT TESTIMONY OF DAVID HEDRICK

ON BEHALF OF

GRAND CANYON STATE ELECTRIC COOPERATIVE ASSOCIATION, INC.

FEBRUARY 25, 2016

TABLE OF CONTENTS

BACKGROUND AND PURPOSE

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is David W. Hedrick, and my business address is 5555 North Grand Boulevard, Oklahoma City, Oklahoma 73112-5507.

Q. BY WHOM ARE YOU EMPLOYED, AND WHAT IS YOUR POSITION?

A. I am employed by Guernsey Engineers, Architects and Consultants. I am Senior Vice-President and Manager of the Analytical Services group.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND WORK EXPERIENCE.

A, I have earned a Bachelor of Science degree from the University of Central Oklahoma in mathematics and a M.B.A degree from Oklahoma City University. I have been employed with Guernsey since 1981. My primary area of responsibility is rate analysis and cost of service work for electric distribution cooperatives and electric generation/transmission cooperatives. Attached hereto as Exhibit DWH-1 is my resume with a listing of the projects and clients with which I have been involved.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE REGULATORY COMMISSIONS?

A. Yes. I have testified before the Arizona Corporation Commission, the Arkansas Public Service Commission, the Colorado Corporation Commission, the Oklahoma Corporation Commission, the Public Utility Commission of Texas, and the Wyoming Public Service Commission.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS MATTER?

A. I am testifying on behalf of Grand Canyon State Electric Cooperative Association, Inc. ("GCSECA").

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. My testimony provides GCSECA's position regarding the cost of solar distributed generation on its electric distribution cooperative members (the "Cooperatives").[1] My testimony will address:

a. The impact of Distributed Generation ("DG") and Net Metering on the Cooperatives;
b. The Cooperatives' Avoided Costs and the fact that their wholesale capacity costs are not reduced as a result of solar DG;
c. The lack of reduction in the Cooperatives' distribution costs as a result of solar DG;
d. The negative impact of DG on the Cooperatives is more significant than for other utilities;
e. The development of charges and/or credits for DG should be based on the same criteria used to develop the rates and charges for other customers;
f. Programs to mitigate the costs of DG should be fair and equitable to all customers; and
g. Legislation and other authoritative materials regarding the costs and benefits of solar DG.

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[1] GCSECA's electric distribution cooperative members include Duncan Valley Electric Cooperative, Inc.; Garkane Energy Cooperative, Inc.; Graham County Electric Cooperative, Inc.; Navopache Electric Cooperative, Inc.; Mohave Electric Cooperative, Inc.; Sulphur Springs Valley Electric Cooperative, Inc.; and Trico Electric Cooperative, Inc.

IMPACT OF DG AND NET METERING

Q. PLEASE PROVIDE AN OVERVIEW OF THE IMPACT THAT DG INSTALLED BY MEMBER CONSUMERS HAS ON THE COOPERATIVES AND THEIR MEMBERS.

A. The Cooperatives deliver electric service to their members using extensive distribution systems. Their distribution systems consist of electric facilities built to serve the total capacity of the electric load and customer-specific electric facilities that are required to provide service regardless of how much energy is consumed. The capacity-related facilities include substations, a portion of the overhead and underground lines, and a portion of the transformers. The customer-related facilities include a portion of the overhead and underground lines, a portion of the transformers, the service lines, and the meters. The costs of providing service associated with both the capacity- and customer-related facilities are fixed in nature. That is, these costs do not vary based on the amount of energy (kWh) consumed by the Cooperatives' members. While a customer density per mile of line will lessen the average per customer cost of these facilities, the Cooperatives have relatively few customers per mile of line. Most of the Cooperatives were formed in rural areas where the densities and operating margins were deemed too small to attract the necessary capital investment from investor-owned utilities ("IOUs") or even any nearby municipal utility. As a result, the number of customers per mile of line for the Cooperatives tends to be significantly lower and the fixed investment per customer significantly higher than most IOUs.

In addition to the fixed distribution costs of providing service, the Cooperatives also incur fixed wholesale capacity costs to provide electric service to their members from their wholesale power suppliers. These costs are associated with existing generation facilities that ensure the ability to provide continuous service to members. These fixed costs do not vary and are represented in a fixed charge billed by the wholesale suppliers.

Historically, the Cooperatives have recovered the costs of providing service to Residential members through rates that include a monthly service availability charge and an energy charge applied to the monthly kWh consumption. The monthly service availability charges approved by the Arizona Corporation Commission have historically been set at amounts well below the total customer-related cost of providing service per customer. The energy charges have historically been designed to recover the remainder of costs to provide service not included in the service availability charges (which include a portion of the customer-related costs, all of the fixed distribution demand costs, the fixed wholesale demand costs, and the variable energy costs).

This rate design recovers a major portion of the fixed costs in the variable component of the rate. It can function well for the recovery of costs where all of the customers being served in the Residential rate class are similar consuming entities receiving all or most of their energy from a single utility. However, this rate design does not provide for the appropriate recovery of the costs incurred in providing service to customers that have solar DG facilities.

Customers that install DG facilities will reduce the energy (kWh) that is purchased from the Cooperatives by an amount equal to the generation output of their facility.

This reduction in kWh purchased from the Cooperatives results in a loss of fixed costs being recovered through the energy component of the rate. The fixed distribution demand and customer costs that the Cooperatives incur to provide service are similar for all Residential customers, whether they have DG or not. These fixed distribution demand and customer costs incurred by the Cooperatives are not reduced as a result of the installation of DG. Yet, because of the existing rate structure and the reduction in kWh purchased by the DG customers, the fixed costs included in the energy component of the rate are not recovered. As a result, the Cooperatives' customers with DG do not pay the appropriate fixed demand and customer costs for the provision of electric service, while the remainder of customers pay more than their equitable share of those costs. The installation of DG initially results in recovery of less revenue than the existing rates were designed to recover. This inadequate recovery of lost fixed costs and under-recovery of authorized revenues must ultimately be recovered either from customers with DG or from all of the Cooperatives' remaining customers with consumption.

Q. ARE MEMBERS WITH DG CONTINUING TO UTILIZE THE GRID FOR SERVICE?

A. Yes. Members of the Cooperatives may believe that if their net power flow is zero that they are not using the grid. This is simply not true. First of all, those with DG systems don't produce power all of the time. When they are producing in excess of their own needs, the excess energy is put back on the grid. The Cooperatives' systems then serve essentially as a battery to provide energy when the DG customers are not producing power sufficient to meet their load requirements.

It is important to understand that the grid provides much more than power. The grid services that the Cooperatives and other utilities provide include reliability, reserves, frequency control, voltage control, and redundancy as physical quantities flowing through the grid. Members may have net zero power flows, but reliability is flowing into the members, and none is flowing out: not a net zero. Voltage control is flowing into the members, and none is flowing out: not a net zero. Frequency control is consumed by the members, and none is provided by the members: not a net zero. In short, while members may have reached a "net zero" threshold on energy (kWh), they are a large net negative on very expensive grid services that everyone else has to pay for. Stating that you don't use the grid because you are net zero is like saying, "I drive the same road to and from work each day, so I net zero mileage on the road and, therefore, I don't use the road."

Q. WHAT ARE "LOST FIXED COSTS" RELATED TO DG?

A. The energy charge in the Cooperatives' Residential rates include three cost components: purchased power demand costs, purchased power energy costs, and distribution wires costs. The purchased power demand costs and distribution wires costs are fixed costs that do not vary based on kWh consumption and are not reduced as a result of a member's reduced consumption, even though these costs are recovered in the energy charge of the Residential rate. Therefore, as energy consumption is reduced due to installed DG, these fixed costs are no longer recovered from these consumers. These costs not recovered from members with DG are known as "lost fixed costs."

Q. WHAT IS THE MAGNITUDE OF THE UNRECOVERED FIXED COSTS?

A. The impact on the various Cooperatives differs according to their member profile and specific costs. But, I do have two examples that demonstrate the impact. Exhibit DWH-2 provides a calculation of the lost fixed costs resulting from service provided to Residential members with DG under Sulphur Springs Valley Electric Cooperative, Inc.'s ("SSVEC") existing Net Metering Tariff NM-1. At the end of 2014, SSVEC provided service to 1,013 Residential members with DG. The average size of the DG system installed is 5.62 kW (AC) with a capacity factor of approximately 25%. The average monthly production for a unit of this size is 1,026 kWh. Pursuant to its Net Metering tariff, SSVEC must compensate the consumer for the total production from a DG unit at the full retail rate. As a result, every kWh generated by a consumer's DG unit results in the lost fixed costs to SSVEC identified on Exhibit DWH-2. The average monthly lost fixed costs associated with the purchased power demand costs is $43.85 44.61 DK per customer under the existing Residential rate. The average monthly lost fixed costs associated with distribution wires costs is ~~$49.85~~ 49.05 DK per customer under the existing Residential rate. The total average monthly lost fixed cost is ~~$93.70~~ 93.66 DK per customer. The estimated lost fixed costs for SSVEC's 1,013 customers for an annual period under the existing Residential rate would, therefore, be $1,139,013. $1,138,652 DK

Exhibit DWH-2.1 provides a calculation of the lost fixed costs resulting from service provided to Residential members with DG under Trico Electric Cooperative, Inc.'s ("Trico") existing Net Metering Tariff. At the end of 2014, Trico provided service to 1,262 Residential members with DG. The average size of the DG system installed is 6.51 kW (AC) with a capacity factor of approximately 25%. The average monthly production for a unit of this size is 922 kWh. Pursuant to its Net Metering tariff, Trico must compensate the consumer for the total production from a DG unit at the full retail rate. As a result, every kWh generated by a consumer's DG unit results in the lost fixed costs to Trico identified on Exhibit DWH-2.1. The average monthly lost fixed costs associated with the purchased power demand costs is $45.57 per customer under the existing Residential rate. The average monthly lost fixed costs associated with distribution wires costs is $37.77 per customer under the existing Residential rate. The total average monthly lost fixed cost is $83.34 per customer. The estimated lost fixed costs for Trico's 1,262 customers for an annual period under the existing Residential rate would, therefore, be $1,262,079.

Q. WHAT IMPACT DOES ARIZONA'S EXISTING NET METERING POLICY HAVE ON THE COOPERATIVES?

A. The existing Net Metering policy is found in Arizona Administrative Code R14-2-2306, which provides as follows:

> A. On a monthly basis, the Net Metering Customer shall be billed or credited based upon the rates applicable under the Customer's currently effective standard rate schedule and any appropriate rider schedules.
>
> B. The billing period for Net Metering will be the same as the billing period under the Customer's applicable standard rate schedule.
>
> C. If the kWh supplied by the Electric Utility exceeds the kWh that are generated by the Net Metering Facility and delivered back to the Electric Utility during the billing period, the Customer shall be billed for the net

kWh supplied by the Electric Utility in accordance with the rates and charges under the Customer's standard rate schedule.

D. If the electricity generated by the Net Metering Customer exceeds the electricity supplied by the Electric Utility in the billing period, the Customer shall be credited during the next billing period for the excess kWh generated. That is, the excess kWh during the billing period will be used to reduce the kWh supplied (not kW or kVA demand or customer charges) and billed by the Electric Utility during the following billing period.

E. Customers taking service under time-of-use rates who are to receive credit in a subsequent billing period for excess kWh generated shall receive such credit during the next billing period during the on- or off-peak periods corresponding to the on- or off-peak periods in which the kWh were generated by the Customer.

F. Once each calendar year the Electric Utility shall issue a check or billing credit to the Net Metering Customer for the balance of any credit due in excess of amounts owed by the Customer to the Electric Utility. The payment for any remaining credits shall be at the Electric Utility's Avoided Cost. That Avoided Cost shall be clearly identified in the Electric Utility's Net Metering tariff.

As discussed above, members with installed DG reduce the energy (kWh) purchased from the Cooperatives and, thereby, cause lost fixed costs to be incurred. Arizona's existing Net Metering policy exacerbates the loss of fixed costs by requiring the Cooperatives to pay (via energy credits) the full retail rate for energy generated by the members, even though the retail rate far exceeds the value of the excess generation. Instead of full retail rates, Avoided Cost rates (discussed below) are the more appropriate form of compensation of excess generation. The current policy of over-compensation for DG energy creates a cost that all members of the Cooperatives must pay. The application of the Net Metering policy in its current form is not equitable.

AVOIDED COST RATE AND WHOLESALE CAPACITY COSTS

Q. WHAT ARE THE COOPERATIVES' AVOIDED COST RATES?

A. Avoided Costs are those costs that are eliminated as a result of power produced by DG resources. The Cooperatives' Avoided Cost rates are calculated based on the wholesale fuel and energy cost per kWh charged by the Cooperatives' wholesale power suppliers.

Q. WHY DO THE AVOIDED COST RATES INCLUDE ONLY THE WHOLESALE FUEL AND ENERGY COSTS?

A. Typically, the Cooperatives do not provide their own generation, but rather contract with third-party generators, such as Arizona Electric Power Cooperative, investor-owned utilities, or other providers for their wholesale power requirements. These existing contracts, which provide the vast majority of power used to serve the Cooperatives' customers, include a fixed charge payment for the cost of generation capacity. This fixed charge payment is constant and does not vary based on consumption. As a result, any potential reduction in capacity requirements created by the operation of DG does not translate into a reduction in generation capacity costs for the Cooperatives. Therefore, there is no capacity component included in the calculation of the Cooperatives' Avoided Cost rates. Only the variable components of the wholesale rate – fuel and energy – are included in the determination of the Avoided Cost rates. To the extent that a DG facility produces kWh that offset the wholesale supplier's delivery of kWh, only the associated fuel and energy costs are truly avoided.

DISTRIBUTION SYSTEM COSTS

Q. ARE THERE QUANTIFIABLE AVOIDED DISTRIBUTION SYSTEM COSTS ASSOCIATED WITH SOLAR DG?

A. The experience of the Cooperatives is that solar DG does not reduce their distribution costs of providing service. Because of the intermittency and lack of reliability of rooftop solar DG, a customer with rooftop solar must still rely on power provided from the electric grid during times when the DG unit is not operating or when the DG unit does not provide sufficient generation to serve the customer's entire load. As a result, the size of the facilities required to provide service to a customer with DG is no different than for a standard customer without DG. This means that the metering, transformer, and service drop at the customer's service location would be the same as for any other similarly situated customer. The sizing of the Cooperatives' substation facilities and overhead/underground primary distribution line facilities are, likewise, unaffected by the presence of rooftop solar DG. The planning process for construction of distribution facilities is affected by solar DG only to the extent that additional equipment and devices are required to address operational issues, such as circuit loading, voltage regulation, power factor problems, and protection coordination. Such equipment could include but not be limited to additional regulators, capacitors, breakers, reclosers, and fuses. The need for additional equipment to deal with operational issues becomes more significant as the number of customers with solar DG on an individual circuit increases.

IMPACT OF DG ON THE COOPERATIVES

Q. DO THE ISSUES RELATED TO THE RECOVERY OF COSTS ASSOCIATED WITH SOLAR DG HAVE A MORE PRONOUNCED IMPACT ON THE COOPERATIVES THAN ON THEIR INVESTOR-OWNED NEIGHBORS?

A. Yes. All utilities share cost recovery issues related to solar DG. However, there are two reasons why the recovery of the distribution costs of providing service to customers with solar DG is a bigger problem for the Cooperatives.

First, the Cooperatives are located in rural areas and, therefore, have a much lower number of customers per mile. As a result, they require a much higher level of plant investment per consumer to provide service. This leads to a higher distribution cost of providing service per kWh. Exhibit DWH-3 reflects the differences in line density and average cost for the more rural Cooperatives in comparison with APS and UNS. This higher level of distribution costs for the Cooperatives means that the level of lost fixed costs created by customers with solar DG is a more significant issue for the Cooperatives. Approving rates and charges that allow for a better recovery of the distribution costs associated with providing service to customers with solar DG is an essential step in ensuring that all customers pay their fair and equitable share of the costs for distribution service.

The second reason that the recovery of the distribution costs for service to solar DG customers is a more significant issue to the Cooperatives is their small size and the fact that the areas served by the Cooperatives are the most economically challenged counties in Arizona. Their small size means there are fewer customers over which to spread any subsidies created by solar DG. Furthermore, customers with lower incomes are less likely to participate in rooftop solar and least able to pay any subsidy caused by the lost recovery of fixed costs from those customers that do deploy rooftop solar.

DEVELOPMENT OF DG CHARGES AND CREDITS

Q. WHAT STANDARD SHOULD BE APPLIED TO DEVELOP THE CHARGES AND CREDITS FOR SOLAR DG?

A. There has been considerable discussion, not only in Arizona, but across the country, regarding methods for quantifying the future benefits of solar DG. It would be appropriate that the same standards used in the development of rates for Arizona utilities be applied in determining the value of solar DG. The primary standard in rate making is that a utility may include for recovery in its rates only those expenses that are known, measurable, and of a continuing nature. In addition, utilities have not been allowed to recover in current rates those costs that are for future periods. The Cooperatives do not have information or data regarding any future generation capacity savings, transmission savings, or environmental savings associated with the implementation of solar DG that would comply with the current rate-setting standard. Therefore, the Cooperatives are concerned by proposals to develop charges and credits for current rates that would be based on a different standard, specifically one that would require recognition of future unquantifiable benefits or potential future quantifiable benefits of solar DG.

PROGRAMS TO MITIGATE DG COSTS

Q. WHAT OTHER CONCERNS DO THE COOPERATIVES HAVE REGARDING THE RECOVERY OF COSTS ASSOCIATED WITH SOLAR DG?

A. The Cooperatives are concerned that programs or plans implemented to mitigate the impacts of solar DG could result in additional costs to all of their members. Discussions have taken place regarding the appropriate means by which to deal with the recovery of lost fixed costs in an equitable manner. One option discussed was the establishment of demand rates for all customers.

For utilities that have interval demand meters in place system wide, properly designed demand rates may provide a means of fixed cost recovery from customers based on how they use the grid. One significant concern with this option, however, is that most of the Cooperatives have demand meters installed and utilize demand rates only for commercial and industrial rate classes. The installation of demand meters and the other necessary communications equipment and software to establish demand rates for all customers would be prohibitively expensive for many of the Cooperatives and take years to implement and, thus, would not address the immediate issues. In addition, most of the Cooperatives have fixed generation costs that do not get reduced by lowering the demand of the individual cooperative. Thus, a demand rate would not result in any fixed cost savings to the cooperative which could be passed on to its members. To the extent the Commission is considering demand rates as one method to address the issues in this docket, it should provide the Cooperatives with flexibility based on each Cooperative's particular circumstances.

NON-ARIZONA AUTHORITIES

Q. ARE THE ISSUES RELATED TO DG CUSTOMERS LIMITED ONLY TO ARIZONA?

A. No. The issues related to DG customers and Net Metering are being addressed across the country. Other state regulatory bodies have developed laws and orders pertaining to the cost issues that are informative. Attached as Exhibit DWH-4 is legislation that was passed in Oklahoma that requires utilities in the state to eliminate subsidies to customers with DG. Specifically, the law states:

> *C. No retail electric supplier shall allow customers with distributed generation installed after the effective date of this act to be subsidized by customers in the same class of service who do not have distributed generation.*
>
> *D. A higher fixed charge for customers within the same class of service that have distributed generation installed after the effective date of this act, as compared to the fixed charges of those customers who do not have distributed generation, is a means to avoid subsidization between customers within that class of service and shall be deemed in the public interest.*

Exhibit DWH-5 is legislation that was passed in Arkansas to amend the requirements for utilities to compensate Net Metering customers. Section 3 of the act directs the Arkansas Public Service Commission to establish rates, terms, and conditions for net-metering contracts, including:

(A)(i) A requirement that the rates charged to each net-metering customer recover the electric utility's entire cost of providing service to each net-metering customer within each of the electric utility's class of customers.

(ii) The electric utility's entire cost of providing service to each net metering customer within each of the electric utility's class of customers under subdivision (b)(1)(A)(i) of this section:

(a) Includes without limitation any quantifiable additional cost associated with the net-metering customer's use of the electric utility's capacity, distribution system, or transmission system and any effect on the electric utility's reliability; and

(b) Is net of any quantifiable benefits associated with the interconnection with and providing service to the net-metering customer, including without limitation benefits to the electric utility's capacity, distribution system or transmission system.

In addition to the legislation passed in Oklahoma and Arkansas, the Wisconsin Public Service Commission has also recently provided comment on DG subsidies. On page 62 of the Order in Docket No. 05-DR-107 (December 23, 2014), the commission states:

As Wisconsin courts have long recognized, rate design is a quintessential legislative function firmly left to the discretion of the Commission. Other substantial state and federal programs are designed specifically to support the development and implementation of conservation and renewable energy resources. The Commission is not required to use rate design as a hidden subsidy for these resources. This Commission continues to support customers who want to own *their own generation; however, the Commission also has an obligation to those customers who do not want to or who cannot afford to own generation to make sure these customers are not subsidizing the costs for those who choose to and are able to own their own generation.*

Q. WHAT ADDITIONAL INFORMATION HAVE YOU PROVIDED FOR CONSIDERATION WITH REGARD TO THE COST RECOVERY ISSUE FOR DG CUSTOMERS?

A. Attached as Exhibit DWH-6 is an article from the December 2014 *Electricity Journal* entitled "Valuation of Distributed Solar: A Qualitative View."[2] The article was written by Mr. Ashley Brown, the Executive Director of the Harvard Electricity Policy Group, former Commissioner of the Ohio Public Utility Commission, and former chairman of NARUC, and Jillian Bunyan, an attorney formerly with the United States Environmental Protection Agency's Office of Regional Counsel. The preface to the article provides insight regarding the content of the article:

> *A critical evaluation of the arguments used by solar DG advocates shows that those arguments may often overvalue solar DG. It is time to reassess the value of solar DG from production to dispatch and to calibrate our pricing policies to make certain that our efforts are equitable and carrying us in the right direction.*

These examples of legislation and commission orders, as well as the *Electricity Journal* article, confirm that (1) there are significant cost recovery issues associated

[2] 1040-6190/© 2014 Elsevier Inc. All rights reserved., http://dx.doi.org/10.1016/j.tej.2014.11.005.

with the provision of service to customers with installed solar DG and (2) the current use of Net Metering is not an effective or equitable means to compensate customers for that excess generation.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes, it does.

guernsey ENGINEERS ARCHITECTS CONSULTANTS

EDUCATION:

M.B.A., Oklahoma City University, 1993
B.S., Mathematics, University of Central Oklahoma, 1986

PERTINENT EXPERIENCE FOR THE PROJECT:

Mr. Hedrick specializes in the development of revenue requirements, cost of service, rate design, line extension analysis, special contract development, pole attachment rates, valuation analysis and other financial analysis for electric, water, and wastewater utility systems. He is also responsible for the preparation of rate filings and has presented expert testimony before state regulators, including Arizona, Arkansas, Colorado, Oklahoma, Texas and Wyoming. Mr. Hedrick's clients include both distribution providers and wholesale providers. He was instrumental in the development of the CoOPTIONS: family of computer software for use in unbundled utility cost of service studies and financial forecasting.

As Manager of the Analytical Solutions Group, Mr. Hedrick has oversight of all studies, analyses and filings that are developed by the group. He continues to represent clients before the appropriate regulatory authority and is responsible for the preparation of rate filings and other analytical studies.

SPECIFIC CONSULTING EXPERIENCE:

Acquisitions, Consolidations & Valuation Analysis

Mr. Hedrick has provided analytical support for consolidation studies in Texas and Wyoming. In addition, he has been involved in the valuation analysis of utility assets for purposes of acquisition and determination of fair market value for clients in Oklahoma and Kansas.

Retail Rate Analysis, Cost of Service Studies, and Line Extension Analysis

Mr. Hedrick's rate analysis and cost of service experience includes the following:

Arizona

- Navopache Electric Cooperative, Inc. – Regulated by Arizona Corporation Commission
- Sulphur Springs Valley Electric Cooperative, Inc. - Regulated by Arizona Corporation Comm.
- Trico Electric Cooperative, Inc. - Regulated by Arizona Corporation Commission

Arkansas

- Arkansas Valley Electric Cooperative Corporation – Regulated by Arkansas PSC and Oklahoma Corporation Commission
- Ouachita Electric Cooperative Corporation – Regulated by Arkansas PSC
- Ozarks Electric Cooperative Corporation – Regulated by Arkansas PSC

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5555 N. Grand Boulevard
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405.416.8157
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david.hedrick@guernsey.us

Colorado

- Colorado Rural Electric Association
- Delta-Montrose Electric Association
- Empire Electric Association, Inc.
- Grand Valley Rural Power Lines
- Holy Cross Electric Association, Inc.
- Mountain Parks Electric, Inc.
- Poudre Valley REA, Inc.
- San Luis Valley Rural Electric Cooperative, Inc.
- Yampa Valley Electric Association, Inc.

Iowa

- Corn Belt Power Cooperative
- Iowa Lakes Electric Cooperative, Inc.
- Midland Power Cooperative, Inc.

Kansas

- Ark Valley Electric Cooperative Association
- Caney Valley Electric Cooperative Association
- CMS Electric Cooperative, Inc.
- Flint Hills Rural Electric Cooperative Association
- Kansas Electric Power Cooperative
- Lyon-Coffey Electric Cooperative, Inc.
- City of Meade
- Ninnescah Rural Electric Cooperative Association, Inc.
- Pioneer Electric Cooperative, Inc.
- Sedgwick County Electric Cooperative Association, Inc.
- Western Cooperative Electric Association, Inc.

Louisiana

- Claiborne Electric Cooperative

Mississippi

- Southern Pine EPA
- Yazoo Valley EPA

Nebraska

- Dawson County Public Power District

New Mexico

- Farmers Electric Cooperative, Inc.
- Lea County Electric Cooperative, Inc.

Oklahoma

- City of Blackwell
- Caddo Electric Cooperative
- Central Rural Electric Cooperative, Inc.

- Choctaw Electric Cooperative, Inc.
- Cimarron Electric Cooperative, Inc.
- Cookson Hills Electric Cooperative, Inc.
- Cotton Electric Cooperative, Inc.
- City of Duncan
- East Central Oklahoma Electric Cooperative
- Indian Electric Cooperative, Inc.
- Kay Electric Cooperative, Inc.
- Kiwash Electric Cooperative, Inc.
- Lake Region Electric Cooperative, Inc.
- City of Mangum
- Northeast Oklahoma Electric Cooperative, Inc.
- Northfork Electric Cooperative
- Northwestern Electric Cooperative, Inc.
- Oklahoma Electric Cooperative, Inc.
- City of Ponca City
- Rural Electric Cooperative, Inc.
- Southeastern Electric Cooperative, Inc.
- Southwest Rural Electric Association
- Tri-County Electric Cooperative, Inc.
- Verdigris Valley Electric Cooperative

Texas

- Bailey County ECA
- Bandera Electric Cooperative, Inc.
- Big Country Electric Cooperative, Inc.
- Bluebonnet Electric Cooperative, Inc.
- Central Texas Electric Cooperative, Inc.
- Concho Valley Electric Cooperative, Inc.
- Cooke County Electric Cooperative Assn.
- CoServ Electric
- Deaf Smith Electric Cooperative, Inc.
- Fannin County Electric Cooperative, Inc.
- Farmers Electric Cooperative, Inc.
- Fort Belknap Electric Cooperative, Inc.
- Grayson-Collin Electric Cooperative, Inc.
- Greenbelt Electric Cooperative, Inc.
- HILCO Electric Cooperative, Inc.
- Jackson Electric Cooperative, Inc.
- Lamar County Electric Cooperative, Inc.
- Lighthouse Electric Cooperative, Inc.
- Lyntegar Electric Cooperative, Inc.
- Magic Valley Electric Cooperative, Inc.
- Medina Electric Cooperative, Inc.
- Navarro County Electric Cooperative, Inc.
- Navasota Valley Electric Cooperative, Inc.
- North Plains Electric Cooperative, Inc.
- Nueces Electric Cooperative, Inc.
- Pedernales Electric Cooperative, Inc.

- Rita Blanca Electric Cooperative, Inc.
- San Bernard Electric Cooperative, Inc.
- South Plains Electric Cooperative, Inc.
- Southwest Rural Electric Association, Inc., Okla.
- Southwest Texas Electric Cooperative, Inc.
- Swisher Electric Cooperative, Inc.
- Taylor Electric Cooperative, Inc.
- Texas Electric Cooperatives, Inc., Statewide Association
- Tri-County Electric Cooperative, Inc.
- Trinity Valley Electric Cooperative, Inc.
- United Cooperative Services
- Wharton County Electric Cooperative, Inc.
- Wise Electric Cooperative, Inc.

Wyoming

- Big Horn REC – Regulated by Wyoming Public Service Commission until 2007
- Carbon Power & Light, Inc. – Regulated by Wyoming Public Service Commission until 2007
- High Plains Power, Inc. – Regulated by Wyoming Public Service Commission until 2007
- Powder River Energy Corporation – Regulated by Wyoming Public Service Commission
- Wyrulec Company – Regulated by Wyoming Public Service Commission until 2007

Wholesale Rate Analysis and Cost of Service Studies

- Corn Belt Power Cooperative, Humboldt, Iowa
- Kansas Electric Power Cooperative, Topeka, Kansas
- Grand River Dam Authority, Vinita, Oklahoma
- Oklahoma Municipal Power Authority, Edmond, Oklahoma
- Western Farmers Electric Cooperative, Anadarko, Oklahoma
- Central Electric Power Cooperative, Columbia, South Carolina
- Piedmont Municipal Power Authority, Greer, South Carolina
- Brazos Electric Cooperative, Waco, Texas
- Golden Spread Electric Cooperative, Amarillo, Texas
- Old Dominion Electric Cooperative, Richmond, Virginia
- Allegheny Electric Cooperative, Harrisburg, Pennsylvania
- South Mississippi Electric Power Association, Hattiesburg, Mississippi
- Minnkota Power Cooperative, Grand Forks, North Dakota
- Rayburn Country Electric Cooperative, Rockwall, Texas

Special Projects

Development of Distributed Generation Procedures and Guidelines Manual:

- Western Farmers Electric Cooperative, Anadarko, Oklahoma
- KAMO Electric, Vinita, Oklahoma
- Texas Electric Cooperatives, Austin, Texas

Energy Policy Act of 2005 / EISA 2007 - Testimony in Support of Cooperative Staff's Position in Consideration of new PURPA Standards:

- Central Rural Electric Cooperative, Stillwater, Oklahoma
- Cotton Electric Cooperative, Walters, Oklahoma
- Farmers Electric Cooperative, Greenville, Texas
- Grand River Dam Authority, Vinita, Oklahoma
- Grayson-Collin Electric Cooperative, Van Alstyne, Texas
- HILCO Electric Cooperative, Itasca, Texas
- Lake Region Electric Cooperative, Hulbert, Oklahoma
- Lyntegar Electric Cooperative, Tahoka, Texas
- Magic Valley Electric Cooperative, Mercedes, Texas
- Northwestern Electric Cooperative, Woodward, Oklahoma
- Oklahoma Electric Cooperative, Norman, Oklahoma
- Tri-County Electric Cooperative, Azle, Texas
- Tri-County Electric Cooperative, Hooker, Oklahoma
- United Electric Co-op Services, Cleburne, Texas

Testimony before Colorado State House and Senate Committees in support of the Colorado Rural Electrification Association with regard to HB1169, Mandating Net Metering for Electric Cooperatives.

The "Fresh Look" review of East Kentucky Power Cooperative on behalf of the cooperative's distribution members as required by the Kentucky Corporation Commission. 2011 - 2012

Education and Training

Mr. Hedrick provides educational seminars and training for cooperative staff and boards of directors, statewide associations, and professional organizations on the topics of Rate Analysis, Cost of Service, Rate Design, Line Extension Policy, and related issues.

Expert Witness

Mr. Hedrick has provided expert testimony related to the development of revenue requirements, cost of service, rate design, and special contract issues in Arizona, Arkansas, Oklahoma, Texas, and Wyoming.

Financial Forecasting & Analysis

Mr. Hedrick prepares and provides training in the development of financial forecast models for electric cooperatives and municipal utility systems.

Software Sales & Support

Mr. Hedrick provided assistance in the development of software for GUERNSEY's 10-year Financial Forecast, Cost of Service, and Financial Performance Analysis programs. Mr. Hedrick is proficient in the use of these software packages and provides support to client users.

Strategic Planning & Analysis

Mr. Hedrick has provided assistance to electric cooperative boards of directors in the development of strategic goals and objectives.

Publications and Presentations:

Articles:

Hedrick, David W. "Retail Rate Development: The Role of the Cooperative Board." *Management Quarterly*, published by NRECA's Education and Training Department. (Spring 2005): 20-35.

Presentations Made by Mr. Hedrick:

"Knowledge is Power: Financial Forecasting." Seminar written and presented by Guernsey personnel annually since 2006 in Oklahoma City, Okla. Mr. Hedrick has been a presenter for this seminar numerous times.

"Knowledge is Power: Understanding Rates and Cost of Service." Seminar written and presented by Guernsey personnel annually since 2005, in Oklahoma City, Okla., as well as other locations. Mr. Hedrick has been a presenter numerous times.

"Distributed Generation Net Metering Issues." Written for and presented at *TEC Engineers Association Annual Meeting*. September 2006.

"Net Metering Issues." Written for and presented at *G&T Planners Association Meeting,* Tucson. Arizona, September 2006.

"Development of Distributed Generation Policies and Procedures." Written and presented for *Texas Electric Cooperatives' Managers Meeting*. San Antonio, Texas, December 2, 2004.

"Rate Design in a Restructured Environment." Written and presented for *Texas Electric Cooperatives Accountants Association*. Austin, Texas, April 19, 2000.

EXPERIENCE RECORD:

1981-Present - C. H. Guernsey & Company, Oklahoma City, Oklahoma

2013 - Senior Vice President, Board of Directors
2008-2013 - Vice President for Guernsey
2005-Present - Manager, Analytical Solutions Group

SULPHUR SPRINGS VALLEY ELECTRIC COOPERATIVE

CALCULATION OF LOST FIXED COST RECOVERY
AS A RESULT OF MEMBER OWNED DISTRIBUTED GENERATION SERVED ON THE RESIDENTIAL RATE
ADMINISTERED IN CONJUNCTION WITH NET METERING TARIFF NM - 1 (EXISTING POLICY)

			Existing Rates
1	Total Residential Energy Charge including WPCA		$ 0.119768
2	Purchased Power Energy Cost included in Residential Rate		$ 0.028450
3	Purchased Power Demand Cost included in Residential Rate		$ 0.043493
	Remainder: Distribution Wires		
4	Component in Residential Energy Charge	L1 - L2 - L3	$ 0.047825
	Lost Fixed Cost Calculation:		
5	Total Residential DG Customers at TY End		1,013
	Monthly kWh Produced by 5.62 kW AC		
6	PV System with 25% Capacity Factor	5.62 kW x 730 Hrs x 25%	1,026
7	Purch Power Demand Lost Fixed Cost - Monthly	L6 x L3	$ 44.61
8	Distr. Wires Lost Fixed Cost - Monthly	L6 x L4	$ 49.05
9	Total Lost Fixed Costs - Monthly	L7 + L8	$ 93.66
10	Total Lost Fixed Costs Annual	L9 x L5 x 12	$ 1,138,552

TRICO ELECTRIC COOPERATIVE, INC.

CALCULATION OF LOST FIXED COST RECOVERY
AS A RESULT OF MEMBER OWNED DISTRIBUTED GENERATION SERVED ON THE RESIDENTIAL RATE

			Existing Rate
1	Energy Charge (Includes WPCA)		$ 0.121161
2	Purchased Power Energy Cost		$ 0.030795
3	Purchased Power Demand Cost		$ 0.049412
	Remainder: Distribution Wires		
4	Component in Residential Energy Charge	L1 - L2 - L3	$ 0.040954
	<u>Lost Fixed Cost Calculation:</u>		
5	Total Residential DG Customers at TY End		1,262
	Monthly kWh Produced by 6.51 kW AC		
6	PV System (Estimated)	Estimated	922
7	PV System kWh Compensated at Full Retail		922
8	Purch Power Demand Lost Fixed Cost - Monthly	L7 x L3	$ 45.57
9	Distr. Wires Lost Fixed Cost - Monthly	L7 x L4	$ 37.77
10	Total Lost Fixed Costs - Monthly	L8 + L9	$ 83.34
11	Total Lost Fixed Costs Annual	L10 x L5 x 12	$ 1,262,079

COMPARISON OF LINE DENSITY AND DISTRIBUTION WIRES COST

	Number of Consumers	Distribution Miles of Line	Consumers Per Mile	Residential Distr. Wires ($/kWh) (3)
Duncan Valley (1)	2,327	453	5.1	
Graham County (1)	8,875	1,098	8.1	$ 0.03183
Navopache (1)	40,042	2,475	16.2	$ 0.03027
Sulphur Springs (1)	52,815	3,765	14.0	$ 0.04740
TRICO (1)	40,242	3,466	11.6	$ 0.03860
APS (1)	1,174,760	29,148	40.3	$ 0.02700
UNS(1)	91,821	2,309	39.8	$ 0.01430
TEP (2)	414,749	7,061	58.7	$ 0.00870

(1) Data for 2014
(2) Data for 2013
(3) Distribution wires cost for a 1,000 kWh customer included in energy charge per tariff

EXHIBIT DWH - 4

An Act

ENROLLED SENATE
BILL NO. 1456

By: Griffin of the Senate

and

Turner, Echols, Jackson, Newell, Schwartz, Murphey, Brumbaugh, Pittman, Rousselot and Fisher of the House

An Act relating to public utilities; amending 17 O.S. 2011, Section 156, which relates to distributed generation costs; defining terms; modifying prohibition relating to recovery of certain fixed costs from electric customers utilizing certain distributed generation; prohibiting subsidization of certain costs among customer class; requiring rate tariff adjustment by certain date; and providing an effective date.

SUBJECT: Electrical power distribution requirements

BE IT ENACTED BY THE PEOPLE OF THE STATE OF OKLAHOMA:

SECTION 1. AMENDATORY 17 O.S. 2011, Section 156, is amended to read as follows:

Section 156. <u>A. As used in this section:</u>

<u>1. "Distributed generation" means:</u>

<u>a. a device that provides electric energy that is owned, operated, leased or otherwise utilized by the customer,</u>

b. is interconnected to and operates in parallel with the retail electric supplier's grid and is in compliance with the standards established by the retail electric supplier,

c. is intended to offset only the energy that would have otherwise been provided by the retail electric supplier to the customer during the monthly billing period,

d. does not include generators used exclusively for emergency purposes,

e. does not include generators operated and controlled by a retail electric supplier, and

f. does not include customers who receive electric service which includes a demand-based charge.

2. "Fixed charge" means any fixed monthly charge, basic service, or other charge not based on the volume of energy consumed by the customer, which reflects the actual fixed costs of the retail electric supplier.

3. "Retail electric supplier" means an entity engaged in the furnishing of retail electric service within the State of Oklahoma and is rate regulated by the Oklahoma Corporation Commission.

B. No ~~public utility~~ retail electric supplier shall increase rates charged or enforce a surcharge ~~on the basis of the use or installation of a solar energy device by a consumer~~ above that required to recover the full costs necessary to serve customers who install distributed generation on the customer side of the meter after the effective date of this act.

C. No retail electric supplier shall allow customers with distributed generation installed after the effective date of this act to be subsidized by customers in the same class of service who do not have distributed generation.

D. A higher fixed charge for customers within the same class of service that have distributed generation installed after the effective date of this act, as compared to the fixed charges of those customers who do not have distributed generation, is a means to avoid subsidization between customers within that class of service and shall be deemed in the public interest.

E. Retail electric suppliers shall implement tariffs in compliance with this act no later than December 31, 2015.

SECTION 2. This act shall become effective November 1, 2014.

EXHIBIT DWH - 4

Passed the Senate the 12th day of March, 2014.

Presiding Officer of the Senate

Passed the House of Representatives the 14th day of April, 2014.

Presiding Officer of the House of Representatives

OFFICE OF THE GOVERNOR

Received by the Office of the Governor this 15th day of April, 2014, at 3:46 o'clock P M.

By: Audrey Rockwell

Approved by the Governor of the State of Oklahoma this 21st day of April, 2014, at 3:43 o'clock P M.

Governor of the State of Oklahoma

OFFICE OF THE SECRETARY OF STATE

Received by the Office of the Secretary of State this 21st day of April, 2014, at 5:40 o'clock P. M.

By: Chris Benge

Stricken language would be deleted from and underlined language would be added to present law.
Act 827 of the Regular Session

State of Arkansas *As Engrossed: H2/26/15 H3/17/15*
90th General Assembly
Regular Session, 2015

A Bill

HOUSE BILL 1004

By: Representative S. Meeks

For An Act To Be Entitled

AN ACT TO REQUIRE ELECTRIC UTILITIES TO COMPENSATE NET-METERING CUSTOMERS FOR NET EXCESS GENERATION CREDITS IN CERTAIN CIRCUMSTANCES; AND FOR OTHER PURPOSES.

Subtitle

TO REQUIRE ELECTRIC UTILITIES TO COMPENSATE NET-METERING CUSTOMERS FOR NET EXCESS GENERATION CREDITS IN CERTAIN CIRCUMSTANCES.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF ARKANSAS:

SECTION 1. Arkansas Code § 23-18-603(6), concerning a definition used under the Arkansas Renewable Energy Development Act of 2001, is amended to read as follows:

(6) "Net-metering facility" means a facility for the production of electrical energy that:

(A) Uses solar, wind, hydroelectric, geothermal, or biomass resources to generate electricity, including, but not limited to, fuel cells and micro turbines that generate electricity if the fuel source is entirely derived from renewable resources;

(B) Has a generating capacity of not more than:

(i) The greater of twenty-five kilowatts (25 kW) or one hundred percent (100%) of the net-metering customer's highest monthly usage in the previous twelve (12) months for residential use; or ~~three~~

(ii) Three hundred kilowatts (300 kW) for any other

use unless otherwise allowed by a commission under § 23-18-604(b)(5);

(C) Is located in Arkansas;

(D) Can operate in parallel with an electric utility's existing transmission and distribution facilities; and

(E) Is intended primarily to offset part or all of the net-metering customer requirements for electricity; and

SECTION 2. The introductory language of Arkansas Code § 23-18-604(b), concerning the authority of the Arkansas Public Service Commission, is amended to read as follows:

(b) Following notice and opportunity for public comment, ~~the Arkansas Public Service Commission~~ a commission:

SECTION 3. Arkansas Code § 23-18-604(b)(1), concerning the authority of the Arkansas Public Service Commission, is amended to read as follows:

(1) Shall establish appropriate rates, terms, and conditions for net-metering contracts, including ~~a~~:

(A)(i) A requirement that the rates charged to each net-metering customer recover the electric utility's entire cost of providing service to each net-metering customer within each of the electric utility's class of customers.

(ii) The electric utility's entire cost of providing service to each net-metering customer within each of the electric utility's class of customers under subdivision (b)(1)(A)(i) of this section:

(a) Includes without limitation any quantifiable additional cost associated with the net-metering customer's use of the electric utility's capacity, distribution system, or transmission system and any effect on the electric utility's reliability; and

(b) Is net of any quantifiable benefits associated with the interconnection with and providing service to the net-metering customer, including without limitation benefits to the electric utility's capacity, reliability, distribution system, or transmission system; and

(B) A requirement that net-metering equipment be installed to accurately measure the electricity:

~~(A)~~ (i) Supplied by the electric utility to each

net-metering customer; and

~~(B)~~ (ii) Generated by each net-metering customer that is fed back to the electric utility over the applicable billing period;

SECTION 4. Arkansas Code § 23-18-604(b)(5) and (6), concerning the authority of the Arkansas Public Service Commission, are amended to read as follows:

(5) May increase the ~~peak~~ generating capacity limits for individual net-metering facilities if doing so results in distribution system, environmental, or public policy benefits; ~~and~~

(6) Shall provide that:

(A)(i) The net excess generation credit remaining in a net-metering customer's account at the close of ~~an annual~~ a billing cycle~~, up to an amount equal to four (4) months' average usage during the annual billing cycle that is closing, shall be credited to the net-metering customer's account for use during the next annual billing cycle;~~ shall not expire and shall be carried forward to subsequent billing cycles indefinitely.

(ii) However, for net excess generation credits older than twenty-four (24) months, a net-metering customer may elect to have the electric utility purchase the net excess generation credits in the net-metering customer's account at the electric utility's estimated annual average avoided cost rate for wholesale energy if the sum to be paid to the net-metering customer is at least one hundred dollars ($100).

(iii) An electric utility shall purchase at the electric utility's estimated annual average avoided cost rate for wholesale energy any net excess generation credit remaining in a net-metering customer's account when the net-metering customer:

(a) Ceases to be a customer of the electric utility;

(b) Ceases to operate the net-metering facility; or

(c) Transfers the net-metering facility to another person; and

~~(B) Except as provided in subdivision (b)(6)(A) of this~~

EXHIBIT DWH - 5

~~section, any net excess generation credit remaining in a net-metering customer's account at the close of an annual billing cycle shall expire; and~~

~~(C) Any~~ (B) A renewable energy credit created as the result of electricity supplied by a net-metering customer is the property of the net-metering customer that generated the renewable energy credit~~.~~; and

SECTION 5. Arkansas Code § 23-18-604(b), concerning the authority of the Arkansas Public Service Commission, is amended to add an additional subdivision to read as follows:

(7) May allow a net-metering facility with a generating capacity that exceeds three hundred kilowatts (300 kW) if:

(A) The net-metering facility is not for residential use; and

(B) Allowing an increased generating capacity for the net-metering facility would increase the state's ability to attract businesses to Arkansas.

SECTION 6. Arkansas Code § 23-18-604, concerning the authority of the Arkansas Public Service Commission, is amended to add additional subsections to read as follows:

(c)(1) As used in this section, "avoided costs":

(A) For the Arkansas Public Service Commission, means the same as defined in § 23-3-702; and

(B) For a municipal utility, is defined by the governing body of the municipal utility.

(2) Avoided costs shall be determined under § 23-3-704.

(d)(1) Except as provided in subdivision (d)(2) of this section, an electric utility shall separately meter, bill, and credit each net-metering facility even if one (1) or more net-metering facilities are under common ownership.

(2)(A) At the net-metering customer's discretion, an electric utility may apply net-metering credits from a net-metering facility to the bill for another meter location if the net-metering facility and the separate *meter location are under common ownership within a single electric utility's service area.*

(B) Net excess generation shall be credited first to the

net-metering customer's meter to which the net-metering facility is physically attached.

(C) After applying net excess generation under subdivision (d)(2)(B) of this section and upon request of the net-metering customer under subdivision (d)(2)(A) of this section, any remaining net excess generation shall be credited to one (1) or more of the net-metering customer's meters in the rank order provided by the net-metering customer.

/s/S. Meeks

APPROVED: 03/31/2015

EXHIBIT DWH -6

Valuation of Distributed Solar: A Qualitative View

A critical evaluation of the arguments used by solar DG advocates shows that those arguments may often overvalue solar DG. It is time to reassess the value of solar DG from production to dispatch and to calibrate our pricing policies to make certain that our efforts are equitable and carrying us in the right direction.

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I. Assessing the Value of Distributed Solar Generation – An Overview

The purpose of this article is to assess the value of residential distributed generation (DG) solar photovoltaics (PV) and appropriate pricing for its value and output. In particular, the article will address the question of whether retail net metering, the way that it is presently applied in most states, is an equitable way to compensate customers who own or lease solar DG. The article will also critically examine the argument for the "value of solar" approach to compensating residential solar DG customers. The article will conclude that retail net metering and "value of solar" are severely flawed schemes for pricing solar DG.

Retail net metering overvalues both the energy and capacity of solar DG, imposes cross-subsidies on non-solar residential customers, and is socially regressive because it effectively transfers wealth from less affluent to more affluent consumers. The "value of solar" approach being advanced by

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some solar DG advocates subjectively, and often artificially, inflates the value of solar DG and discounts the costs. This article also concludes that proposals for market-based energy prices, as well as demand and fixed charges as applied to solar DG hosts, are reasonable ways to rectify the cross-subsidies in net metering. It suggests that market-based prices for solar DG provide the best incentives for making solar more efficient and economically viable for the long term.

Solar PV has some very real benefits and long-term potential. The marginal costs of producing this energy are zero. If one looks at environmental externalities, then the carbon emissions from the actual process of producing this energy itself, without taking the secondary effects into consideration, are also zero. Significantly, the costs of producing and installing solar PV have declined in recent years, adding to the potential long-term attractiveness of solar. Those are very real benefits that would be valuable to capture. In its current, most common configuration, however, solar DG has some drawbacks that inhibit it from capturing its full value.

Solar PV is intermittent and thus requires backup from other generators and cannot be relied on to be available when called upon to produce energy. Thus, its energy value is entirely dependent on when it is produced and its capacity value is, at best, marginal. To fully develop the resource, therefore, it is imperative to provide pricing that will incent the fulfillment of solar PV's potential, by linking itself to storage, more efficient ways of catching the sun's energy, or with other types of generation (e.g. wind) that complement its availability. Thus, it is critical that prices be set in such a fashion as to provide incentives for productivity and reliability and not to subsidize solar DG at a decidedly low degree of optimization. Currently, rates for most residential consumers are based on volume. That is, residential customers are simply billed based on the number of kilowatt-hours that they consume based on average costs to serve all residential consumers. Solar has huge potential, but to attain it, solar DG needs to receive the price signals to actually fulfill its potential.

In its current, most common configuration, solar DG has some drawbacks that inhibit it from capturing its full value.

Not only does net metering deprive solar PV of the price signals necessary to capture its full value, it also leads the changes in retail pricing that undermine the promotion of energy efficiency. As solar DG becomes more widely deployed, utilities and their regulators will likely become increasingly concerned with diminution of revenues required to support the distribution system that is caused by the use of net metering. That concern will inevitably lead utilities and regulators to recover more of their costs through the fixed, rather than the variable, components of their rates. Thus, the price signal to be more efficient will be substantially diluted.

Many in the solar industry have come to recognize that retail net metering (NEM) is, in this age of smart grid and smart pricing, no longer a defensible method for pricing solar DG. Having recognized the inevitable demise of a pricing system that favors solar DG through cross-subsidization by other customers, many solar DG advocates have shifted to an argument that pricing should be based on consideration of the "value of solar." While the authors do not subscribe to that point of view, as the argument is being included in the national conversation, it seems appropriate to address it.

II. Solar DG and Retail Net Metering – Definition of Terms

Powering your home with clean energy generated from the

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solar panels on your roof, and selling the excess energy to the utility, are appealing prospects to a public increasingly attuned to environmental, energy efficiency, and self-sufficiency considerations. It is not hard to see why solar DG has substantial public appeal.

To begin, it is necessary to note that the terms "net metering," "retail net metering," and "net energy metering" will be used interchangeably and synonymously throughout the article. Net metering refers to when electricity meters run forward when solar DG customers are purchasing energy from the grid. When those customers produce energy and consume it on their premises, the meter slows down and then simply stops, and when the customer produces more energy than is consumed on the premises, the meter runs backwards. Thus, the solar DG customer pays full retail value for all energy taken off the grid, pays nothing for energy or distribution when self-consuming energy produced on the premises, and is paid the fully delivered retail price for all energy exported into the system. At the end of whatever period is specified, the meter is read and the customer either pays the net balance due, or the utility pays the customer for excess energy delivered. The reconciliation is made without regard to when energy is produced or consumed. This is how transactions between owners of residential DG and utilities have traditionally been handled.

There are other forms of net metering such as wholesale net metering, where exports into the system are compensated at the wholesale price, often the local marginal price (LMP). There are other variations as well, but for purposes of the article, when the terms NEM or net metering are used, they refer to the retail variety.

There are, conceptually, four possible approaches to pricing energy produced by solar DG.

There are, conceptually, four possible approaches to pricing energy produced by solar DG. One market-based approach is to set the price to reflect the market clearing price in the wholesale market at the time the energy is produced. A second approach would be a cost-based approach, where the price is set based on a review of the costs or according to standard costing methodology. A third approach, already defined above, would be net metering. Finally, a fourth approach would be to administratively derive a "value of solar" based on analysis of avoided costs and whatever else the evaluators believe to be worthy of measure.

As you will see, while the authors do not believe this fourth approach to be appropriate, analysis of the criteria its advocates believe are important should be conducted and evaluated – not to set the price, but simply to establish the context for evaluating the reasonableness of the pricing methodology approved.

III. 'Value of Solar' vs. Wholistic Analysis

Optimally, prices for electricity are determined by a competitive market or, absent competitive conditions, should be derived from cost-based regulation. In both cases the prices are subjected to an external discipline that should result in efficient resource decisions devoid of arbitrary or "official" biases. Subjective consideration of the "value" of particular technologies and where they may rank in the merit order of "social desirability," effectively removes the discipline that is more likely to produce efficient results. Moreover, even where non-economic externalities are thrown into the valuation mix, the pricing of an energy resource must still be disciplined by examination of the economic merit order in attaining the externality objective. Whereas both the marketplace and transparent cost-based regulation are likely to produce coherent pricing that

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allows us to enjoy a degree of comfort knowing that efficient performance will likely lead to productivity, subjective consideration of soft criteria, like "value of solar," are a step away from economic coherence and efficiency.

Economics are critical and efficiency is of vital importance. There are also other economic values, besides efficiency, including those that go beyond short-term efficiency. Certainly, many people believe that other, non-economic factors need to be considered. Similarly, the fairness of the impact on customers also needs to be factored into any decision. There has, for many years, been a running debate in electricity regulation as to whether externalities ought to be factored into regulatory decisions. This article does not intend to join that debate, nor express any point of view as to what is permissible or impermissible under applicable law. Rather, this article suggests that if externalities are to be considered, then all relevant ones deserve attention, as opposed to "cherry picking" the issues to best protect a particular interest. Further, if non-economic objectives are to be factored into ratemaking, then it is wise to carefully consider the most economically efficient ways of attaining those objectives.

There are a number of criteria that are important to the full valuation of solar PV. One should begin by looking at the cost of producing energy. Beyond that, the criteria would include availability/capacity, reliability, energy value, impact on system operations and dispatch, transmission costs and effects, distribution costs and effects, and hedge value. Solar DG proponents often phrase these issues in terms of avoided costs. In addition to those dimensions, there are also the following: degree of subsidization and cross-subsidization, efficiency considerations, impact on alternative technologies, market price impact, reliability, and social effects including the environmental, customer, and social class impacts. There is also the issue of whether solar DG enhances the level of competition in the industry.

Certainly, many people believe that other, non-economic factors need to be considered.

IV. Net Energy Metering – Why Are We Paying More for Less?

Retail net energy metering, as practiced, does not capture all of the value enumerated above. NEM significantly overvalues distributed solar generation. More specifically, it does the following:

1. Creates a cross-subsidy from non-solar to solar customers;
2. Fails to reflect the inefficiency of small-scale solar PV relative to other forms of generation, including alternative renewable resources;
3. Constitutes price discrimination in favor of an inefficient resource;
4. Significantly overvalues both the capacity and reliability value of solar DG;
5. Adversely impacts the degree of competitiveness in the industry;
6. Artificially inflates the transmission value of solar DG;
7. Fails to account for the fact that the value of energy varies widely depending on when it is actually produced;
8. Distorts price signals for energy efficiency;
9. Causes socially regressive economic impact;
10. Assumes system benefits from solar DG that, in fact, may not exist;
11. Overvalues its contribution to carbon reduction;
12. Vastly inflates its value as a fuel hedge; and
13. Undervalues and underfunds the distribution system.

Despite failing to capture these values, NEM has become the prevalent form of tariff for residential solar DG in

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the United States. This is because NEM was never developed as part of a fully and deliberatively reasoned pricing policy. NEM was simply never a conscious policy decision. It is basically a default product of two (no longer relevant) considerations, one practical and the other technological. The practical reason is that residential distributed generation had such an insignificant presence in the market that its economic impact was marginal at best. Thus, no one was seriously concerned about "getting the prices right." The second, technological reason is that until recently the meters most commonly deployed, especially at residential premises, have had very little capability other than to run forward, backward, and stop. Thus, for technical reasons, NEM was simple to implement and administer and, as a practical matter given the paucity of DG, there was no compelling reason to go to the trouble of remedying a clearly defective pricing regime. Many states have recognized the problems with NEM but, seeing no alternatives, put in place production caps to limit any harm caused by a clearly deficient pricing regime.

V. Residential Retail Net Metering Sets Up Unfair and Counterproductive Cross-Subsidies

Beyond failing to capture the values above, there are other problems with NEM. Under NEM, when DG providers export energy to the system, consumers are required to pay them full retail rates for a wholesale product. What everyone agrees upon is that solar DG provides an energy value, but there is considerable disagreement about what that value is. Solar proponents argue that solar DG has a capacity value as well. That value, if it exists at all, is minimal. While there may well be reasons to treat DG differently with respect to wholesale transmission there is, absent a solar host leaving the grid, absolutely no reason to discriminate between wholesale and DG products with regard to the fixed costs of the distribution system and its operations.

If the costs of the distribution system were variable with energy production, that exemption would be sensible, but they are not.

Under NEM, however, solar DG providers are compensated at full retail prices for what they provide. That includes the not-insignificant cost of services that they do not provide, including distribution costs, administrative, and back office operations. There can be no justification for forcing consumers to pay a provider for service that they not only do not provide but, in fact, have no capability to provide.

Solar DG producers remain connected to the grid and are fully reliant upon it during the many hours of the day when solar energy is not available. Under NEM, that solar DG producer is excused from paying his/her share of the costs of the distribution system when energy is being produced on the premises. If the costs of the distribution system were variable with energy production, that exemption would be sensible, but they are not. Distribution costs are fixed, and do not vary with energy production or consumption. Thus, excusing solar DG customers from paying for their own distribution costs when their solar units are producing energy has no justification in either policy or economics. Making matters worse, the costs solar DG providers do not pay under NEM are either reallocated to non-solar customers or have to be absorbed by the utility. Both outcomes are unacceptable and unjustifiable. There is no reason why solar DG customers should receive free backup service, compliments of either their neighbors or the utility.

Utilities are obliged to provide full requirements service to all of their customers, including, of course, their solar host

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customers. In regard to solar hosts, the utility is obliged, in case the on-premises generation does not cover their full demand, to fill the gap between the full demand and the amount of self-generation. Utilities are also obliged to purchase energy and/or capacity so that solar hosts may rely on the utility when solar units are not generating. Given that solar PV units are intermittent and unpredictable regarding when they will produce, providing that backup is an ongoing responsibility and cost to utilities. Compounding those costs is the fact, as stated elsewhere in the article, peak times of electricity use (i.e. when prices are highest) are trending later in the day, when solar PV does not produce. As such, utilities must provide electricity to solar hosts at times when demand is high and energy prices are high. It would violate a the fundamental principle of regulation that cost causers should pay for the costs they impose, not to recognize the actual costs of that backup service in the rates paid by solar hosts.

Another cross-subsidy relates to the intermittent nature of solar energy. No utility with an obligation to serve can be fully reliant on the availability of solar when it is needed. Indeed, no solar host who values reliability can afford to be dependent on his/her own solar DG unit. While this point will be discussed further *infra* suffice it to say that this gives rise to two types of demand charge related cross-subsidy. The first arises when the distributor relies on the availability of solar for making day-ahead purchases and the other arises when it does not do so. When it does rely on the availability of solar and it turns out that solar energy is not available when called upon, the

utility is compelled to purchase replacement energy in the spot market at the marginal cost, which is almost certainly higher than the price of the solar energy on whose availability it had relied. In notable contrast to what happens in the wholesale market when a supplier who is relied upon fails to deliver, those incremental costs have to be borne by the utility, which passes them on to all customers, as opposed to being borne by the specific solar DG customer whose failure to deliver caused the costs to be incurred.

If the distributor, in recognition of solar's intermittency, instead chooses to hedge against the risk of solar's unavailability, the cost of the hedge is likewise passed on to all customers rather than simply those whose supply unpredictability caused the cost to be incurred. Both of these forms of cross-subsidy violate a bedrock principle of regulation – costs should be allocated to the cost causer. The function of that principle, of course, is to provide price signals to improve performance, but NEM fails to provide such signals and essentially holds solar DG providers harmless for their own very low capacity factors and inefficient performance.

NEM cross-subsidies, in large part, provide short-term benefits to the solar DG industry, but are highly detrimental to the value of solar in the long term. In the short term they constitute a wealth transfer from non-solar customers to the solar industry. In the long term, however, they are actually harmful to solar energy because NEM provides absolutely no incentive to improve the performance of a generating resource that, among renewables, already ranks last in efficiency and in cost effectiveness for reducing carbon emissions. In effect, the solar DG industry is putting its short-term profits ahead of the long-term value of solar energy. If solar DG advocates prevail in seeking to maintain NEM, that victory will be short-lived, because markets, both regulated and unregulated, do not prop up inefficient resources over the long term.

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NEM is also woefully ineffective at providing the appropriate price signals. Electricity prices can be quite volatile over the course of every day and vary seasonally as well. Rather than reflecting those prices, NEM simply treats all energy the same regardless of the time during which it is produced. For example, NEM fails to differentiate between energy produced on-peak and off-peak. In one scenario, it prices off-peak solar DG at a level that is averaged with on-peak prices, thus effectively over-valuing the energy. Conversely, if solar DG were actually produced on-peak, NEM would average that price with off-peak prices, thus undervaluing the energy. Any form of dynamic pricing, ranging from time of use to real-time, could address this issue with more precision than flat, averaged prices. Interestingly, under the first scenario, cross-subsidies would be paid to solar producers, while in the second scenario, solar producers would be cross-subsidizing the other ratepayers. In short, the price signal, and the efficiency that would flow from that, is rendered incoherent.

Some may argue that cross-subsidies are necessary to promote the growth of renewable energy, and certainly that can be debated. However, modernizing NEM to provide appropriate price signals would not remove the tax credits and other government-sanctioned or -sponsored subsidies. The fact that conscious subsidies and/or cross-subsidies are designed to promote a particular technology raises two key issues. First, many would argue that the government, including regulators, should not be picking winners and losers in the marketplace. While there may be merit to that view, it must also be recognized that, there may be

circumstances where, for policy reasons, government might want to provide support for a socially and economically desirable technology and/or assist it with research funding and to get it over the commercialization hump. That leads inexorably to the second and more relevant issue concerning solar DG: namely, that subsidies and cross-subsidies need to be designed as near-term boosts rather than a permanent crutch, and should be transparent. In other words, subsidies/cross-subsidies should be designed to serve as both a stimulus for the designated technology and an incentive to the producers and vendors of the technology to become more efficient. It might also be noted that subsidies from the Treasury are more appropriate for achieving broad social benefits that are cross-subsidies derived from a subset of the full society deriving the benefit.

In the case of solar DG, the objective of a subsidy/cross-subsidy would be to attain grid parity, assuming reasonably efficient operations, with other resources. The objective is to assist a technology to achieve commercial viability. The problem with NEM, of course, is that it is effectively an arbitrary financial boost of potentially endless duration, with absolutely no built-in incentive to increase efficiency and/or to achieve grid parity. In effect it requires non-solar customers to pay more for the least efficient renewable resource in common use and provide the solar industry with no economic incentive to improve its productivity or availability or wean itself off dependence on the cross-subsidy. It also has the effect of putting more efficient resources, particularly other renewables, at a competitive disadvantage. In short, NEM effectively substitutes political judgment for economic efficiency to determining marketplace success.

The reason why solar DG vendors and providers cling to cross-subsidies is because they find more comfort in receiving substantial cross-subsidies than

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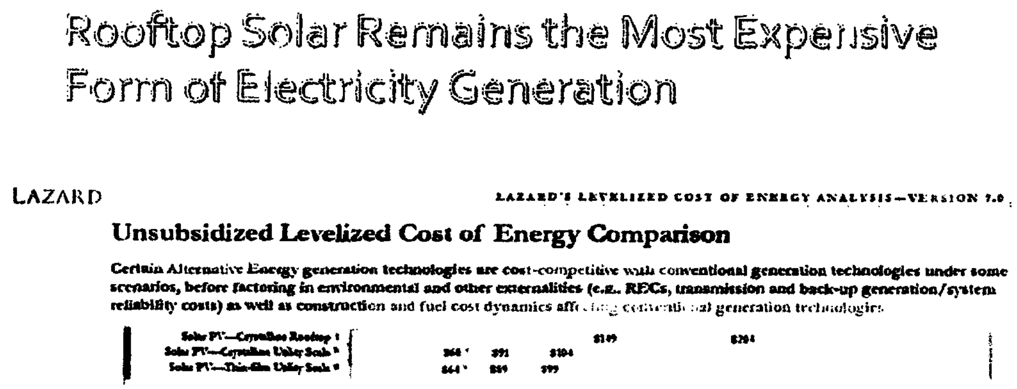

Figure 1: Rooftop Solar Remains the Most Expensive Form of Electricity Generation

they do in the prospect of becoming competitive. Solar DG is the most expensive form of renewable generation that is widely used today (Figure 1).

The technological and practical reasons for permitting such incoherent pricing are no longer present in the marketplace. We now have pricing methods that are capable of measuring DG production as well as consumption on a more dynamic basis. In addition, solar DG market penetration has dramatically increased to the point that it can no longer be dismissed as marginal, so appropriate pricing is now a non-trivial issue. In addition, we now have very precise, location-specific energy and transmission price signals that provide a very transparent market price by which one can measure the economic value of distributed generation. These new developments, plus the fact that NEM was put in place on a default basis, mean that it is now time for a full-blown policy consideration of the most appropriate pricing policy for distributed generation.

For all of the reasons noted, NEM pricing results in large cross-subsidies, offers no incentives for efficiency – indeed, may even provide disincentives to invest in efficiency improvements – and results in consumers paying energy prices for solar DG that are far in excess of its market value and not even subject to cost-based oversight. Moreover, its *raison d'être* – inability to more accurately price solar DG facilities and low market penetration by solar energy – no longer exists. Solar energy is penetrating the market in greater numbers and is likely to continue to do so. Secondly, more sophisticated pricing enables us to measure solar energy and customer behavior on a much more efficient, dynamic basis. The fundamental reality is that NEM completely fails to capture the value of the product being priced.

VI. Placing a Value of Solar DG – Pricing and Economic Efficiency

Needless to say, pricing is of critical importance. It is important to address pricing in the context of tangible, enumerated values. Such an analysis is in contrast to certain efforts by solar DG advocates to attach a subjective value to solar and then derive prices from that value. It is preferable to derive prices from the values established by either costs or market, not ephemeral and subjective considerations.

It is worth re-emphasizing just how imperfect NEM actually is. The price of electric energy is not constant. Wholesale markets reflect that reality. Net metering and many forms of incentives do not reflect the values established by the market. Rather, a net metering regime relieves the solar panel host of any obligation to pay for the costs of the distribution system when energy is being produced, even though he/she

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Table 1: Rooftop Solar Subsidies Heavily Utilize Funding from Non-Solar Customers

DTE Energy [illegible]

SolarCurrents [illegible] mechanism

	Sol[illegible] (Ph[illegible]	[illegible]	Funding Mechanism
Up-front solar subsidy	$2.40/W	$0.20/W	Renewable Surcharge
On-going solar subsidy	$0.11/kWh	$0.03/kWh	**Renewable Surcharge**
Net metering subsidy (unrecovered fixed cost)	**$0.09/kWh**	**$0.09/kWh**	***Unrecovered fixed costs are funded by non-solar customers**
Total SolarCurrents and Net metering subsidy	**$0.20/kWh**	**0.12/kWh**	

remains reliant on it and, when the meter runs backwards, is effectively paid the full retail price for energy exported from the customer's premises. As a point of illustration, see Table 1 for a funding mechanism for residential customers presented by DTE Energy to the Michigan Public Service Commission. According to DTE, the 9 cent per kilowatt-hour (kWh) net metering credit represents a differential that non-participating customers must pay.

Under NEM, compensation at retail rates is not cost-reflective because net metering means that solar DG energy exported into the distribution network is compensated at the full bundled retail rate rather than at a price based on the unbundled cost of producing the energy. In almost all jurisdictions, that retail rate is flat and constant. Thus, it does not reflect the obvious fact that the energy has greater value at peak demand than it does off-peak. It is a deeply flawed value proposition. The fact is that the wholesale market produces hour-by-hour prices that provide generators, renewable and non-renewable alike, and consumers with important price signals that reflect real-time values. Both generators and demand responders are compensated according to those real-time prices. Solar DG-produced energy, by contrast, is compensated on a basis that lacks a foundation in either market or cost. The compensation is out of market because it is a flat price regardless of when it is produced or, for that matter, fails to reflect that many hours of the day that solar panels produce absolutely nothing. It is hard to avoid the conclusion that on an economic basis, the NEM-derived price paid for solar DG energy completely misses the value of solar during most hours of the day. Interestingly, part of the cause for this incorrect valuation is that rooftop solar units have generally been installed facing south, as opposed to west. Because demand peaks have been trending later in the day (as illustrated in the California and New England figures below), this southern exposure has proven to render peak production for solar even less coincident with demand. Had the appropriate market prices been in effect, it is highly unlikely that such a costly error would have occurred.

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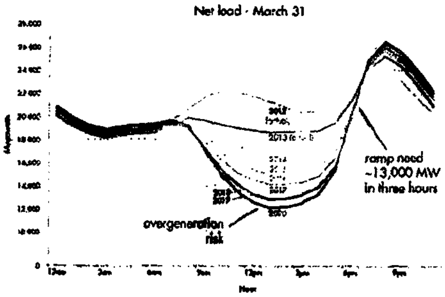
The Duck Curve - California

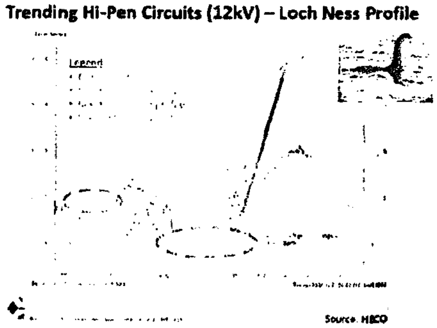
Net load - March 31



http://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

The Nessie Curve - Hawaii

Trending Hi-Pen Circuits (12kV) – Loch Ness Profile



www.greentechmedia.com/articles/read/hawaiis-solar-grid-landscape-and-the-nessie-curve.

Figure 2: Ramping Needs Increased Due to Lack of Solar Prodution During Peak Demand

As is dramatically illustrated in the graph at left in Figure 2, enticed by a number of factors, not the least of which is net metering, substantial investment in the growth of solar capacity in the Golden State has enormously magnified the need for additional fossil plants, operating on a ramping basis, to compensate for the dropoff in solar production at peak. In that context, the absence of any meaningful signal to make solar more efficient (e.g. linking it with storage) is simply something that can no longer be tolerated. Not coincidentally, the charts from both the California and New England ISOs (found further *infra*), as well as that from DTE, illustrate the wisdom of compensating solar DG at LMP, so its price accurately reflects its value at the time of actual production and avoids requiring non-solar customers to pay prices for energy that far exceed its value.

A. Capacity value

The capacity value of a generating asset is derived from its availability to produce energy when called upon to do so. If a generator is not available when needed, it has little or no capacity value. By its very nature, solar DG on its own, without its own backup capacity (e.g. storage), can only produce energy intermittently. It is completely dependent on sunshine. Unless sunshine is guaranteed at all times solar DG is called upon to produce, it cannot be relied upon to always be available when needed. Moreover, even if all days were reliably sunny, the energy derived from the sun is only accessible at certain times of the day. In many jurisdictions, the presence and potency of sunshine is not coincident with peak demand. Frequently, for example, solar DG capacity is greatest in the early afternoon, while peak demand occurs later in the afternoon or in early evening. The two charts in Figure 3 illustrate the lack of coincidence of solar production and peak demand in New England.[1]

These two charts dramatically demonstrate that, on the days chosen as representative of summer and winter in New England, solar PV is completely absent during the winter peak, reaches its peak production as peak demand is rising in the summertime, and drops off dramatically during almost the entire plateau period when demand is at peak. It should also be noted that on the days chosen, the sun was shining. The graph, of course, would look very different on cloudy days when solar production is virtually nil.

The Electric Power Research Institute (EPRI) graphs in Figure 4 reveal similar patterns on a national level. The first graph

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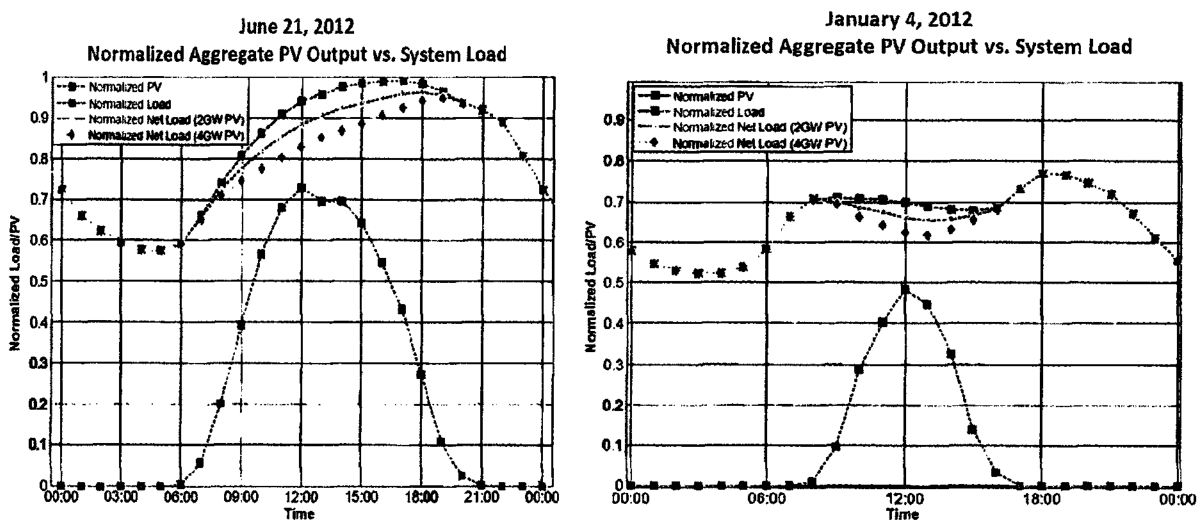

Figure 3: Lack of Coincidence of Solar Production and Peak Demand in New England

depicts the peak load reduction and ramp rate impacts resulting from high penetration of solar PV. The second illustrates the fact that because residential load and PV system output do not match, solar DG hosts use the grid for purchasing or selling energy most of the time.

As noted above, providers of capacity in the wholesale market may also have availability issues. In their case, however, if they are not available when called upon to produce, they are typically obligated to either provide replacement energy or to pay the

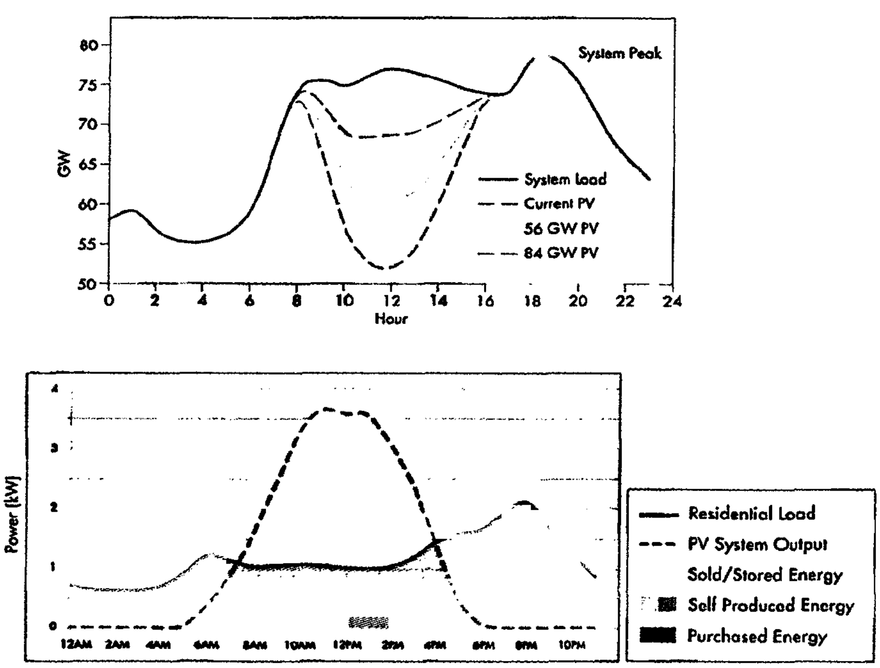

Figure 4: Increased Ramp Rates, Peak Load Reduction and Reliance on the Grid

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marginal cost of energy that they failed to deliver. Unless a similar obligation is imposed on solar DG providers, the capacity value of solar DG is reduced even further. Good pricing policy would suggest that DG prices should be fully reflective of the value of the type of capacity that is actually provided. As currently implemented, net metering does not adequately reflect how the capacity availability measures up to demand.

B. Availability and reliability

Many advocates of solar DG assert that it enhances overall reliability because the units are small, widely distributed but close to load, and not reliant on the high-voltage transmission system. It is argued that they are less impacted by disasters and weather disturbances. At best, these claims are highly speculative and, for the reasons noted below, quite dubious. It would be a mistake to attribute added value to solar DG because of reliability.

Solar DG is subject to disaster as much as any other installations. High winds, for example, can harm rooftop solar as much as any other facility connected or unconnected to the grid. Cloudy conditions can disrupt solar output while not affecting anything else on the grid.

Solar DG has more reliability benefit in some places than others. In Brazil, for instance, a system that largely relies on large hydropower plants with large storage reservoirs, solar has considerable long-term reliability value because whenever it generates energy it conserves water in the reservoirs, thereby adding to the reliability of the system. However, in a thermal-dominated system (like much of the United States), where there is little or no

storage, reliability has to be measured on more of a real-time basis. Therefore, solar's intermittency makes it unable to assure its availability when called upon to deliver energy. Indeed, it is far more likely that a thermal unit will have to provide reliability to back up a solar unit than the other way around.

It is also important to examine rooftop solar reliability issues in two contexts: that of the individual customer and that of the system as a whole. Solar DG vendors, as part of their sales pitch, claim that reliability is increased for a specific customer with a rooftop solar unit because on-site generation provides the possibility of maintaining electric power when the surrounding grid is down. When the sun is shining, this claim may be true. Conversely, without the sun, the claim has no validity. However, that argument only applies to the solar host.

On a technical point, a power inverter is an electronic device or circuitry that changes direct current to alternating current. During a system outage the power inverter is automatically switched off to prevent the backflow of live energy onto the system. That is a universal protocol to prevent line workers and the public from encountering live voltage they do not anticipate. Thus, if a solar DG unit is functioning properly, when the grid is down, the solar DG customer's inverter will also go down, making it impossible to export energy. If the solar DG unit is not functioning properly, then the unit may be exporting, but will do so at considerable risk to public safety and to workers trying to restore service. The result is that the solar panel provides virtually no reliability to anyone other than perhaps to the solar host.

Attributing reliability benefits to an intermittent resource is a stretch. By definition, intermittent resources are supplemental to baseload units. The only possible exceptions to that are, as noted above, where there are individual reliability benefits or where the availability of the unit is

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coincident with peak demand or has the effect of conserving otherwise depletable resources. Absent those circumstances, and absent storage, it is almost certainly the case that the system provides reliability for solar DG, rather than the other way around. That is particularly ironic given that in the context of net metering, solar DG hosts do not pay for that backup service while generating electric energy. In essence, in a net metering context, non-solar customers pay solar DG providers for reliability benefits that solar DG does not provide them, while solar DG customers do not pay for the reliability benefits they actually do receive.

From an investment perspective, solar DG pricing methods, like NEM, which redirect distribution revenues from distributors to solar PV providers who offer no distribution services are detrimental to reliability as they either deprive the sector of capital needed to maintain high levels of service or demand additional revenues from non-solar DG users who would ordinarily not have to pay such a disproportionate share of the costs. For utilities, the diversion of funds leaves them with a Hobson's choice of either delaying maintenance and/or needed investment, or seeking additional funds – in effect, a cross-subsidy from non-solar users. It is also relevant to reliability to again note that the prevalence of intermittent resources on the grid, including solar DG, may well cause new, cleaner, and more efficient generation to appear less attractive to investors. Over the long term, that effect could lead to reliability problems associated with inadequate generating capacity, especially at times of peak demand.

C. Solar DG does not avoid transmission costs

It is nearly impossible to demonstrate that solar DG will obviate the need for transmission, much less quantify the cost savings associated with this purported benefit. Of course, there is a simple way to calculate any actual transmission savings, and that is by compensating solar DG providers in the organized markets at the locational marginal cost of electricity at their location. That compensation model would have the benefit of capturing both the energy value and the demonstrable transmission value of solar DG. Absent that formulation, efforts to calculate actual transmission savings would be a difficult, perhaps entirely academic, task.

Solar DG advocates assert that real transmission savings are achieved through the deployment of DG, especially in systems that use locational marginal cost pricing. The argument is that by producing energy at the distribution level, less transmission service will be required, thereby reducing or deferring the need for new transmission facilities. It is also often contended that DG will reduce congestion costs, and perhaps even provide some ancillary services. All of that is theoretically possible but certainly not uniformly, or even inevitably, true.

Of course it is true that DG, absent any adverse, indirect effect it might have on the operations of the high-voltage grid, does not incur any transmission costs in bringing its energy to market. However, that is quite different than asserting that DG provides actual transmission savings. In fact, it would be incorrect to simply conclude across the board that solar DG will achieve transmission savings. It is possible that there could be transmission savings associated with solar DG deployment, but that can only be ascertained on a fact- and location-specific basis. Such savings would most likely be derived from reducing congestion or providing ancillary services of some kind. It is also theoretically

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possible, but highly unlikely, that massive deployment of solar DG will eliminate (or, more likely, defer) the need to build new transmission facilities. For a variety of reasons, including the complexities of transmission planning, the time horizons involved, the complex interactions of multiple parties, and economies of scale in building transmission, it is improbable that solar DG actually saves any investment in transmission capacity.

Indeed, a mere glance at the California ISO duck graph showing the need for ramping capacity to make up for the intermittent availability of solar DG provides a *prima facie* case for believing that the opposite is true and that solar DG may cause a need for more transmission to be built. These and other charts also show that as long as solar does not reduce peak energy use, transmission is likely needed to serve peak hours. Regardless, it is virtually impossible to demonstrate that, other the possibilities of reducing congestions costs (a value fully captured by LMP), there is very little likelihood of transmission saving being derived from solar DG.

D. Solar DG does not avoid distribution costs

It is more likely that solar DG will cause more distribution costs than it saves. That is because these generation sources could change voltage flows in ways that will require more controls, adjustments, and maintenance. Moving from a one-way to a two-way system will certainly increase the need for technical equipment to manage the reliability of the system. While DG solar may not be the only cause of this move the intermittent nature of solar makes

it particularly difficult to manage. It will also inevitably increase transaction costs for the utility to execute interconnection agreements and do the billing for an inherently more complicated transaction than simply supplying energy to a customer. It is impossible, unless a solar DG host leaves the grid, to envision a circumstance where solar DG would effectuate distribution savings.

Regarding distribution line losses, DG offers value only to DG providers when they consume what they produce because any DG output exported to the system is subject to the same line loss calculations that any other generator experiences. If there were locational prices on the distribution system, there might be line loss benefits that could be captured by DG but, since those price signals do not exist, the argument is purely academic.

VII. Lower Hedge Value

The theory advanced by some solar DG proponents is that because the marginal cost of solar is zero, it serves as a hedge against price volatility. In theory, that might make sense. In reality, however, solar is an intermittent resource that cannot serve as a meaningful hedge unless such zero-cost energy is both sufficiently and timely produced. Thus, solar DG is the equivalent of a risky counterparty whose financial position renders him incapable of assuring payment when required. Moreover, the value of a hedge depends on the amount of money the purchaser of the hedge is obliged to pay for the insurance and the amount and probability of the price he/she seeks to avoid paying. With a NEM system (or the high-priced "value of solar" approach that solar DG advocates seek), the price paid is highly likely to exceed the fuel or energy price most utilities would hedge against. In short, the argument ventures into the realm of the absurd. It amounts to: *Pay me a fixed price that is higher than the price you want to avoid, in order to avoid price volatility.*

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The argument that solar DG provides a valuable hedge function is reduced to virtual absurdity by the fact that the so-called hedge is not callable. In short, if the price rises to the level against which the hedge purchaser wants to be insured against, the solar provider of the hedge is not obliged to pay. That being the case, there is no hedge whatsoever.

VIII. Effects of Solar DG on Other Renewable Resources

A. Impact of a low capacity factor

Since 2008, as Figure 5 from the United States Energy Information Administration (EIA) points out, solar PV has had the lowest capacity factor of any commonly used renewable energy resource in the U.S. It is also worth noting that while the overall costs of installing solar panels has declined (as noted above) the productivity of solar PV has remained constant at consistently low levels. It should be noted that the chart below compares only "utility-scale" projects. As noted in the Lazard study above, distributed solar is even less cost effective than utility-scale solar, which already occupies last place on the Department of Energy (DOE) ratings.

The stark reality of solar PV's combination of high prices and poor capacity factor carries over into the cost of reducing carbon emissions. An interesting dialog occurred recently between Charles Frank, an economist at the Brookings Institution, and Amory Lovins of the Rocky Mountain Institute.[2] Their dialogue, while contentious on many points, reflects similar views on the realities depicted in the EIA chart. Frank analyzed five non- or low-emitting generation resources by their cost effectiveness in reducing carbon and concluded that nuclear and natural gas, followed by hydro, wind, and solar were, in that order, the most cost-effective types of generators for reducing carbon. Lovins took issue with Frank for using outdated data and for not looking at energy efficiency. He also argued that nuclear ranked last in cost effectiveness, and expressed some reservations about the ranking of natural gas. However, what is significant is that, among renewable resources, Lovins concurred with Frank that solar DG is the least efficient renewable resource for reducing carbon. Thus, in the view of both men – who hold quite divergent views on how best to reduce carbon emissions – not only is solar DG expensive, it is the least cost-effective renewable resource for reducing carbon emissions.

B. Impact of higher-than-market price

Higher-than-market prices paid for solar DG has adverse effects on other renewable resources. All wholesale generators, renewable and otherwise, have to incorporate transmission and distribution costs into the price of energy delivered to customers. As mentioned above, it is true that transmission issues play out differently for distributed generation than for wholesale generation. Since DG, by definition, does not rely on transmission capacity, although DG might impact congestion costs in various ways, wholesale energy's delivered cost reflects transmission capacity

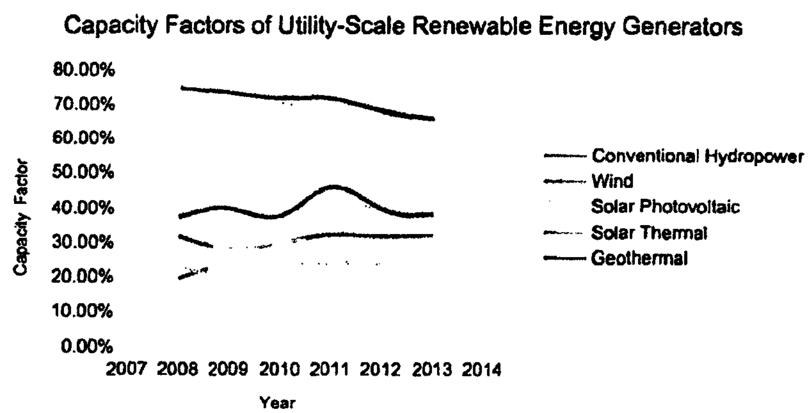

Figure 5: Capacity Factors of Utility-Scale Renewable Energy Generators

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costs while DG's does not. Thus, any competitive advantage for DG on that score is quite natural. However, under the net metering scheme, DG providers also do not have to incorporate distribution costs into their end product, and that results in a serious economic distortion of the generation markets in general as well as specifically in renewable markets. In fact, as noted *supra*, solar DG providers under NEM are actually paid for delivering their energy even though they provide no such service. Wholesale generators, unlike their DG counterparts, enjoy no such comparable enrichment for service they do not provide. The effect of NEM's highly inefficient and non-cost-reflective rates is to distort market prices in ways that reward inefficiency and will likely distort price signals that are essential for an efficient marketplace.

In addition, at a critical mass, artificially elevated solar DG prices are highly likely to create distortions and inefficiencies in the capacity and energy prices found within organized markets. An environment with two parallel pricing regimes, one market- or cost-based, and the other an arbitrary one neither market- nor cost-based, is simply economically incoherent and unsustainable. The overall effect of net metering is to increase the prices consumers pay for energy overall, without any assurance of any long-term benefit. Solar DG is artificially elevated to a preferential position above more-efficient, larger-scale generation, including all other renewables. The disparity in treatment between solar DG and other forms of energy suggests that net metering is not only federal preemption bait (as further discussed below); it is fundamentally anti-competitive as well. Indeed, it compels consumers to both cross-subsidize less efficient producers and to pay higher prices

than necessary for energy. It will also entice investors to allocate their capital to toward more profitable but less efficient generation. In terms of efficiency and public benefit, the incentives inherent in NEM are simply perverse.

Large-scale bulk power renewables (e.g. large-scale wind and solar farms, geothermal) are put at a particular disadvantage by NEM pricing of solar DG independent of costs or market for two basic reasons. First, large-scale renewables are more efficient and more cost-effective than DG, yet net metering provides a subsidy only to the less efficient form of generation. In fact, solar DG providers are compensated for the energy they export at a price that can range from two to six times the market price for energy. Second, in those states with renewable portfolio standards (RPS), the entry of a critical mass of non-cost-justified solar DG units into the market could have the effect of driving more efficient, large-scale renewables out of a fair share of the RPS market. The effect, in a competitive market, is to bias the market to incentivize highly inefficient small-scale solar to the detriment of less costly larger-scale solar.

C. Comprehensive environmental analysis

Any analysis of the environmental impact of the generation mix should include an examination of the least-cost, most efficient ways to get to the desired results. Problematically, the preferential pricing of less efficient solar DG imposes an unnecessarily high-cost approach to reducing carbon. Results such as that cannot be justified on the basis of externalities, which are no different between DG and larger-scale renewables. Indeed, it seems probable that overpayments for DG have the effect of squeezing more efficient forms of renewable energy out of RPS markets by using preferential pricing to grab a disproportionate share of the RPS market and driving up the cost of reducing carbon.

In the long run, of course, the inherent favoritism in pricing DG

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at levels arbitrarily higher than other renewable energy sources does not bode well for either the future of renewables or the objective of efficiently reducing carbon emissions. Discrimination in favor of inefficient resources on a long-term basis is simply not sustainable. The inevitable backlash in both the marketplace and public perception has the potential to sweep away public support for renewable energy and perhaps for strong environmental controls as well, an outcome no one concerned about the environment would want. One of the most notable ironies emanating from the use of net metering to price solar DG is that it will almost certainly lead to changes in retail pricing that will undermine the promotion of energy efficiency. The reason for this is that as solar DG becomes more widely deployed, utilities and their regulators will likely become increasingly concerned with the diminution of revenues required to support the distribution system that is caused by the use of net metering.

Those concerns are derived from the fact that under NEM, when solar DG is being self-consumed at the host premises, no revenues are being paid by that host to the utility for providing what essentially amounts to a battery to supplement their self-generation. Since the costs of the distribution are fixed and not variable with the use of "behind the meter" generation, net metering results in a delta of revenue that is either made up for by non-solar customers or constitutes a loss for the utility. Neither outcome is likely to be satisfactory to either the utility or the regulators. Inevitably there will be ratemaking consequences. That problem is compounded, of course, by the fact that when the excess output of rooftop solar is being exported into the grid the solar provider is

being paid as if he/she was delivering the energy, a service obviously provided by the distribution utility. Thus, not only are solar hosts not paying their fair share of fixed costs, they are, by the operation of net metering, actually taking revenues away from the entity that actually provides the service. From the standpoint of the utility and of the non-solar ratepayers who have to bear the burden of such uneconomic and inequitable revenue allocation, rate design remedies will be sought.

One likely remedy to be proposed is to modify the fixed/variable ratio in rates. While distributions are indisputably fixed costs, regulators have generally divided the recovery of those costs on a different basis. Some have been recovered on a fixed basis, while others have been recovered on a variable, volumetric basis. There are two critical policy reasons why this has been the case. The first is that fixed charges tend to impose a disproportionate burden on low-income households and on customers whose consumption is relatively light. The other reason is that volumetric-based charges send a signal to end users that the more they consume, the more they pay. Stated succinctly, the price signal promotes the efficient use of energy. If the revenue stream to cover distribution costs is diminished through mechanisms like net metering, utilities concerned about revenue requirements and regulators, concerned about reliability will, almost inevitably, shift more costs into non-by passable fixed charges, thus imposing more of a burden on low-income households and, equally important, diluting price signals for energy efficiency. In short, net metering will almost certainly, at some point, serve to both cause cost recovery to be socially regressive, and to discourage energy efficiency. In effect, net metering will likely become a classic case of anti-green pricing.

The anti-green pricing aspect of net metering is also exemplified by the behavioral pattern it incents among solar hosts. As shown on both the California and New England

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graphs above, solar production slacks off and ultimately disappears as demand reaches its peak. Despite that, solar hosts are never signaled through prices that their consumption is no longer being supported by zero-marginal-cost solar production. Indeed, in most cases net metering determines prices on an average-cost basis, even though solar production, even in the best of circumstances, is only available a fraction of the time period used for averaging. Thus, solar hosts are essentially lulled into a pattern induced by low marginal prices, which continue in periods of peak demand, thereby driving the peak demand even higher, a result that is truly perverse, both economically and environmentally. In short, net metering and energy efficiency are simply not compatible.

D. Net metering and energy efficiency are incompatible

Many experts from all facets of the renewable energy discussion will assert that energy efficiency is an important, if not the most important, means to increase carbon reductions. Assuming those experts are correct, it is important to consider the ways in which net metering impacts incentives for energy efficiency. While solar DG and energy efficiency are not inherently anathema, net metering is not compatible with energy efficiency. As discussed above, net metering is a compensation mechanism that causes utilities and regulators to move costs into the fixed category, thereby diluting the price signals that would encourage energy efficiency.

E. Possible federal preemption

State regulators, in setting prices for solar DG, should also be

conscious of the potential for jurisdictional disputes should DG prices cause any dislocation in wholesale markets. Because of the economic distortions caused by NEM, there are some who are calling for DG to be under the control of the Federal Energy Regulatory Commission (FERC) rather than state public utilities commissions' jurisdiction.[3] Unless states begin to remedy the price distortions inherent in net metering, it would be surprising if many aggrieved wholesale generators did not seek relief from FERC. In a somewhat analogous situation, New Jersey and Maryland sought to use state subsidies/mandates to support the construction of new power plants in order to manipulate and/or bypass the PJM capacity market. FERC, in a decision which was later affirmed by the Third Circuit Court of Appeals, struck down the state program by preemption. State commissions that continue to prop up a net metering regime with no basis in either market-based pricing or cost-of-service regulation may well discover the prospect of preemption hanging over them.[4] Further foreshadowing preemption are several other examples of state net metering programs running contrary to federal pricing regimes.

The Public Utility Regulatory Policies Act (PURPA) places an avoided-cost ceiling on power purchases; net metering evades that ceiling. Under net metering arrangements, not only are purchases of excess power mandated at levels well in excess of avoided costs, but they also include a cross-subsidy from non-solar customers for the distribution costs of solar DG providers. Bulk power renewables are subject to all of the rules of the wholesale market, which may include such costs as congestion costs, ancillary services, penalties for no availability, and others. Under net metering, solar DG providers are subject to none of these disciplines. In addition, some wholesale renewable generators complain that the arbitrarily high prices paid under net metering have the effect of attracting enough solar DG providers to fill up the RPS market, so that they

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are being effectively squeezed out of the portfolio entirely.

What is particularly ironic about this effect is that, as noted above, distributed, small-scale solar is the least efficient form of commonly used renewable energy sources in the United States. All of these factors indicate that an increasing number of parties are likely to be motivated to ask FERC to preempt net metering and other state-mandated regimes that allow for unreasonably discriminatory and anti-competitive pricing.

IX. Factors Mitigating Environmental Benefits

Expectations of environmental externality benefits may be the biggest motivator for supporting and subsidizing solar DG. Proponents of solar DG note that solar has zero carbon or other harmful emissions from the process of producing energy. Additionally, to the extent that wide deployment of solar PV avoids the need to invest in technologies that do have carbon and other undesirable emissions, there is an environmental benefit that avoids the social costs associated with pollution. In the absence of legal limits on relevant emissions such costs, solar DG advocates correctly point out, are not captured in the internalized costs of the competing technologies. Therefore, solar DG advocates suggest that regulators and policymakers should take these external social costs into consideration in setting prices for various forms of energy.

The use of external social costs, as opposed to solely the internalized economics of various forms of energy is a controversial subject. Many oppose the use of externalities as a factor in pricing because it distorts the market and makes social judgments economic regulators may not be

empowered to make. In the views of such opponents, the only externalities that ought to be incorporated into pricing are those that are internalized by legal mandate. Proponents of incorporating externalities into rates contend that doing so is the only way to accurately reflect all social costs. They also contend that factoring in environmental externalities is a form of insurance against future regulatory requirements. While this article takes no position as to the merits of incorporating externalities into ratemaking, it will address this issue, on the assumption that at least some regulators and policymakers will look at externalities for purposes of assessing the value of solar DG.

Before delving into this issue any further, it is important to note that the United States Environmental Protection Agency (EPA), whose jurisdiction over carbon emissions has been affirmed by the U.S, Supreme Court,[5] has proposed new rules under Section 111(d) of the Clean Air Act that would, if promulgated, internalize the costs of carbon into electricity ratemaking, so the issue of whether or not to consider the costs of carbon would no longer be debatable. Thus, there is a great deal of uncertainty which, in the short term, effectively strengthens the hand of those who contend consideration of carbon emissions would be a form of insurance against future regulation. In the longer term, however, the likelihood that carbon emissions will be internalized gives rise to very serious questions as to the value of including externalities which, over time may run contrary to the economics of internalized carbon costs. It is also worth noting that there are already several states that have adopted controls on carbon emissions. In those states, it is especially important to make certain that renewable policy and pricing enhances efficiency in compliance, as opposed to confusing means and ends. Regardless, the environmental issue, in terms of solar DG, is

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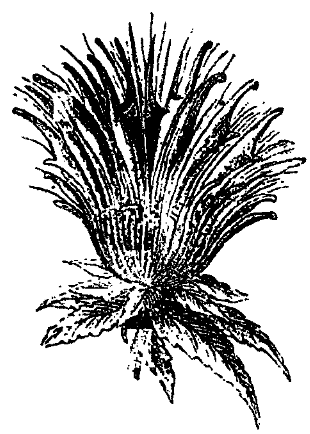
how cost effective such installations are for reducing carbon.

There is little dispute that solar DG is the least efficient of all renewable energy resources in common use in this country. As noted, there is even a consensus, which includes Amory Lovins, that agrees that solar DG is the least efficient renewable resource for reducing carbon. That view is fully supported by the facts in the California duck graph, as well as the ISO-New England and EPRI Value of the Grid data, which demonstrate conclusively that solar DG is consistently off-peak. When priced at net metering levels, it is also the most expensive renewable resource, thereby producing a perverse paradigm that where the least efficient resource costs the most. Therefore, it is evident, without considering any other factors, that solar DG is the least cost-effective use of renewable energy to reduce carbon emissions. There is also the reality that, as a general rule the least efficient and "dirtiest" plants are most likely getting dispatched at times of peak demand. Thus, in the rare instance that solar DG is available at peak in the United States, it is not displacing the most carbon emitting plants. Instead, it is displacing more efficient, less polluting generating units. Moreover, as an intermittent resource, its availability is highly uncertain and fossil plants are often called upon to operate on a less efficient, more carbon-emitting basis than if they were running as pure baseload. Thus solar DG is not only expensive, it is also much more likely to displace low-emitting, more efficient generation than less efficient, dirtier units. In addition, as noted earlier, net metering significantly dilutes the price signals for environmentally benign energy efficiency.



Those conclusions have been borne out by developments in Germany. In that country, where there has been a very dramatic increase in reliance on intermittent energy, prices have risen 37 percent since 2005, and were accompanied by spikes in both carbon emissions and the use of brown coal (lignite). While there are very significant difference between most states and Germany, perhaps most notably that Germany has decided to close down its nuclear plants (although it has replaced much of the domestic nuclear with imported nuclear energy), the experience in that country is very telling.[6] The German example clearly demonstrates that increased dependence on renewable energy resources, particularly intermittent resources, does not, as many solar DG proponents claim, *ipso facto*, mean fewer carbon emissions, and may, in fact, cause the opposite to occur. It also demonstrates that prices will escalate dramatically if the feed in tariffs are as far in excess of market as NEM prices are, as shown by the DTE graph above. The Germans, incidentally, have recognized their miscalculations and are dramatically recalibrating their strategy.

X. Regressive Social Impact

There are social effects beyond the environment that have to be taken into account if externalities are to be factored into ratemaking. Any failure to examine environmental externalities without recognizing that there are other social externalities to be considered as well will yield highly skewed results. Perhaps the most important of those is the social impact.

The social impacts of solar DG are caused by three main factors. First, as noted above, solar DG users have their electricity costs cross-subsidized by their neighbors who completely rely on the grid. Second, some data suggests that solar DG users are unusual electricity users. Third, not everyone can afford to be a solar DG user. To address the second point, unlike typical residential customers, in some regions solar

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DG users use little or no grid power at midday but quickly ramp up demand on peak, when PV production wanes (as is demonstrated by the charts in from the New England and California ISOs). Utilities must be able not only to serve full load on days when solar PV is not performing, but also to ramp up resources quickly to address the peak created by solar DG users. In order to ramp up as needed, utilities will purchase energy at the marginal price and then distribute those costs across all users, not just solar DG users. Thus, users without solar DG may be penalized for the use patterns of their solar DG neighbors. A comparison of residential electricity consumers in the western United States may be found below in Figure 6.[7]

Further, the impact of net metering is not simply the creation of a cross-subsidy from non-solar PV customers to solar PV customers but, as has been pointed out in a recent study by E3,[8] it is a cross-subsidy from less affluent households to more affluent ones. Indeed, the average median household income of net energy metering customers in California is 68 percent higher than that of the average household in the state, according to the study. In a recent proceeding, the staff of the Arizona Commerce Commission noted the same consequence.[9] As one wry observer in California noted, net metering is not "Robin Hood" but rather it is "robbin' the hood." In order to install rooftop solar panels, often individuals must be homeowners with high credit ratings or sufficient capital. Leasing arrangements are also widespread, but are generally available only to customers who own their own premises and they require the assignment of most of the rooftop solar benefits to the lessor. Many electricity customers, particularly less affluent ones, do not own homes or lost their homes in the most recent recession. The electricity customers who are unable to afford rooftop solar are forced to subsidize those who are already in a more favorable financial position. Thus, it is entirely fair to characterize NEM as a wealth transfer from less affluent ratepayers to more affluent ones.

Tariffs with a regressive social impact are certainly worthy of consideration from a policy and rate-making perspective. Thus, if externalities are to be weighed in setting pricing for solar DG, then it is important to avoid inordinate cost shifting and, in particular, to avoid adding new burdens to the less affluent in order to provide benefits to those further up on the income scale.

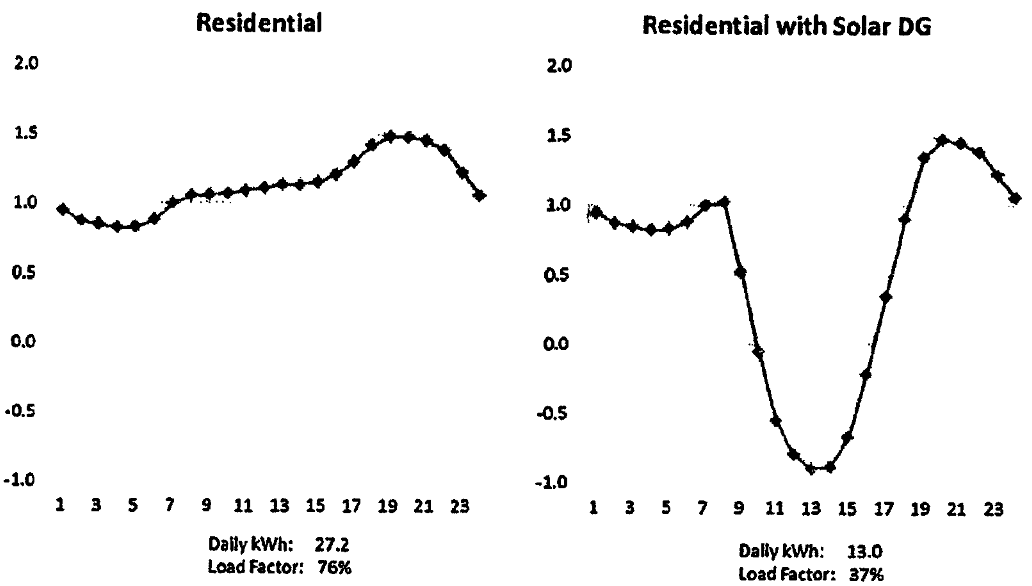

Figure 6: Typical Residential Loads Average Day – Iowa

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XI. Impact on Job Creation

The impact of solar PV on jobs is often cited as an externality benefit. Any analysis of the job impact must be comprehensive and not an effort to cherry pick data. For instance, merely citing the number of solar installers employed does not tell us much. Many aspirations for more jobs manufacturing PV units in the United States have not materialized due to China's capture of the market. Other impacts to be considered are the effect of solar PV on electric rates and the impact of that on the job market, not only in terms of what happens with rates, but also in terms of the rate structure that is implemented as a result of more market penetration by solar DG. For example, it is conceivable that any movements toward more fixed costs could discourage energy efficiency work thus displacing jobs in manufacturing and installing energy efficiency technology.

XII. Conclusion

There is value in solar DG, but that value is severely diminished and placed in peril if its pricing discourages efficiency improvements and distorts critical price signals in the marketplace. It is similarly counterproductive to the future of solar DG if its pricing has socially regressive effects and if it sucks needed revenue away from the essential distribution grid. From an economic point of view solar DG has energy value, the potential for reducing some transmission costs, and perhaps under the right circumstances, some capacity value, and ought to be compensated accordingly. With regard to externalities, it is not entirely clear, when viewed in the entire scope of its impact, that solar DG, has positive environmental value, but it is absolutely

clear that when net metering is deployed, it is simply not a cost-effective means for reducing carbon emissions. In fact, it is possible that solar DG might do more harm than good if it has the effect of removing price incentives for energy efficiency, and if it causes older plants to extend their lives and to operate inefficiently on a ramping basis for which they were not designed. It seems clear that if we are to capture the full value of solar DG, net metering must be discarded and replaced with a market-based pricing system that values the resource appropriately and includes incentives for making it more efficient over the long run.■

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BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS

DOUG LITTLE, Chairman
BOB STUMP
BOB BURNS
TOM FORESE
ANDY TOBIN

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF VALUE AND COST OF DISTRIBUTED GENERATION	**DOCKET NO. E-00000J-14-0023**

DIRECT TESTIMONY OF DAVID HEDRICK

ON BEHALF OF

SULPHUR SPRINGS VALLEY ELECTRIC COPERATIVE, INC.

FEBRUARY 25, 2016

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BACKGROUND AND PURPOSE

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is David W. Hedrick, and my business address is 5555 North Grand Boulevard, Oklahoma City, Oklahoma 73112-5507.

Q. BY WHOM ARE YOU EMPLOYED, AND WHAT IS YOUR POSITION?

A. I am employed by Guernsey Engineers, Architects and Consultants. I am Senior Vice-President and Manager of the Analytical Services group.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND WORK EXPERIENCE.

A, I have earned a Bachelor of Science degree from the University of Central Oklahoma in mathematics and a M.B.A degree from Oklahoma City University. I have been employed with Guernsey since 1981. My primary area of responsibility is rate analysis and cost of service work for electric distribution cooperatives and electric generation/transmission cooperatives. Attached hereto as Exhibit DWH-1 is my resume with a listing of the projects and clients with which I have been involved.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE REGULATORY COMMISSIONS?

A. Yes. I have testified before the Arizona Corporation Commission, the Arkansas Public Service Commission, the Colorado Corporation Commission, the Oklahoma Corporation Commission, the Public Utility Commission of Texas, and the Wyoming Public Service Commission.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS MATTER?

A. I am testifying on behalf of Sulphur Springs Valley Electric Cooperative, Inc. ("SSVEC" or "Cooperative").

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. My testimony provides SSVEC's position regarding the cost of solar distributed generation on its electric distribution cooperative members. My testimony will address:

a. The impact of Distributed Generation ("DG") and Net Metering on the Cooperative;
b. The Cooperative's Avoided Costs and the fact that its wholesale capacity costs are not reduced as a result of solar DG;
c. The lack of reduction in the Cooperative's distribution costs as a result of solar DG;
d. The negative impact of DG on the Cooperative is more significant than for other utilities;
e. The development of charges and/or credits for DG should be based on the same criteria used to develop the rates and charges for other customers;
f. Programs to mitigate the costs of DG should be fair and equitable to all customers; and
g. Legislation and other authoritative materials regarding the costs and benefits of solar DG.

IMPACT OF DG AND NET METERING

Q. PLEASE PROVIDE AN OVERVIEW OF THE IMPACT THAT DG INSTALLED BY MEMBER CONSUMERS HAS ON THE COOPERATIVE AND ITS MEMBERS.

A. SSVEC delivers electric service to its members using extensive distribution systems. Its distribution systems consists of electric facilities built to serve the total capacity of the electric load and customer-specific electric facilities that are required to provide service regardless of how much energy is consumed. The capacity-related facilities include substations, a portion of the overhead and underground lines, and a portion of the transformers. The customer-related facilities include a portion of the overhead and underground lines, a portion of the transformers, the service lines, and the meters. The costs of providing service associated with both the capacity- and customer-related facilities are fixed in nature. That is, these costs do not vary based on the amount of energy (kWh) consumed by the Cooperative's members. While a customer density per mile of line will lessen the average per customer cost of these facilities, the Cooperative has relatively few customers per mile of line. Most of the cooperatives in Arizona were formed in rural areas where the densities and operating margins were deemed too small to attract the necessary capital investment from investor-owned utilities ("IOUs") or even any nearby municipal utility. As a result, the number of customers per mile of line for the cooperatives tends to be significantly lower and the fixed investment per customer significantly higher than most IOUs.

In addition to the fixed distribution costs of providing service, the Cooperative also incurs fixed wholesale capacity costs to provide electric service to its members from its wholesale power suppliers. These costs are associated with existing generation facilities that ensure the ability to provide continuous service to members. These fixed costs do not vary and are represented in a fixed charge billed by the wholesale suppliers.

Historically, the Cooperative has recovered the costs of providing service to Residential members through rates that include a monthly service availability charge and an energy charge applied to the monthly kWh consumption. The monthly service availability charges approved by the Arizona Corporation Commission have historically been set at amounts well below the total customer-related cost of providing service per customer. The energy charges have historically been designed to recover the remainder of costs to provide service not included in the service availability charges (which include a portion of the customer-related costs, all of the fixed distribution demand costs, the fixed wholesale demand costs, and the variable energy costs).

This rate design recovers a major portion of the fixed costs in the variable component of the rate. It can function well for the recovery of costs where all of the customers being served in the Residential rate class are similar consuming entities receiving all or most of their energy from a single utility. However, this rate design does not provide for the appropriate recovery of the costs incurred in providing service to customers that have solar DG facilities.

Customers that install DG facilities will reduce the energy (kWh) that is purchased from the Cooperative by an amount equal to the generation output of their facilities. This reduction in kWh purchased from the Cooperative results in a loss of fixed costs being recovered through the energy component of the rate. The fixed distribution demand and customer costs that the Cooperative incurs to provide service are similar for all Residential customers, whether they have DG or not. These fixed distribution demand and customer costs incurred by the Cooperative are not reduced as a result of the installation of DG. Yet, because of the existing rate structure and the reduction in kWh purchased by the DG customers, the fixed costs included in the energy component of the rate are not recovered. As a result, the Cooperative's customers with DG do not pay the appropriate fixed demand and customer costs for the provision of electric service, while the remainder of customers pay more than their equitable share of those costs. The installation of DG initially results in recovery of less revenue than the existing rates were designed to recover. This inadequate recovery of lost fixed costs and under-recovery of authorized revenues must ultimately be recovered either from customers with DG or from all of the Cooperative's remaining customers with consumption.

Q. **ARE MEMBERS WITH DG CONTINUING TO UTILIZE THE GRID FOR SERVICE?**

A. Yes. Members of the Cooperative may believe that if their net power flow is zero that they are not using the grid. This is simply not true. First of all, those with DG systems don't produce power all of the time. When they are producing in excess of their own needs, the excess energy is put back on the grid. The Cooperative's systems then serve essentially as a battery to provide energy when the DG customers are not producing power sufficient to meet their load requirements.

It is important to understand that the grid provides much more than power. The grid services that the Cooperative and other utilities provide include reliability, reserves, frequency control, voltage control, and redundancy as physical quantities flowing through the grid. Members may have net zero power flows, but reliability is flowing into the members, and none is flowing out: not a net zero. Voltage control is flowing into the members, and none is flowing out: not a net zero. Frequency control is consumed by the members, and none is provided by the members: not a net zero. In short, while members may have reached a "net zero" threshold on energy (kWh), they are a large net negative on very expensive grid services that everyone else has to pay for. Stating that you don't use the grid because you are net zero is like saying, "I drive the same road to and from work each day, so I net zero mileage on the road and, therefore, I don't use the road."

Q. WHAT ARE "LOST FIXED COSTS" RELATED TO DG?

A. The energy charge in the Cooperative's Residential rates include three cost components: purchased power demand costs, purchased power energy costs, and distribution wires costs. The purchased power demand costs and distribution wires costs are fixed costs that do not vary based on kWh consumption and are not reduced as a result of a member's reduced consumption, even though these costs are recovered in the energy charge of the Residential rate. Therefore, as energy consumption is reduced due to installed DG, these fixed costs are no longer recovered from these consumers. These costs not recovered from members with DG are known as "lost fixed costs."

Q. WHAT IS THE MAGNITUDE OF THE UNRECOVERED FIXED COSTS?

A. Exhibit DWH-2 provides a calculation of the lost fixed costs resulting from service provided to Residential members with DG under Sulphur Springs Valley Electric Cooperative, Inc.'s existing Net Metering Tariff NM-1. At the end of 2014, SSVEC provided service to 1,013 Residential members with DG. The average size of the DG system installed is 5.62 kW (AC) with a capacity factor of approximately 25%. The average monthly production for a unit of this size is 1,026 kWh. Pursuant to its Net Metering tariff, SSVEC must compensate the consumer for the total production from a DG unit at the full retail rate. As a result, every kWh generated by a consumer's DG unit results in the lost fixed costs to SSVEC identified on Exhibit DWH-2. The average monthly lost fixed costs associated with the purchased power demand costs is ~~$43.85~~ 44.61 DH per customer under the existing Residential rate. The average monthly lost fixed costs associated with distribution wires costs is ~~$49.85~~ 49.05 DH per customer under the existing Residential rate. The total average monthly lost fixed cost is ~~$93.70~~ 93.66 DH per customer. The estimated lost fixed costs for SSVEC's 1,013 customers for an annual period under the existing Residential rate would, therefore, be ~~$1,139,013~~. 1,138552 DH

Q. WHAT IMPACT DOES ARIZONA'S EXISTING NET METERING POLICY HAVE ON THE COOPERATIVES?

A. The existing Net Metering policy is found in Arizona Administrative Code R14-2-2306, which provides as follows:

> A. On a monthly basis, the Net Metering Customer shall be billed or credited based upon the rates applicable under the Customer's currently effective standard rate schedule and any appropriate rider schedules.

B. The billing period for Net Metering will be the same as the billing period under the Customer's applicable standard rate schedule.

C. If the kWh supplied by the Electric Utility exceeds the kWh that are generated by the Net Metering Facility and delivered back to the Electric Utility during the billing period, the Customer shall be billed for the net kWh supplied by the Electric Utility in accordance with the rates and charges under the Customer's standard rate schedule.

D. If the electricity generated by the Net Metering Customer exceeds the electricity supplied by the Electric Utility in the billing period, the Customer shall be credited during the next billing period for the excess kWh generated. That is, the excess kWh during the billing period will be used to reduce the kWh supplied (not kW or kVA demand or customer charges) and billed by the Electric Utility during the following billing period.

E. Customers taking service under time-of-use rates who are to receive credit in a subsequent billing period for excess kWh generated shall receive such credit during the next billing period during the on- or off-peak periods corresponding to the on- or off-peak periods in which the kWh were generated by the Customer.

F. Once each calendar year the Electric Utility shall issue a check or billing credit to the Net Metering Customer for the balance of any credit due in excess of amounts owed by the Customer to the Electric Utility. The payment for any remaining credits shall be at the Electric Utility's Avoided Cost. That Avoided Cost shall be clearly identified in the Electric Utility's Net Metering tariff.

As discussed above, members with installed DG reduce the energy (kWh) purchased from the Cooperative and, thereby, cause lost fixed costs to be incurred. Arizona's existing Net Metering policy exacerbates the loss of fixed costs by requiring the Cooperative to pay (via energy credits) the full retail rate for energy generated by the members, even though the retail rate far exceeds the value of the excess generation. Instead of full retail rates, Avoided Cost rates (discussed below) are the more appropriate form of compensation of excess generation. The current policy of over-compensation for DG energy creates a cost that all members of the Cooperative must pay. The application of the Net Metering policy in its current form is not equitable.

AVOIDED COST RATE AND WHOLESALE CAPACITY COSTS

Q. WHAT ARE THE COOPERATIVE'S AVOIDED COST RATES?

A. Avoided Costs are those costs that are eliminated as a result of power produced by DG resources. The Cooperative's Avoided Cost rates are calculated based on the wholesale fuel and energy cost per kWh charged by the Cooperative's wholesale power suppliers.

Q. WHY DO THE AVOIDED COST RATES INCLUDE ONLY THE WHOLESALE FUEL AND ENERGY COSTS?

A. The Cooperative does not provide all of its own generation, but rather contracts with Arizona Electric Power Cooperative and other providers for its wholesale power requirements. These existing contracts, which provide the vast majority of power used to serve the Cooperative's customers, include a fixed charge payment for the cost of generation capacity. This fixed charge payment is constant and does not vary based on consumption. As a result, any potential reduction in capacity requirements created by the operation of DG does not translate into a reduction in generation capacity costs for the Cooperative. Therefore, there is no capacity component included in the calculation of the Cooperative's Avoided Cost rates. Only the variable components of the wholesale rate – fuel and energy – are included in the determination of the Avoided Cost rates. To the extent that a DG facility produces kWh that offset the wholesale supplier's delivery of kWh, only the associated fuel and energy costs are truly avoided.

DISTRIBUTION SYSTEM COSTS

Q. ARE THERE QUANTIFIABLE AVOIDED DISTRIBUTION SYSTEM COSTS ASSOCIATED WITH SOLAR DG?

A. The experience of the Cooperative is that solar DG does not reduce its distribution costs of providing service. Because of the intermittency and lack of reliability of rooftop solar DG, a customer with rooftop solar must still rely on power provided from the electric grid during times when the DG unit is not operating or when the DG unit does not provide sufficient generation to serve the customer's entire load. As a result, the size of the facilities required to provide service to a customer with DG is no different than for a standard customer without DG. This means that the metering, transformer, and service drop at the customer's service location would be the same as for any other similarly situated customer. The sizing of the Cooperative's substation facilities and overhead/underground primary distribution line facilities are, likewise, unaffected by the presence of rooftop solar DG. The planning process for construction of distribution facilities is affected by solar DG only to the extent that additional equipment and devices are required to address operational issues, such as circuit loading, voltage regulation, power factor problems, and protection coordination. Such equipment could include but not be limited to additional regulators, capacitors, breakers, reclosers, and fuses. The need for additional equipment to deal with operational issues becomes more significant as the number of customers with solar DG on an individual circuit increases.

IMPACT OF DG ON THE COOPERATIVES

Q. DO THE ISSUES RELATED TO THE RECOVERY OF COSTS ASSOCIATED WITH SOLAR DG HAVE A MORE PRONOUNCED IMPACT ON THE COOPERATIVES THAN ON THEIR INVESTOR-OWNED NEIGHBORS?

A. Yes. All utilities share cost recovery issues related to solar DG. However, there are two reasons why the recovery of the distribution costs of providing service to customers with solar DG is a bigger problem for the cooperatives.

First, the cooperatives are located in rural areas and, therefore, have a much lower number of customers per mile. As a result, they require a much higher level of plant investment per consumer to provide service. This leads to a higher distribution cost of providing service per kWh. Exhibit DWH-3 reflects the differences in line density and average cost for the more rural cooperatives in comparison with APS and UNS. This higher level of distribution costs for the cooperatives means that the level of lost fixed costs created by customers with solar DG is a more significant issue for the cooperatives. Approving rates and charges that allow for a better recovery of the distribution costs associated with providing service to customers with solar DG is an essential step in ensuring that all customers pay their fair and equitable share of the costs for distribution service.

The second reason that the recovery of the distribution costs for service to solar DG customers is a more significant issue to the cooperatives is their small size and the fact that the areas served by the cooperatives are the most economically challenged counties in Arizona. Their small size means there are fewer customers over which to spread any subsidies created by solar DG. Furthermore, customers with lower incomes are less likely to participate in rooftop solar and least able to pay any subsidy caused by the lost recovery of fixed costs from those customers that do deploy rooftop solar.

DEVELOPMENT OF DG CHARGES AND CREDITS

Q. WHAT STANDARD SHOULD BE APPLIED TO DEVELOP THE CHARGES AND CREDITS FOR SOLAR DG?

A. There has been considerable discussion, not only in Arizona, but across the country, regarding methods for quantifying the future benefits of solar DG. It would be appropriate that the same standards used in the development of rates for Arizona utilities be applied in determining the value of solar DG. The primary standard in rate making is that a utility may include for recovery in its rates only those expenses that are known, measurable, and of a continuing nature. In addition, utilities have not been allowed to recover in current rates those costs that are for future periods. SSVEC does not have information or data regarding any future generation capacity savings, transmission savings, or environmental savings associated with the implementation of solar DG that would comply with the current rate-setting standard. Therefore, SSVEC is concerned by proposals to develop charges and credits for current rates that would be based on a different standard, specifically one that would require recognition of future unquantifiable benefits or potential future quantifiable benefits of solar DG.

PROGRAMS TO MITIGATE DG COSTS

Q. WHAT OTHER CONCERNS DOES SSVEC HAVE REGARDING THE RECOVERY OF COSTS ASSOCIATED WITH SOLAR DG?

A. SSVEC is concerned that programs or plans implemented to mitigate the impacts of solar DG could result in additional costs to all of its members. Discussions have taken place regarding the appropriate means by which to deal with the recovery of lost fixed costs in an equitable manner. One option discussed was the establishment of demand rates for all customers.

For utilities that have interval demand meters in place system wide, properly designed demand rates may provide a means of fixed cost recovery from customers based on how they use the grid. One significant concern with this option, however, is that most of the cooperatives have demand meters installed and utilize demand rates only for commercial and industrial rate classes. The installation of demand meters and the other necessary communications equipment and software to establish demand rates for all customers would be prohibitively expensive for SSVEC and take years to implement and, thus, would not address the immediate issues. In addition, SSVEC has fixed generation costs that do not get reduced by lowering the demand of the individual cooperative. Thus, a demand rate would not result in any fixed cost savings to the cooperative which could be passed on to its members. To the extent the Commission is considering demand rates as one method to address the issues in this docket, it should provide the cooperatives with flexibility based on each cooperative's particular circumstances.

NON-ARIZONA AUTHORITIES

Q. ARE THE ISSUES RELATED TO DG CUSTOMERS LIMITED ONLY TO ARIZONA?

A. No. The issues related to DG customers and Net Metering are being addressed across the country. Other state regulatory bodies have developed laws and orders pertaining to the cost issues that are informative. Attached as Exhibit DWH-4 is legislation that was passed in Oklahoma that requires utilities in the state to eliminate subsidies to customers with DG. Specifically, the law states:

> *C. No retail electric supplier shall allow customers with distributed generation installed after the effective date of this act to be subsidized by customers in the same class of service who do not have distributed generation.*
>
> *D. A higher fixed charge for customers within the same class of service that have distributed generation installed after the effective date of this act, as compared to the fixed charges of those customers who do not have distributed generation, is a means to avoid subsidization between customers within that class of service and shall be deemed in the public interest.*

Exhibit DWH-5 is legislation that was passed in Arkansas to amend the requirements for utilities to compensate Net Metering customers. Section 3 of the act directs the Arkansas Public Service Commission to establish rates, terms, and conditions for net-metering contracts, including:

(A)(i) A requirement that the rates charged to each net-metering customer recover the electric utility's entire cost of providing service to each net-metering customer within each of the electric utility's class of customers.

(ii) The electric utility's entire cost of providing service to each net metering customer within each of the electric utility's class of customers under subdivision (b)(1)(A)(i) of this section:

(a) Includes without limitation any quantifiable additional cost associated with the net-metering customer's use of the electric utility's capacity, distribution system, or transmission system and any effect on the electric utility's reliability; and

(b) Is net of any quantifiable benefits associated with the interconnection with and providing service to the net-metering customer, including without limitation benefits to the electric utility's capacity, distribution system or transmission system.

In addition to the legislation passed in Oklahoma and Arkansas, the Wisconsin Public Service Commission has also recently provided comment on DG subsidies. On page 62 of the Order in Docket No. 05-DR-107 (December 23, 2014), the commission states:

As Wisconsin courts have long recognized, rate design is a quintessential legislative function firmly left to the discretion of the Commission. Other substantial state and federal programs are designed specifically to support the development and implementation of conservation and renewable energy resources. The Commission is not required to use rate design as a hidden subsidy for these resources. This Commission continues to support customers who want to own their own generation;

however, the Commission also has an obligation to those customers who do not want to or who cannot afford to own generation to make sure these customers are not subsidizing the costs for those who choose to and are able to own their own generation.

Q. WHAT ADDITIONAL INFORMATION HAVE YOU PROVIDED FOR CONSIDERATION WITH REGARD TO THE COST RECOVERY ISSUE FOR DG CUSTOMERS?

A. Attached as Exhibit DWH-6 is an article from the December 2014 *Electricity Journal* entitled "Valuation of Distributed Solar: A Qualitative View."[1] The article was written by Mr. Ashley Brown, the Executive Director of the Harvard Electricity Policy Group, former Commissioner of the Ohio Public Utility Commission, and former chairman of NARUC, and Jillian Bunyan, an attorney formerly with the United States Environmental Protection Agency's Office of Regional Counsel. The preface to the article provides insight regarding the content of the article:

> *A critical evaluation of the arguments used by solar DG advocates shows that those arguments may often overvalue solar DG. It is time to reassess the value of solar DG from production to dispatch and to calibrate our pricing policies to make certain that our efforts are equitable and carrying us in the right direction.*

These examples of legislation and commission orders, as well as the *Electricity Journal* article, confirm that (1) there are significant cost recovery issues associated with the provision of service to customers with installed solar DG and (2) the current use of Net Metering is not an effective or equitable means to compensate customers

[1] 1040-6190/© 2014 Elsevier Inc. All rights reserved. http://dx.doi.org/10.1016/j.tej.2014.11.005.

for that excess generation.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes, it does.

guernsey

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CONSULTANTS

DAVID W. HEDRICK
SENIOR VICE PRESIDENT /
MANAGER, ANALYTICAL SOLUTIONS

EDUCATION:

M.B.A., Oklahoma City University, 1993
B.S., Mathematics, University of Central Oklahoma, 1986

PERTINENT EXPERIENCE FOR THE PROJECT:

Mr. Hedrick specializes in the development of revenue requirements, cost of service, rate design, line extension analysis, special contract development, pole attachment rates, valuation analysis and other financial analysis for electric, water, and wastewater utility systems. He is also responsible for the preparation of rate filings and has presented expert testimony before state regulators, including Arizona, Arkansas, Colorado, Oklahoma, Texas and Wyoming. Mr. Hedrick's clients include both distribution providers and wholesale providers. He was instrumental in the development of the CoOPTIONS: family of computer software for use in unbundled utility cost of service studies and financial forecasting.

As Manager of the Analytical Solutions Group, Mr. Hedrick has oversight of all studies, analyses and filings that are developed by the group. He continues to represent clients before the appropriate regulatory authority and is responsible for the preparation of rate filings and other analytical studies.

SPECIFIC CONSULTING EXPERIENCE:

Acquisitions, Consolidations & Valuation Analysis

Mr. Hedrick has provided analytical support for consolidation studies in Texas and Wyoming. In addition, he has been involved in the valuation analysis of utility assets for purposes of acquisition and determination of fair market value for clients in Oklahoma and Kansas.

Retail Rate Analysis, Cost of Service Studies, and Line Extension Analysis

Mr. Hedrick's rate analysis and cost of service experience includes the following:

Arizona

- Navopache Electric Cooperative, Inc. - Regulated by Arizona Corporation Commission
- Sulphur Springs Valley Electric Cooperative, Inc. - Regulated by Arizona Corporation Comm.
- Trico Electric Cooperative, Inc. - Regulated by Arizona Corporation Commission

Arkansas

- Arkansas Valley Electric Cooperative Corporation - Regulated by Arkansas PSC and Oklahoma Corporation Commission
- Ouachita Electric Cooperative Corporation - Regulated by Arkansas PSC
- Ozarks Electric Cooperative Corporation - Regulated by Arkansas PSC

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Colorado

- Colorado Rural Electric Association
- Delta-Montrose Electric Association
- Empire Electric Association, Inc.
- Grand Valley Rural Power Lines
- Holy Cross Electric Association, Inc.
- Mountain Parks Electric, Inc.
- Poudre Valley REA, Inc.
- San Luis Valley Rural Electric Cooperative, Inc.
- Yampa Valley Electric Association, Inc.

Iowa

- Corn Belt Power Cooperative
- Iowa Lakes Electric Cooperative, Inc.
- Midland Power Cooperative, Inc.

Kansas

- Ark Valley Electric Cooperative Association
- Caney Valley Electric Cooperative Association
- CMS Electric Cooperative, Inc.
- Flint Hills Rural Electric Cooperative Association
- Kansas Electric Power Cooperative
- Lyon-Coffey Electric Cooperative, Inc.
- City of Meade
- Ninnescah Rural Electric Cooperative Association, Inc.
- Pioneer Electric Cooperative, Inc.
- Sedgwick County Electric Cooperative Association, Inc.
- Western Cooperative Electric Association, Inc.

Louisiana

- Claiborne Electric Cooperative

Mississippi

- Southern Pine EPA
- Yazoo Valley EPA

Nebraska

- Dawson County Public Power District

New Mexico

- Farmers Electric Cooperative, Inc.
- Lea County Electric Cooperative, Inc.

Oklahoma

- City of Blackwell
- Caddo Electric Cooperative
- Central Rural Electric Cooperative, Inc.

- Choctaw Electric Cooperative, Inc.
- Cimarron Electric Cooperative, Inc.
- Cookson Hills Electric Cooperative, Inc.
- Cotton Electric Cooperative, Inc.
- City of Duncan
- East Central Oklahoma Electric Cooperative
- Indian Electric Cooperative, Inc.
- Kay Electric Cooperative, Inc.
- Kiwash Electric Cooperative, Inc.
- Lake Region Electric Cooperative, Inc.
- City of Mangum
- Northeast Oklahoma Electric Cooperative, Inc.
- Northfork Electric Cooperative
- Northwestern Electric Cooperative, Inc.
- Oklahoma Electric Cooperative, Inc.
- City of Ponca City
- Rural Electric Cooperative, Inc.
- Southeastern Electric Cooperative, Inc.
- Southwest Rural Electric Association
- Tri-County Electric Cooperative, Inc.
- Verdigris Valley Electric Cooperative

Texas

- Bailey County ECA
- Bandera Electric Cooperative, Inc.
- Big Country Electric Cooperative, Inc.
- Bluebonnet Electric Cooperative, Inc.
- Central Texas Electric Cooperative, Inc.
- Concho Valley Electric Cooperative, Inc.
- Cooke County Electric Cooperative Assn.
- CoServ Electric
- Deaf Smith Electric Cooperative, Inc.
- Fannin County Electric Cooperative, Inc.
- Farmers Electric Cooperative, Inc.
- Fort Belknap Electric Cooperative, Inc.
- Grayson-Collin Electric Cooperative, Inc.
- Greenbelt Electric Cooperative, Inc.
- HILCO Electric Cooperative, Inc.
- Jackson Electric Cooperative, Inc.
- Lamar County Electric Cooperative, Inc.
- Lighthouse Electric Cooperative, Inc.
- Lyntegar Electric Cooperative, Inc.
- Magic Valley Electric Cooperative, Inc.
- Medina Electric Cooperative, Inc.
- Navarro County Electric Cooperative, Inc.
- Navasota Valley Electric Cooperative, Inc.
- North Plains Electric Cooperative, Inc.
- Nueces Electric Cooperative, Inc.
- Pedernales Electric Cooperative, Inc.

- Rita Blanca Electric Cooperative, Inc.
- San Bernard Electric Cooperative, Inc.
- South Plains Electric Cooperative, Inc.
- Southwest Rural Electric Association, Inc., Okla.
- Southwest Texas Electric Cooperative, Inc.
- Swisher Electric Cooperative, Inc.
- Taylor Electric Cooperative, Inc.
- Texas Electric Cooperatives, Inc., Statewide Association
- Tri-County Electric Cooperative, Inc.
- Trinity Valley Electric Cooperative, Inc.
- United Cooperative Services
- Wharton County Electric Cooperative, Inc.
- Wise Electric Cooperative, Inc.

Wyoming

- Big Horn REC - Regulated by Wyoming Public Service Commission until 2007
- Carbon Power & Light, Inc. - Regulated by Wyoming Public Service Commission until 2007
- High Plains Power, Inc. - Regulated by Wyoming Public Service Commission until 2007
- Powder River Energy Corporation - Regulated by Wyoming Public Service Commission
- Wyrulec Company - Regulated by Wyoming Public Service Commission until 2007

Wholesale Rate Analysis and Cost of Service Studies

- Corn Belt Power Cooperative, Humboldt, Iowa
- Kansas Electric Power Cooperative, Topeka, Kansas
- Grand River Dam Authority, Vinita, Oklahoma
- Oklahoma Municipal Power Authority, Edmond, Oklahoma
- Western Farmers Electric Cooperative, Anadarko, Oklahoma
- Central Electric Power Cooperative, Columbia, South Carolina
- Piedmont Municipal Power Authority, Greer, South Carolina
- Brazos Electric Cooperative, Waco, Texas
- Golden Spread Electric Cooperative, Amarillo, Texas
- Old Dominion Electric Cooperative, Richmond, Virginia
- Allegheny Electric Cooperative, Harrisburg, Pennsylvania
- South Mississippi Electric Power Association, Hattiesburg, Mississippi
- Minnkota Power Cooperative, Grand Forks, North Dakota
- Rayburn Country Electric Cooperative, Rockwall, Texas

Special Projects

Development of Distributed Generation Procedures and Guidelines Manual:

- Western Farmers Electric Cooperative, Anadarko, Oklahoma
- KAMO Electric, Vinita, Oklahoma
- Texas Electric Cooperatives, Austin, Texas

Energy Policy Act of 2005 / EISA 2007 - Testimony in Support of Cooperative Staff's Position in Consideration of new PURPA Standards:

- Central Rural Electric Cooperative, Stillwater, Oklahoma
- Cotton Electric Cooperative, Walters, Oklahoma
- Farmers Electric Cooperative, Greenville, Texas
- Grand River Dam Authority, Vinita, Oklahoma
- Grayson-Collin Electric Cooperative, Van Alstyne, Texas
- HILCO Electric Cooperative, Itasca, Texas
- Lake Region Electric Cooperative, Hulbert, Oklahoma
- Lyntegar Electric Cooperative, Tahoka, Texas
- Magic Valley Electric Cooperative, Mercedes, Texas
- Northwestern Electric Cooperative, Woodward, Oklahoma
- Oklahoma Electric Cooperative, Norman, Oklahoma
- Tri-County Electric Cooperative, Azle, Texas
- Tri-County Electric Cooperative, Hooker, Oklahoma
- United Electric Co-op Services, Cleburne, Texas

Testimony before Colorado State House and Senate Committees in support of the Colorado Rural Electrification Association with regard to HB1169, Mandating Net Metering for Electric Cooperatives.

The "Fresh Look" review of East Kentucky Power Cooperative on behalf of the cooperative's distribution members as required by the Kentucky Corporation Commission. 2011 - 2012

Education and Training

Mr. Hedrick provides educational seminars and training for cooperative staff and boards of directors, statewide associations, and professional organizations on the topics of Rate Analysis, Cost of Service, Rate Design, Line Extension Policy, and related issues.

Expert Witness

Mr. Hedrick has provided expert testimony related to the development of revenue requirements, cost of service, rate design, and special contract issues in Arizona, Arkansas, Oklahoma, Texas, and Wyoming.

Financial Forecasting & Analysis

Mr. Hedrick prepares and provides training in the development of financial forecast models for electric cooperatives and municipal utility systems.

Software Sales & Support

Mr. Hedrick provided assistance in the development of software for GUERNSEY's 10-year Financial Forecast, Cost of Service, and Financial Performance Analysis programs. Mr. Hedrick is proficient in the use of these software packages and provides support to client users.

Strategic Planning & Analysis

Mr. Hedrick has provided assistance to electric cooperative boards of directors in the development of strategic goals and objectives.

Publications and Presentations:

Articles:

Hedrick, David W. "Retail Rate Development: The Role of the Cooperative Board." *Management Quarterly*, published by NRECA's Education and Training Department. (Spring 2005): 20-35.

Presentations Made by Mr. Hedrick:

"Knowledge is Power: Financial Forecasting." Seminar written and presented by Guernsey personnel annually since 2006 in Oklahoma City, Okla. Mr. Hedrick has been a presenter for this seminar numerous times.

"Knowledge is Power: Understanding Rates and Cost of Service." Seminar written and presented by Guernsey personnel annually since 2005, in Oklahoma City, Okla., as well as other locations. Mr. Hedrick has been a presenter numerous times.

"Distributed Generation Net Metering Issues." Written for and presented at *TEC Engineers Association Annual Meeting.* September 2006.

"Net Metering Issues." Written for and presented at *G&T Planners Association Meeting,* Tucson. Arizona, September 2006.

"Development of Distributed Generation Policies and Procedures." Written and presented for *Texas Electric Cooperatives' Managers Meeting.* San Antonio, Texas, December 2, 2004.

"Rate Design in a Restructured Environment." Written and presented for *Texas Electric Cooperatives Accountants Association.* Austin, Texas, April 19, 2000.

EXPERIENCE RECORD:

1981-Present - C. H. Guernsey & Company, Oklahoma City, Oklahoma

2013 - Senior Vice President, Board of Directors
2008-2013 – Vice President for Guernsey
2005-Present - Manager, Analytical Solutions Group

DWH - 2

DH

SULPHUR SPRINGS VALLEY ELECTRIC COOPERATIVE

CALCULATION OF LOST FIXED COST RECOVERY
AS A RESULT OF MEMBER OWNED DISTRIBUTED GENERATION SERVED ON THE RESIDENTIAL RATE
ADMINISTERED IN CONJUNCTION WITH NET METERING TARIFF NM - 1 (EXISTING POLICY)

			Existing Rates
1	Total Residential Energy Charge including WPCA		$ 0.119768
2	Purchased Power Energy Cost included in Residential Rate		$ 0.028450
3	Purchased Power Demand Cost included in Residential Rate		$ 0.043493
	Remainder: Distribution Wires		
4	Component in Residential Energy Charge	L1 - L2 - L3	$ 0.047825
	<u>Lost Fixed Cost Calculation:</u>		
5	Total Residential DG Customers at TY End		1,013
	Monthly kWh Produced by 5.62 kW AC		
6	PV System with 25% Capacity Factor	5.62 kW x 730 Hrs x 25%	1,026
7	Purch Power Demand Lost Fixed Cost - Monthly	L6 x L3	$ 44.61
8	Distr. Wires Lost Fixed Cost - Monthly	L6 x L4	$ 49.05
9	Total Lost Fixed Costs - Monthly	L7 + L8	$ 93.66
10	Total Lost Fixed Costs Annual	L9 x L5 x 12	$ 1,138,552

DWH-3

COMPARISON OF LINE DENSITY AND DISTRIBUTION WIRES COST

	Number of Consumers	Distribution Miles of Line	Consumers Per Mile	Residential Distr. Wires ($/kWh) (Note 1)
Duncan Valley	2,327	453	5.1	
Graham County	8,875	1,098	8.1	$ 0.03183
Navopache	40,042	2,475	16.2	$ 0.03027
Sulphur Springs	52,815	3,765	14.0	$ 0.04740
TRICO	40,242	3,466	11.6	$ 0.03860
APS	1,132,296	28,000	40.4	$ 0.02700
UNS	91,821	2,309	39.8	$ 0.01430

Data for 2014

Note 1: Distribution wires cost for a 1,000 kWh customer included in energy charge per tariff

EXHIBIT DWH - 4

An Act

ENROLLED SENATE
BILL NO. 1456

By: Griffin of the Senate

and

Turner, Echols, Jackson, Newell, Schwartz, Murphey, Brumbaugh, Pittman, Rousselot and Fisher of the House

An Act relating to public utilities; amending 17 O.S. 2011, Section 156, which relates to distributed generation costs; defining terms; modifying prohibition relating to recovery of certain fixed costs from electric customers utilizing certain distributed generation; prohibiting subsidization of certain costs among customer class; requiring rate tariff adjustment by certain date; and providing an effective date.

SUBJECT: Electrical power distribution requirements

BE IT ENACTED BY THE PEOPLE OF THE STATE OF OKLAHOMA:

SECTION 1. AMENDATORY 17 O.S. 2011, Section 156, is amended to read as follows:

Section 156. A. As used in this section:

1. "Distributed generation" means:

a. a device that provides electric energy that is owned, operated, leased or otherwise utilized by the customer,

b. is interconnected to and operates in parallel with the retail electric supplier's grid and is in compliance with the standards established by the retail electric supplier,

c. is intended to offset only the energy that would have otherwise been provided by the retail electric supplier to the customer during the monthly billing period,

d. does not include generators used exclusively for emergency purposes,

e. does not include generators operated and controlled by a retail electric supplier, and

f. does not include customers who receive electric service which includes a demand-based charge.

2. "Fixed charge" means any fixed monthly charge, basic service, or other charge not based on the volume of energy consumed by the customer, which reflects the actual fixed costs of the retail electric supplier.

3. "Retail electric supplier" means an entity engaged in the furnishing of retail electric service within the State of Oklahoma and is rate regulated by the Oklahoma Corporation Commission.

B. No ~~public utility~~ retail electric supplier shall increase rates charged or enforce a surcharge ~~on the basis of the use or installation of a solar energy device by a consumer~~ above that required to recover the full costs necessary to serve customers who install distributed generation on the customer side of the meter after the effective date of this act.

C. No retail electric supplier shall allow customers with distributed generation installed after the effective date of this act to be subsidized by customers in the same class of service who do not have distributed generation.

D. A higher fixed charge for customers within the same class of service that have distributed generation installed after the effective date of this act, as compared to the fixed charges of those customers who do not have distributed generation, is a means to avoid subsidization between customers within that class of service and shall be deemed in the public interest.

E. Retail electric suppliers shall implement tariffs in compliance with this act no later than December 31, 2015.

SECTION 2. This act shall become effective November 1, 2014.

EXHIBIT DWH - 4

Passed the Senate the 12th day of March, 2014.

Presiding Officer of the Senate

Passed the House of Representatives the 14th day of April, 2014.

Presiding Officer of the House
of Representatives

OFFICE OF THE GOVERNOR

Received by the Office of the Governor this 15th day of April, 2014, at 3:46 o'clock P M.

By: Audrey Rockwell

Approved by the Governor of the State of Oklahoma this 21st day of April, 2014, at 3:43 o'clock P M.

Governor of the State of Oklahoma

OFFICE OF THE SECRETARY OF STATE

Received by the Office of the Secretary of State this 21st day of April, 2014, at 5:40 o'clock P. M.

By:

EXHIBIT DWH - 5

Stricken language would be deleted from and underlined language would be added to present law.
Act 827 of the Regular Session

State of Arkansas *As Engrossed: H2/26/15 H3/17/15*
90th General Assembly
A Bill
Regular Session, 2015 HOUSE BILL 1004

By: Representative S. Meeks

For An Act To Be Entitled

AN ACT TO REQUIRE ELECTRIC UTILITIES TO COMPENSATE NET-METERING CUSTOMERS FOR NET EXCESS GENERATION CREDITS IN CERTAIN CIRCUMSTANCES; AND FOR OTHER PURPOSES.

Subtitle

TO REQUIRE ELECTRIC UTILITIES TO COMPENSATE NET-METERING CUSTOMERS FOR NET EXCESS GENERATION CREDITS IN CERTAIN CIRCUMSTANCES.

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF ARKANSAS:

SECTION 1. Arkansas Code § 23-18-603(6), concerning a definition used under the Arkansas Renewable Energy Development Act of 2001, is amended to read as follows:

(6) "Net-metering facility" means a facility for the production of electrical energy that:

(A) Uses solar, wind, hydroelectric, geothermal, or biomass resources to generate electricity, including, but not limited to, fuel cells and micro turbines that generate electricity if the fuel source is entirely derived from renewable resources;

(B) Has a generating capacity of not more than:

(i) The greater of twenty-five kilowatts (25 kW) or one hundred percent (100%) of the net-metering customer's highest monthly usage in the previous twelve (12) months for residential use; or ~~three~~

(ii) Three hundred kilowatts (300 kW) for any other

use unless otherwise allowed by a commission under § 23-18-604(b)(5);

(C) Is located in Arkansas;

(D) Can operate in parallel with an electric utility's existing transmission and distribution facilities; and

(E) Is intended primarily to offset part or all of the net-metering customer requirements for electricity; and

SECTION 2. The introductory language of Arkansas Code § 23-18-604(b), concerning the authority of the Arkansas Public Service Commission, is amended to read as follows:

(b) Following notice and opportunity for public comment, ~~the Arkansas Public Service Commission~~ a commission:

SECTION 3. Arkansas Code § 23-18-604(b)(1), concerning the authority of the Arkansas Public Service Commission, is amended to read as follows:

(1) Shall establish appropriate rates, terms, and conditions for net-metering contracts, including ~~a~~:

(A)(i) A requirement that the rates charged to each net-metering customer recover the electric utility's entire cost of providing service to each net-metering customer within each of the electric utility's class of customers.

(ii) The electric utility's entire cost of providing service to each net-metering customer within each of the electric utility's class of customers under subdivision (b)(1)(A)(i) of this section:

(a) Includes without limitation any quantifiable additional cost associated with the net-metering customer's use of the electric utility's capacity, distribution system, or transmission system and any effect on the electric utility's reliability; and

(b) Is net of any quantifiable benefits associated with the interconnection with and providing service to the net-metering customer, including without limitation benefits to the electric utility's capacity, reliability, distribution system, or transmission system; and

(B) A requirement that net-metering equipment be installed to accurately measure the electricity:

~~(A)~~ (i) Supplied by the electric utility to each net-metering customer; and

~~(B)~~ (ii) Generated by each net-metering customer that is fed back to the electric utility over the applicable billing period;

SECTION 4. Arkansas Code § 23-18-604(b)(5) and (6), concerning the authority of the Arkansas Public Service Commission, are amended to read as follows:

(5) May increase the ~~peak~~ generating capacity limits for individual net-metering facilities if doing so results in distribution system, environmental, or public policy benefits; ~~and~~

(6) Shall provide that:

(A)(i) The net excess generation credit remaining in a net-metering customer's account at the close of ~~an annual~~ a billing cycle~~, up to an amount equal to four (4) months' average usage during the annual billing cycle that is closing, shall be credited to the net-metering customer's account for use during the next annual billing cycle;~~ shall not expire and shall be carried forward to subsequent billing cycles indefinitely.

(ii) However, for net excess generation credits older than twenty-four (24) months, a net-metering customer may elect to have the electric utility purchase the net excess generation credits in the net-metering customer's account at the electric utility's estimated annual average avoided cost rate for wholesale energy if the sum to be paid to the net-metering customer is at least one hundred dollars ($100).

(iii) An electric utility shall purchase at the electric utility's estimated annual average avoided cost rate for wholesale energy any net excess generation credit remaining in a net-metering customer's account when the net-metering customer:

(a) Ceases to be a customer of the electric utility;

(b) Ceases to operate the net-metering facility; or

(c) Transfers the net-metering facility to another person; and

~~(B) Except as provided in subdivision (b)(6)(A) of this~~

~~section, any net excess generation credit remaining in a net-metering customer's account at the close of an annual billing cycle shall expire; and~~

~~(C) Any~~ (B) A renewable energy credit created as the result of electricity supplied by a net-metering customer is the property of the net-metering customer that generated the renewable energy credit~~.~~; and

SECTION 5. Arkansas Code § 23-18-604(b), concerning the authority of the Arkansas Public Service Commission, is amended to add an additional subdivision to read as follows:

(7) May allow a net-metering facility with a generating capacity that exceeds three hundred kilowatts (300 kW) if:

(A) The net-metering facility is not for residential use; and

(B) Allowing an increased generating capacity for the net-metering facility would increase the state's ability to attract businesses to Arkansas.

SECTION 6. Arkansas Code § 23-18-604, concerning the authority of the Arkansas Public Service Commission, is amended to add additional subsections to read as follows:

(c)(1) As used in this section, "avoided costs":

(A) For the Arkansas Public Service Commission, means the same as defined in § 23-3-702; and

(B) For a municipal utility, is defined by the governing body of the municipal utility.

(2) Avoided costs shall be determined under § 23-3-704.

(d)(1) Except as provided in subdivision (d)(2) of this section, an electric utility shall separately meter, bill, and credit each net-metering facility even if one (1) or more net-metering facilities are under common ownership.

(2)(A) At the net-metering customer's discretion, an electric utility may apply net-metering credits from a net-metering facility to the bill for another meter location if the net-metering facility and the separate *meter location are under common ownership within a single electric utility's service area.*

(B) Net excess generation shall be credited first to the

net-metering customer's meter to which the net-metering facility is physically attached.

(C) After applying net excess generation under subdivision (d)(2)(B) of this section and upon request of the net-metering customer under subdivision (d)(2)(A) of this section, any remaining net excess generation shall be credited to one (1) or more of the net-metering customer's meters in the rank order provided by the net-metering customer.

/s/S. Meeks

APPROVED: 03/31/2015

Valuation of Distributed Solar: A Qualitative View

A critical evaluation of the arguments used by solar DG advocates shows that those arguments may often overvalue solar DG. It is time to reassess the value of solar DG from production to dispatch and to calibrate our pricing policies to make certain that our efforts are equitable and carrying us in the right direction.

Ashley Brown and Jillian Bunyan

Ashley Brown *is Executive Director of the Harvard Electricity Policy Group and Of Counsel in the Boston office of the law firm Greenberg Traurig LLP. Mr. Brown is a former Commissioner of the Public Utilities Commission of Ohio and former Chair of the National Association of Regulatory Commissioners Electricity Committee.*

Jillian Bunyan *is an associate in the Philadelphia office of Greenberg Traurig LLP. Prior to joining the firm, Ms. Bunyan was an attorney in the United States Environmental Protection Agency's Office of Regional Counsel in Seattle, Washington.*

I. Assessing the Value of Distributed Solar Generation – An Overview

The purpose of this article is to assess the value of residential distributed generation (DG) solar photovoltaics (PV) and appropriate pricing for its value and output. In particular, the article will address the question of whether retail net metering, the way that it is presently applied in most states, is an equitable way to compensate customers who own or lease solar DG. The article will also critically examine the argument for the "value of solar" approach to compensating residential solar DG customers. The article will conclude that retail net metering and "value of solar" are severely flawed schemes for pricing solar DG.

Retail net metering overvalues both the energy and capacity of solar DG, imposes cross-subsidies on non-solar residential customers, and is socially regressive because it effectively transfers wealth from less affluent to more affluent consumers. The "value of solar" approach being advanced by

1040-6190/ http://dx.doi.org/10.1016/j.tej.2014.11.005

some solar DG advocates subjectively, and often artificially, inflates the value of solar DG and discounts the costs. This article also concludes that proposals for market-based energy prices, as well as demand and fixed charges as applied to solar DG hosts, are reasonable ways to rectify the cross-subsidies in net metering. It suggests that market-based prices for solar DG provide the best incentives for making solar more efficient and economically viable for the long term.

Solar PV has some very real benefits and long-term potential. The marginal costs of producing this energy are zero. If one looks at environmental externalities, then the carbon emissions from the actual process of producing this energy itself, without taking the secondary effects into consideration, are also zero. Significantly, the costs of producing and installing solar PV have declined in recent years, adding to the potential long-term attractiveness of solar. Those are very real benefits that would be valuable to capture. In its current, most common configuration, however, solar DG has some drawbacks that inhibit it from capturing its full value.

Solar PV is intermittent and thus requires backup from other generators and cannot be relied on to be available when called upon to produce energy. Thus, its energy value is entirely dependent on when it is produced and its capacity value is, at best, marginal. To fully develop the resource, therefore, it is imperative to provide pricing that will incent the fulfillment of solar PV's potential, by linking itself to storage, more efficient ways of catching the sun's energy, or with other types of generation (e.g. wind) that complement its availability. Thus, it is critical that prices be set in such a fashion as to provide incentives for productivity and reliability and not to subsidize solar DG at a decidedly low degree of optimization. Currently, rates for most residential consumers are based on volume. That is, residential customers are simply billed based on the number of kilowatt-hours that they consume based on average costs to serve all residential consumers. Solar has huge potential, but to attain it, solar DG needs to receive the price signals to actually fulfill its potential.

In its current, most common configuration, solar DG has some drawbacks that inhibit it from capturing its full value.

Not only does net metering deprive solar PV of the price signals necessary to capture its full value, it also leads the changes in retail pricing that undermine the promotion of energy efficiency. As solar DG becomes more widely deployed, utilities and their regulators will likely become increasingly concerned with diminution of revenues required to support the distribution system that is caused by the use of net metering. That concern will inevitably lead utilities and regulators to recover more of their costs through the fixed, rather than the variable, components of their rates. Thus, the price signal to be more efficient will be substantially diluted.

Many in the solar industry have come to recognize that retail net metering (NEM) is, in this age of smart grid and smart pricing, no longer a defensible method for pricing solar DG. Having recognized the inevitable demise of a pricing system that favors solar DG through cross-subsidization by other customers, many solar DG advocates have shifted to an argument that pricing should be based on consideration of the "value of solar." While the authors do not subscribe to that point of view, as the argument is being included in the national conversation, it seems appropriate to address it.

II. Solar DG and Retail Net Metering – Definition of Terms

Powering your home with clean energy generated from the

  http://dx.doi.org/10.1016/j.tej.2014.11.005

solar panels on your roof, and selling the excess energy to the utility, are appealing prospects to a public increasingly attuned to environmental, energy efficiency, and self-sufficiency considerations. It is not hard to see why solar DG has substantial public appeal.

To begin, it is necessary to note that the terms "net metering," "retail net metering," and "net energy metering" will be used interchangeably and synonymously throughout the article. Net metering refers to when electricity meters run forward when solar DG customers are purchasing energy from the grid. When those customers produce energy and consume it on their premises, the meter slows down and then simply stops, and when the customer produces more energy than is consumed on the premises, the meter runs backwards. Thus, the solar DG customer pays full retail value for all energy taken off the grid, pays nothing for energy or distribution when self-consuming energy produced on the premises, and is paid the fully delivered retail price for all energy exported into the system. At the end of whatever period is specified, the meter is read and the customer either pays the net balance due, or the utility pays the customer for excess energy delivered. The reconciliation is made without regard to when energy is produced or consumed. This is how transactions between owners of residential DG and utilities have traditionally been handled.

There are other forms of net metering such as wholesale net metering, where exports into the system are compensated at the wholesale price, often the local marginal price (LMP). There are other variations as well, but for purposes of the article, when the terms NEM or net metering are used, they refer to the retail variety.

There are, conceptually, four possible approaches to pricing energy produced by solar DG.

There are, conceptually, four possible approaches to pricing energy produced by solar DG. One market-based approach is to set the price to reflect the market clearing price in the wholesale market at the time the energy is produced. A second approach would be a cost-based approach, where the price is set based on a review of the costs or according to standard costing methodology. A third approach, already defined above, would be net metering. Finally, a fourth approach would be to administratively derive a "value of solar" based on analysis of avoided costs and whatever else the evaluators believe to be worthy of measure.

As you will see, while the authors do not believe this fourth approach to be appropriate, analysis of the criteria its advocates believe are important should be conducted and evaluated – not to set the price, but simply to establish the context for evaluating the reasonableness of the pricing methodology approved.

III. 'Value of Solar' vs. Wholistic Analysis

Optimally, prices for electricity are determined by a competitive market or, absent competitive conditions, should be derived from cost-based regulation. In both cases the prices are subjected to an external discipline that should result in efficient resource decisions devoid of arbitrary or "official" biases. Subjective consideration of the "value" of particular technologies and where they may rank in the merit order of "social desirability," effectively removes the discipline that is more likely to produce efficient results. Moreover, even where non-economic externalities are thrown into the valuation mix, the pricing of an energy resource must still be disciplined by examination of the economic merit order in attaining the externality objective. Whereas both the marketplace and transparent cost-based regulation are likely to produce coherent pricing that

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allows us to enjoy a degree of comfort knowing that efficient performance will likely lead to productivity, subjective consideration of soft criteria, like "value of solar," are a step away from economic coherence and efficiency.

Economics are critical and efficiency is of vital importance. There are also other economic values, besides efficiency, including those that go beyond short-term efficiency. Certainly, many people believe that other, non-economic factors need to be considered. Similarly, the fairness of the impact on customers also needs to be factored into any decision. There has, for many years, been a running debate in electricity regulation as to whether externalities ought to be factored into regulatory decisions. This article does not intend to join that debate, nor express any point of view as to what is permissible or impermissible under applicable law. Rather, this article suggests that if externalities are to be considered, then all relevant ones deserve attention, as opposed to "cherry picking" the issues to best protect a particular interest. Further, if non-economic objectives are to be factored into ratemaking, then it is wise to carefully consider the most economically efficient ways of attaining those objectives.

There are a number of criteria that are important to the full valuation of solar PV. One should begin by looking at the cost of producing energy. Beyond that, the criteria would include availability/capacity, reliability, energy value, impact on system operations and dispatch, transmission costs and effects, distribution costs and effects, and hedge value. Solar DG proponents often phrase these issues in terms of avoided costs. In addition to those dimensions, there are also the following: degree of subsidization and cross-subsidization, efficiency considerations, impact on alternative technologies, market price impact, reliability, and social effects including the environmental, customer, and social class impacts. There is also the issue of whether solar DG enhances the level of competition in the industry.

Certainly, many people believe that other, non-economic factors need to be considered.

IV. Net Energy Metering – Why Are We Paying More for Less?

Retail net energy metering, as practiced, does not capture all of the value enumerated above. NEM significantly overvalues distributed solar generation. More specifically, it does the following:

1. Creates a cross-subsidy from non-solar to solar customers;
2. Fails to reflect the inefficiency of small-scale solar PV relative to other forms of generation, including alternative renewable resources;
3. Constitutes price discrimination in favor of an inefficient resource;
4. Significantly overvalues both the capacity and reliability value of solar DG;
5. Adversely impacts the degree of competitiveness in the industry;
6. Artificially inflates the transmission value of solar DG;
7. Fails to account for the fact that the value of energy varies widely depending on when it is actually produced;
8. Distorts price signals for energy efficiency;
9. Causes socially regressive economic impact;
10. Assumes system benefits from solar DG that, in fact, may not exist;
11. Overvalues its contribution to carbon reduction;
12. Vastly inflates its value as a fuel hedge; and
13. Undervalues and underfunds the distribution system.

Despite failing to capture these values, NEM has become the prevalent form of tariff for residential solar DG in

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the United States. This is because NEM was never developed as part of a fully and deliberatively reasoned pricing policy. NEM was simply never a conscious policy decision. It is basically a default product of two (no longer relevant) considerations, one practical and the other technological. The practical reason is that residential distributed generation had such an insignificant presence in the market that its economic impact was marginal at best. Thus, no one was seriously concerned about "getting the prices right." The second, technological reason is that until recently the meters most commonly deployed, especially at residential premises, have had very little capability other than to run forward, backward, and stop. Thus, for technical reasons, NEM was simple to implement and administer and, as a practical matter given the paucity of DG, there was no compelling reason to go to the trouble of remedying a clearly defective pricing regime. Many states have recognized the problems with NEM but, seeing no alternatives, put in place production caps to limit any harm caused by a clearly deficient pricing regime.

V. Residential Retail Net Metering Sets Up Unfair and Counterproductive Cross-Subsidies

Beyond failing to capture the values above, there are other problems with NEM. Under NEM, when DG providers export energy to the system, consumers are required to pay them full retail rates for a wholesale product. What everyone agrees upon is that solar DG provides an energy value, but there is considerable disagreement about what that value is. Solar proponents argue that solar DG has a capacity value as well. That value, if it exists at all, is minimal. While there may well be reasons to treat DG differently with respect to wholesale transmission there is, absent a solar host leaving the grid, absolutely no reason to discriminate between wholesale and DG products with regard to the fixed costs of the distribution system and its operations.

If the costs of the distribution system were variable with energy production, that exemption would be sensible, but they are not.

Under NEM, however, solar DG providers are compensated at full retail prices for what they provide. That includes the not-insignificant cost of services that they do not provide, including distribution costs, administrative, and back office operations. There can be no justification for forcing consumers to pay a provider for service that they not only do not provide but, in fact, have no capability to provide.

Solar DG producers remain connected to the grid and are fully reliant upon it during the many hours of the day when solar energy is not available. Under NEM, that solar DG producer is excused from paying his/her share of the costs of the distribution system when energy is being produced on the premises. If the costs of the distribution system were variable with energy production, that exemption would be sensible, but they are not. Distribution costs are fixed, and do not vary with energy production or consumption. Thus, excusing solar DG customers from paying for their own distribution costs when their solar units are producing energy has no justification in either policy or economics. Making matters worse, the costs solar DG providers do not pay under NEM are either reallocated to non-solar customers or have to be absorbed by the utility. Both outcomes are unacceptable and unjustifiable. There is no reason why solar DG customers should receive free backup service, compliments of either their neighbors or the utility.

Utilities are obliged to provide full requirements service to all of their customers, including, of course, their solar host

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customers. In regard to solar hosts, the utility is obliged, in case the on-premises generation does not cover their full demand, to fill the gap between the full demand and the amount of self-generation. Utilities are also obliged to purchase energy and/or capacity so that solar hosts may rely on the utility when solar units are not generating. Given that solar PV units are intermittent and unpredictable regarding when they will produce, providing that backup is an ongoing responsibility and cost to utilities. Compounding those costs is the fact, as stated elsewhere in the article, peak times of electricity use (i.e. when prices are highest) are trending later in the day, when solar PV does not produce. As such, utilities must provide electricity to solar hosts at times when demand is high and energy prices are high. It would violate a the fundamental principle of regulation that cost causers should pay for the costs they impose, not to recognize the actual costs of that backup service in the rates paid by solar hosts.

Another cross-subsidy relates to the intermittent nature of solar energy. No utility with an obligation to serve can be fully reliant on the availability of solar when it is needed. Indeed, no solar host who values reliability can afford to be dependent on his/her own solar DG unit. While this point will be discussed further *infra* suffice it to say that this gives rise to two types of demand charge related cross-subsidy. The first arises when the distributor relies on the availability of solar for making day-ahead purchases and the other arises when it does not do so. When it does rely on the availability of solar and it turns out that solar energy is not available when called upon, the

utility is compelled to purchase replacement energy in the spot market at the marginal cost, which is almost certainly higher than the price of the solar energy on whose availability it had relied. In notable contrast to what happens in the wholesale market when a supplier who is relied upon fails to deliver, those incremental costs have to be borne by the utility, which passes them on to all customers, as opposed to being borne by the specific solar DG customer whose failure to deliver caused the costs to be incurred.

If the distributor, in recognition of solar's intermittency, instead chooses to hedge against the risk of solar's unavailability, the cost of the hedge is likewise passed on to all customers rather than simply those whose supply unpredictability caused the cost to be incurred. Both of these forms of cross-subsidy violate a bedrock principle of regulation – costs should be allocated to the cost causer. The function of that principle, of course, is to provide price signals to improve performance, but NEM fails to provide such signals and essentially holds solar DG providers harmless for their own very low capacity factors and inefficient performance.

NEM cross-subsidies, in large part, provide short-term benefits to the solar DG industry, but are highly detrimental to the value of solar in the long term. In the short term they constitute a wealth transfer from non-solar customers to the solar industry. In the long term, however, they are actually harmful to solar energy because NEM provides absolutely no incentive to improve the performance of a generating resource that, among renewables, already ranks last in efficiency and in cost effectiveness for reducing carbon emissions. In effect, the solar DG industry is putting its short-term profits ahead of the long-term value of solar energy. If solar DG advocates prevail in seeking to maintain NEM, that victory will be short-lived, because markets, both regulated and unregulated, do not prop up inefficient resources over the long term.

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NEM is also woefully ineffective at providing the appropriate price signals. Electricity prices can be quite volatile over the course of every day and vary seasonally as well. Rather than reflecting those prices, NEM simply treats all energy the same regardless of the time during which it is produced. For example, NEM fails to differentiate between energy produced on-peak and off-peak. In one scenario, it prices off-peak solar DG at a level that is averaged with on-peak prices, thus effectively over-valuing the energy. Conversely, if solar DG were actually produced on-peak, NEM would average that price with off-peak prices, thus undervaluing the energy. Any form of dynamic pricing, ranging from time of use to real-time, could address this issue with more precision than flat, averaged prices. Interestingly, under the first scenario, cross-subsidies would be paid to solar producers, while in the second scenario, solar producers would be cross-subsidizing the other ratepayers. In short, the price signal, and the efficiency that would flow from that, is rendered incoherent.

Some may argue that cross-subsidies are necessary to promote the growth of renewable energy, and certainly that can be debated. However, modernizing NEM to provide appropriate price signals would not remove the tax credits and other government-sanctioned or -sponsored subsidies. The fact that conscious subsidies and/or cross-subsidies are designed to promote a particular technology raises two key issues. First, many would argue that the government, including regulators, should not be picking winners and losers in the marketplace. While there may be merit to that view, it must also be recognized that, there may be

circumstances where, for policy reasons, government might want to provide support for a socially and economically desirable technology and/or assist it with research funding and to get it over the commercialization hump. That leads inexorably to the second and more relevant issue concerning solar DG: namely, that subsidies and cross-subsidies need to be designed as near-term boosts rather than a permanent crutch, and should be transparent. In other words, subsidies/cross-subsidies should be designed to serve as both a stimulus for the designated technology and an incentive to the producers and vendors of the technology to become more efficient. It might also be noted that subsidies from the Treasury are more appropriate for achieving broad social benefits that are cross-subsidies derived from a subset of the full society deriving the benefit.

In the case of solar DG, the objective of a subsidy/cross-subsidy would be to attain grid parity, assuming reasonably efficient operations, with other resources. The objective is to assist a technology to achieve commercial viability. The problem with NEM, of course, is that it is effectively an arbitrary financial boost of potentially endless duration, with absolutely no built-in incentive to increase efficiency and/or to achieve grid parity. In effect it requires non-solar customers to pay more for the least efficient renewable resource in common use and provide the solar industry with no economic incentive to improve its productivity or availability or wean itself off dependence on the cross-subsidy. It also has the effect of putting more efficient resources, particularly other renewables, at a competitive disadvantage. In short, NEM effectively substitutes political judgment for economic efficiency to determining marketplace success.

The reason why solar DG vendors and providers cling to cross-subsidies is because they find more comfort in receiving substantial cross-subsidies than

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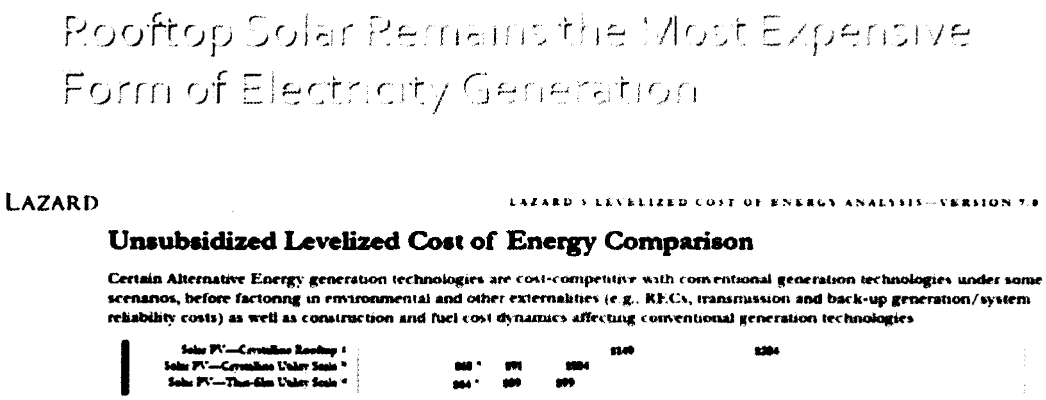

Figure 1: Rooftop Solar Remains the Most Expensive Form of Electricity Generation

they do in the prospect of becoming competitive. Solar DG is the most expensive form of renewable generation that is widely used today (**Figure 1**).

The technological and practical reasons for permitting such incoherent pricing are no longer present in the marketplace. We now have pricing methods that are capable of measuring DG production as well as consumption on a more dynamic basis. In addition, solar DG market penetration has dramatically increased to the point that it can no longer be dismissed as marginal, so appropriate pricing is now a non-trivial issue. In addition, we now have very precise, location-specific energy and transmission price signals that provide a very transparent market price by which one can measure the economic value of distributed generation. These new developments, plus the fact that NEM was put in place on a default basis, mean that it is now time for a full-blown policy consideration of the most appropriate pricing policy for distributed generation.

For all of the reasons noted, NEM pricing results in large cross-subsidies, offers no incentives for efficiency – indeed, may even provide disincentives to invest in efficiency improvements – and results in consumers paying energy prices for solar DG that are far in excess of its market value and not even subject to cost-based oversight. Moreover, its *raison d'être* – inability to more accurately price solar DG facilities and low market penetration by solar energy – no longer exists. Solar energy is penetrating the market in greater numbers and is likely to continue to do so. Secondly, more sophisticated pricing enables us to measure solar energy and customer behavior on a much more efficient, dynamic basis. The fundamental reality is that NEM completely fails to capture the value of the product being priced.

VI. Placing a Value of Solar DG – Pricing and Economic Efficiency

Needless to say, pricing is of critical importance. It is important to address pricing in the context of tangible, enumerated values. Such an analysis is in contrast to certain efforts by solar DG advocates to attach a subjective value to solar and then derive prices from that value. It is preferable to derive prices from the values established by either costs or market, not ephemeral and subjective considerations.

It is worth re-emphasizing just how imperfect NEM actually is. The price of electric energy is not constant. Wholesale markets reflect that reality. Net metering and many forms of incentives do not reflect the values established by the market. Rather, a net metering regime relieves the solar panel host of any obligation to pay for the costs of the distribution system when energy is being produced, even though he/she

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Table 1: Rooftop Solar Subsidies Heavily Utilize Funding from Non-Solar Customers

DTE Energy

Consumers Energy
Count on Us

SolarCurrents and Net Metering funding mechanism for residential customers

	SolarCurrents (Phase 1)	SolarCurrents (Phase 2)	Funding Mechanism
Up-front solar subsidy	$2.40/W	$0.20/W	Renewable Surcharge
On-going solar subsidy	$0.11/kWh	$0.03/kWh	Renewable Surcharge
Net metering subsidy (unrecovered fixed cost)	$0.09/kWh	$0.09/kWh	*Unrecovered fixed costs are funded by non-solar customers
Total SolarCurrents and Net metering subsidy	**$0.20/kWh**	**0.12/kWh**	

remains reliant on it and, when the meter runs backwards, is effectively paid the full retail price for energy exported from the customer's premises. As a point of illustration, see Table 1 for a funding mechanism for residential customers presented by DTE Energy to the Michigan Public Service Commission. According to DTE, the 9 cent per kilowatt-hour (kWh) net metering credit represents a differential that non-participating customers must pay.

Under NEM, compensation at retail rates is not cost-reflective because net metering means that solar DG energy exported into the distribution network is compensated at the full bundled retail rate rather than at a price based on the unbundled cost of producing the energy. In almost all jurisdictions, that retail rate is flat and constant. Thus, it does not reflect the obvious fact that the energy has greater value at peak demand than it does off-peak. It is a deeply flawed value proposition. The fact is that the wholesale market produces hour-by-hour prices that provide generators, renewable and non-renewable alike, and consumers with important price signals that reflect real-time values. Both generators and demand responders are compensated according to those real-time prices. Solar DG-produced energy, by contrast, is compensated on a basis that lacks a foundation in either market or cost. The compensation is out of market because it is a flat price regardless of when it is produced or, for that matter, fails to reflect that many hours of the day that solar panels produce absolutely nothing. It is hard to avoid the conclusion that on an economic basis, the NEM-derived price paid for solar DG energy completely misses the value of solar during most hours of the day. Interestingly, part of the cause for this incorrect valuation is that rooftop solar units have generally been installed facing south, as opposed to west. Because demand peaks have been trending later in the day (as illustrated in the California and New England figures below), this southern exposure has proven to render peak production for solar even less coincident with demand. Had the appropriate market prices been in effect, it is highly unlikely that such a costly error would have occurred.

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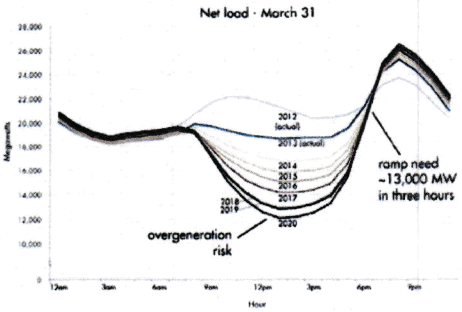
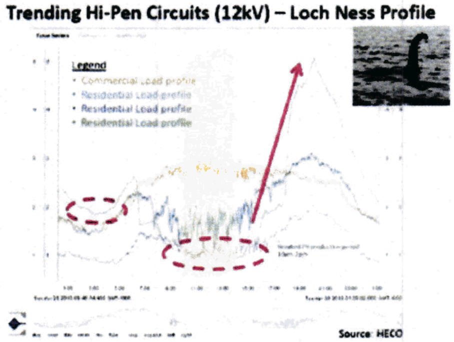
The Duck Curve - California



http://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

The Nessie Curve - Hawaii

Trending Hi-Pen Circuits (12kV) – Loch Ness Profile



www.greentechmedia.com/articles/read/hawaiis-solar-grid-landscape-and-the-nessie-curve

Figure 2: Ramping Needs Increased Due to Lack of Solar Prodution During Peak Demand

As is dramatically illustrated in the graph at left in Figure 2, enticed by a number of factors, not the least of which is net metering, substantial investment in the growth of solar capacity in the Golden State has enormously magnified the need for additional fossil plants, operating on a ramping basis, to compensate for the dropoff in solar production at peak. In that context, the absence of any meaningful signal to make solar more efficient (e.g. linking it with storage) is simply something that can no longer be tolerated. Not coincidentally, the charts from both the California and New England ISOs (found further *infra*), as well as that from DTE, illustrate the wisdom of compensating solar DG at LMP, so its price accurately reflects its value at the time of actual production and avoids requiring non-solar customers to pay prices for energy that far exceed its value.

A. Capacity value

The capacity value of a generating asset is derived from its availability to produce energy when called upon to do so. If a generator is not available when needed, it has little or no capacity value. By its very nature, solar DG on its own, without its own backup capacity (e.g. storage), can only produce energy intermittently. It is completely dependent on sunshine. Unless sunshine is guaranteed at all times solar DG is called upon to produce, it cannot be relied upon to always be available when needed. Moreover, even if all days were reliably sunny, the energy derived from the sun is only accessible at certain times of the day. In many jurisdictions, the presence and potency of sunshine is not coincident with peak demand. Frequently, for example, solar DG capacity is greatest in the early afternoon, while peak demand occurs later in the afternoon or in early evening. The two charts in Figure 3 illustrate the lack of coincidence of solar production and peak demand in New England.[1]

These two charts dramatically demonstrate that, on the days chosen as representative of summer and winter in New England, solar PV is completely absent during the winter peak, reaches its peak production as peak demand is rising in the summertime, and drops off dramatically during almost the entire plateau period when demand is at peak. It should also be noted that on the days chosen, the sun was shining. The graph, of course, would look very different on cloudy days when solar production is virtually nil.

The Electric Power Research Institute (EPRI) graphs in Figure 4 reveal similar patterns on a national level. The first graph

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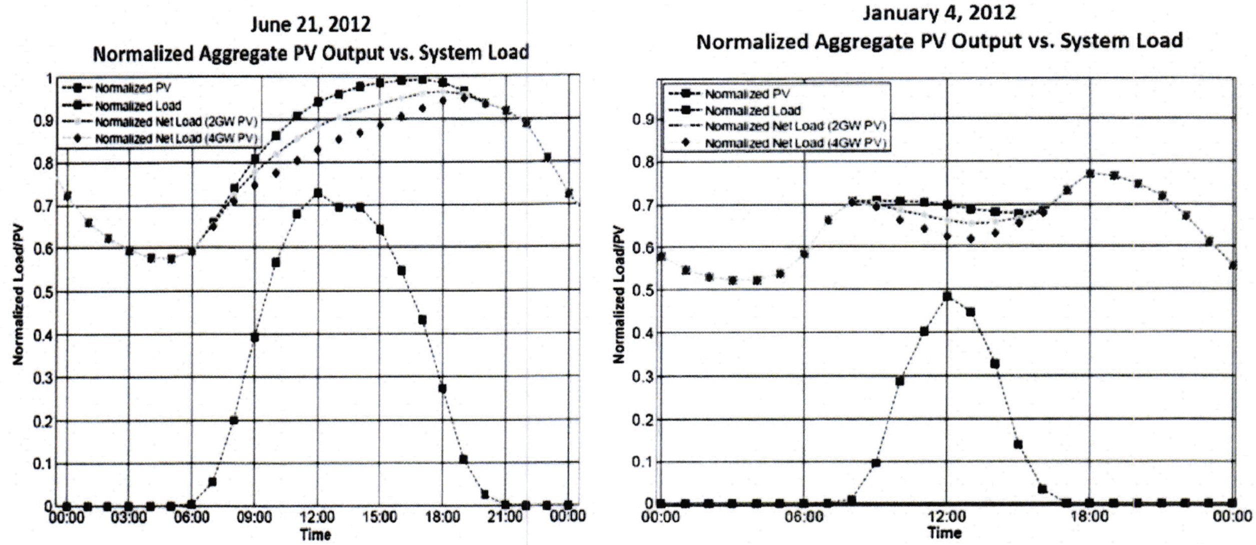

Figure 3: Lack of Coincidence of Solar Production and Peak Demand in New England

depicts the peak load reduction and ramp rate impacts resulting from high penetration of solar PV. The second illustrates the fact that because residential load and PV system output do not match, solar DG hosts use the grid for purchasing or selling energy most of the time.

As noted above, providers of capacity in the wholesale market may also have availability issues. In their case, however, if they are not available when called upon to produce, they are typically obligated to either provide replacement energy or to pay the

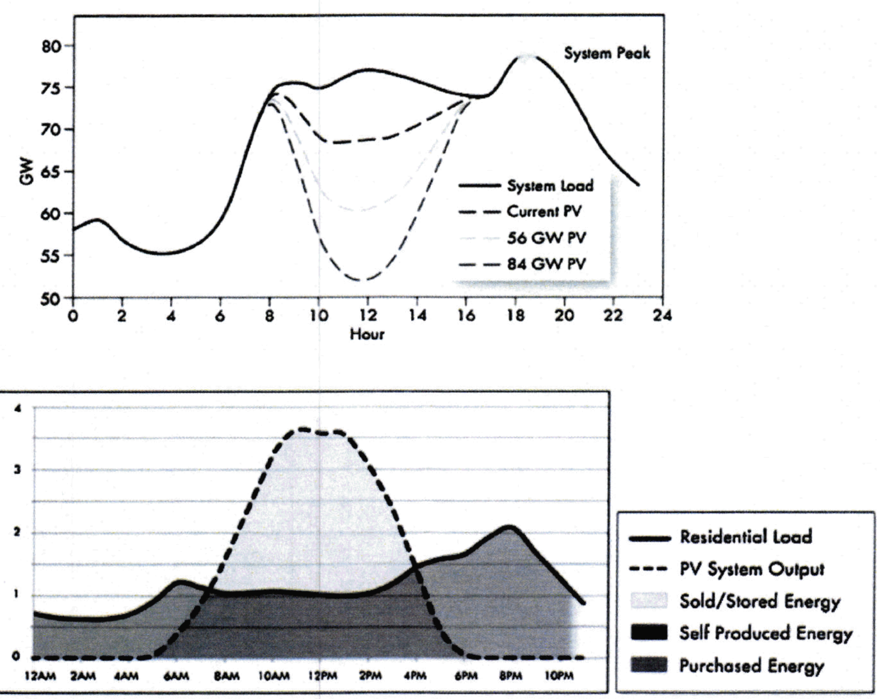

Figure 4: Increased Ramp Rates, Peak Load Reduction and Reliance on the Grid

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marginal cost of energy that they failed to deliver. Unless a similar obligation is imposed on solar DG providers, the capacity value of solar DG is reduced even further. Good pricing policy would suggest that DG prices should be fully reflective of the value of the type of capacity that is actually provided. As currently implemented, net metering does not adequately reflect how the capacity availability measures up to demand.

B. Availability and reliability

Many advocates of solar DG assert that it enhances overall reliability because the units are small, widely distributed but close to load, and not reliant on the high-voltage transmission system. It is argued that they are less impacted by disasters and weather disturbances. At best, these claims are highly speculative and, for the reasons noted below, quite dubious. It would be a mistake to attribute added value to solar DG because of reliability.

Solar DG is subject to disaster as much as any other installations. High winds, for example, can harm rooftop solar as much as any other facility connected or unconnected to the grid. Cloudy conditions can disrupt solar output while not affecting anything else on the grid.

Solar DG has more reliability benefit in some places than others. In Brazil, for instance, a system that largely relies on large hydropower plants with large storage reservoirs, solar has considerable long-term reliability value because whenever it generates energy it conserves water in the reservoirs, thereby adding to the reliability of the system. However, in a thermal-dominated system (like much of the United States), where there is little or no

storage, reliability has to be measured on more of a real-time basis. Therefore, solar's intermittency makes it unable to assure its availability when called upon to deliver energy. Indeed, it is far more likely that a thermal unit will have to provide reliability to back up a solar unit than the other way around.

It is also important to examine rooftop solar reliability issues in two contexts: that of the individual customer and that of the system as a whole. Solar DG vendors, as part of their sales pitch, claim that reliability is increased for a specific customer with a rooftop solar unit because on-site generation provides the possibility of maintaining electric power when the surrounding grid is down. When the sun is shining, this claim may be true. Conversely, without the sun, the claim has no validity. However, that argument only applies to the solar host.

On a technical point, a power inverter is an electronic device or circuitry that changes direct current to alternating current. During a system outage the power inverter is automatically switched off to prevent the backflow of live energy onto the system. That is a universal protocol to prevent line workers and the public from encountering live voltage they do not anticipate. Thus, if a solar DG unit is functioning properly, when the grid is down, the solar DG customer's inverter will also go down, making it impossible to export energy. If the solar DG unit is not functioning properly, then the unit may be exporting, but will do so at considerable risk to public safety and to workers trying to restore service. The result is that the solar panel provides virtually no reliability to anyone other than perhaps to the solar host.

Attributing reliability benefits to an intermittent resource is a stretch. By definition, intermittent resources are supplemental to baseload units. The only possible exceptions to that are, as noted above, where there are individual reliability benefits or where the availability of the unit is

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coincident with peak demand or has the effect of conserving otherwise depletable resources. Absent those circumstances, and absent storage, it is almost certainly the case that the system provides reliability for solar DG, rather than the other way around. That is particularly ironic given that in the context of net metering, solar DG hosts do not pay for that backup service while generating electric energy. In essence, in a net metering context, non-solar customers pay solar DG providers for reliability benefits that solar DG does not provide them, while solar DG customers do not pay for the reliability benefits they actually do receive.

From an investment perspective, solar DG pricing methods, like NEM, which redirect distribution revenues from distributors to solar PV providers who offer no distribution services are detrimental to reliability as they either deprive the sector of capital needed to maintain high levels of service or demand additional revenues from non-solar DG users who would ordinarily not have to pay such a disproportionate share of the costs. For utilities, the diversion of funds leaves them with a Hobson's choice of either delaying maintenance and/or needed investment, or seeking additional funds – in effect, a cross-subsidy from non-solar users. It is also relevant to reliability to again note that the prevalence of intermittent resources on the grid, including solar DG, may well cause new, cleaner, and more efficient generation to appear less attractive to investors. Over the long term, that effect could lead to reliability problems associated with inadequate generating capacity, especially at times of peak demand.

C. Solar DG does not avoid transmission costs

It is nearly impossible to demonstrate that solar DG will obviate the need for transmission, much less quantify the cost savings associated with this purported benefit. Of course, there is a simple way to calculate any actual transmission savings, and that is by compensating solar DG providers in the organized markets at the locational marginal cost of electricity at their location. That compensation model would have the benefit of capturing both the energy value and the demonstrable transmission value of solar DG. Absent that formulation, efforts to calculate actual transmission savings would be a difficult, perhaps entirely academic, task.

Solar DG advocates assert that real transmission savings are achieved through the deployment of DG, especially in systems that use locational marginal cost pricing. The argument is that by producing energy at the distribution level, less transmission service will be required, thereby reducing or deferring the need for new transmission facilities. It is also often contended that DG will reduce congestion costs, and perhaps even provide some ancillary services. All of that is theoretically possible but certainly not uniformly, or even inevitably, true.

Of course it is true that DG, absent any adverse, indirect effect it might have on the operations of the high-voltage grid, does not incur any transmission costs in bringing its energy to market. However, that is quite different than asserting that DG provides actual transmission savings. In fact, it would be incorrect to simply conclude across the board that solar DG will achieve transmission savings. It is possible that there could be transmission savings associated with solar DG deployment, but that can only be ascertained on a fact- and location-specific basis. Such savings would most likely be derived from reducing congestion or providing ancillary services of some kind. It is also theoretically

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possible, but highly unlikely, that massive deployment of solar DG will eliminate (or, more likely, defer) the need to build new transmission facilities. For a variety of reasons, including the complexities of transmission planning, the time horizons involved, the complex interactions of multiple parties, and economies of scale in building transmission, it is improbable that solar DG actually saves any investment in transmission capacity.

Indeed, a mere glance at the California ISO duck graph showing the need for ramping capacity to make up for the intermittent availability of solar DG provides a *prima facie* case for believing that the opposite is true and that solar DG may cause a need for more transmission to be built. These and other charts also show that as long as solar does not reduce peak energy use, transmission is likely needed to serve peak hours. Regardless, it is virtually impossible to demonstrate that, other the possibilities of reducing congestions costs (a value fully captured by LMP), there is very little likelihood of transmission saving being derived from solar DG.

D. Solar DG does not avoid distribution costs

It is more likely that solar DG will cause more distribution costs than it saves. That is because these generation sources could change voltage flows in ways that will require more controls, adjustments, and maintenance. Moving from a one-way to a two-way system will certainly increase the need for technical equipment to manage the reliability of the system. While DG solar may not be the only cause of this move the intermittent nature of solar makes

it particularly difficult to manage. It will also inevitably increase transaction costs for the utility to execute interconnection agreements and do the billing for an inherently more complicated transaction than simply supplying energy to a customer. It is impossible, unless a solar DG host leaves the grid, to envision a circumstance where solar DG would effectuate distribution savings.

Regarding distribution line losses, DG offers value only to DG providers when they consume what they produce because any DG output exported to the system is subject to the same line loss calculations that any other generator experiences. If there were locational prices on the distribution system, there might be line loss benefits that could be captured by DG but, since those price signals do not exist, the argument is purely academic.

VII. Lower Hedge Value

The theory advanced by some solar DG proponents is that because the marginal cost of solar is zero, it serves as a hedge against price volatility. In theory, that might make sense. In reality, however, solar is an intermittent resource that cannot serve as a meaningful hedge unless such zero-cost energy is both sufficiently and timely produced. Thus, solar DG is the equivalent of a risky counterparty whose financial position renders him incapable of assuring payment when required. Moreover, the value of a hedge depends on the amount of money the purchaser of the hedge is obliged to pay for the insurance and the amount and probability of the price he/she seeks to avoid paying. With a NEM system (or the high-priced "value of solar" approach that solar DG advocates seek), the price paid is highly likely to exceed the fuel or energy price most utilities would hedge against. In short, the argument ventures into the realm of the absurd. It amounts to: *Pay me a fixed price that is higher than the price you want to avoid, in order to avoid price volatility.*

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The argument that solar DG provides a valuable hedge function is reduced to virtual absurdity by the fact that the so-called hedge is not callable. In short, if the price rises to the level against which the hedge purchaser wants to be insured against, the solar provider of the hedge is not obliged to pay. That being the case, there is no hedge whatsoever.

VIII. Effects of Solar DG on Other Renewable Resources

A. Impact of a low capacity factor

Since 2008, as Figure 5 from the United States Energy Information Administration (EIA) points out, solar PV has had the lowest capacity factor of any commonly used renewable energy resource in the U.S. It is also worth noting that while the overall costs of installing solar panels has declined (as noted above) the productivity of solar PV has remained constant at consistently low levels. It should be noted that the chart below compares only "utility-scale" projects. As noted in the Lazard study above, distributed solar is even less cost effective than utility-scale solar, which already occupies last place on the Department of Energy (DOE) ratings.

The stark reality of solar PV's combination of high prices and poor capacity factor carries over into the cost of reducing carbon emissions. An interesting dialog occurred recently between Charles Frank, an economist at the Brookings Institution, and Amory Lovins of the Rocky Mountain Institute.[2] Their dialogue, while contentious on many points, reflects similar views on the realities depicted in the EIA chart. Frank analyzed five non- or low-emitting generation resources by their cost effectiveness in reducing carbon and concluded that nuclear and natural gas, followed by hydro, wind, and solar were, in that order, the most cost-effective types of generators for reducing carbon. Lovins took issue with Frank for using outdated data and for not looking at energy efficiency. He also argued that nuclear ranked last in cost effectiveness, and expressed some reservations about the ranking of natural gas. However, what is significant is that, among renewable resources, Lovins concurred with Frank that solar DG is the least efficient renewable resource for reducing carbon. Thus, in the view of both men – who hold quite divergent views on how best to reduce carbon emissions – not only is solar DG expensive, it is the least cost-effective renewable resource for reducing carbon emissions.

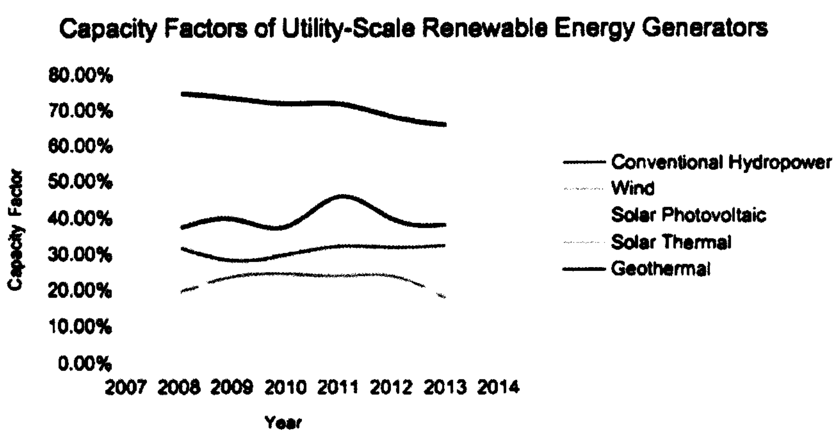

Figure 5: Capacity Factors of Utility-Scale Renewable Energy Generators

B. Impact of higher-than-market price

Higher-than-market prices paid for solar DG has adverse effects on other renewable resources. All wholesale generators, renewable and otherwise, have to incorporate transmission and distribution costs into the price of energy delivered to customers. As mentioned above, it is true that transmission issues play out differently for distributed generation than for wholesale generation. Since DG, by definition, does not rely on transmission capacity, although DG might impact congestion costs in various ways, wholesale energy's delivered cost reflects transmission capacity

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costs while DG's does not. Thus, any competitive advantage for DG on that score is quite natural. However, under the net metering scheme, DG providers also do not have to incorporate distribution costs into their end product, and that results in a serious economic distortion of the generation markets in general as well as specifically in renewable markets. In fact, as noted *supra*, solar DG providers under NEM are actually paid for delivering their energy even though they provide no such service. Wholesale generators, unlike their DG counterparts, enjoy no such comparable enrichment for service they do not provide. The effect of NEM's highly inefficient and non-cost-reflective rates is to distort market prices in ways that reward inefficiency and will likely distort price signals that are essential for an efficient marketplace.

In addition, at a critical mass, artificially elevated solar DG prices are highly likely to create distortions and inefficiencies in the capacity and energy prices found within organized markets. An environment with two parallel pricing regimes, one market- or cost-based, and the other an arbitrary one neither market- nor cost-based, is simply economically incoherent and unsustainable. The overall effect of net metering is to increase the prices consumers pay for energy overall, without any assurance of any long-term benefit. Solar DG is artificially elevated to a preferential position above more-efficient, larger-scale generation, including all other renewables. The disparity in treatment between solar DG and other forms of energy suggests that net metering is not only federal preemption bait (as further discussed below); it is fundamentally anti-competitive as well. Indeed, it compels consumers to both cross-subsidize less efficient producers and to pay higher prices than necessary for energy. It will also entice investors to allocate their capital to toward more profitable but less efficient generation. In terms of efficiency and public benefit, the incentives inherent in NEM are simply perverse.

Large-scale bulk power renewables (e.g. large-scale wind and solar farms, geothermal) are put at a particular disadvantage by NEM pricing of solar DG independent of costs or market for two basic reasons. First, large-scale renewables are more efficient and more cost-effective than DG, yet net metering provides a subsidy only to the less efficient form of generation. In fact, solar DG providers are compensated for the energy they export at a price that can range from two to six times the market price for energy. Second, in those states with renewable portfolio standards (RPS), the entry of a critical mass of non-cost-justified solar DG units into the market could have the effect of driving more efficient, large-scale renewables out of a fair share of the RPS market. The effect, in a competitive market, is to bias the market to incentivize highly inefficient small-scale solar to the detriment of less costly larger-scale solar.

C. Comprehensive environmental analysis

Any analysis of the environmental impact of the generation mix should include an examination of the least-cost, most efficient ways to get to the desired results. Problematically, the preferential pricing of less efficient solar DG imposes an unnecessarily high-cost approach to reducing carbon. Results such as that cannot be justified on the basis of externalities, which are no different between DG and larger-scale renewables. Indeed, it seems probable that overpayments for DG have the effect of squeezing more efficient forms of renewable energy out of RPS markets by using preferential pricing to grab a disproportionate share of the RPS market and driving up the cost of reducing carbon.

In the long run, of course, the inherent favoritism in pricing DG

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at levels arbitrarily higher than other renewable energy sources does not bode well for either the future of renewables or the objective of efficiently reducing carbon emissions. Discrimination in favor of inefficient resources on a long-term basis is simply not sustainable. The inevitable backlash in both the marketplace and public perception has the potential to sweep away public support for renewable energy and perhaps for strong environmental controls as well, an outcome no one concerned about the environment would want. One of the most notable ironies emanating from the use of net metering to price solar DG is that it will almost certainly lead to changes in retail pricing that will undermine the promotion of energy efficiency. The reason for this is that as solar DG becomes more widely deployed, utilities and their regulators will likely become increasingly concerned with the diminution of revenues required to support the distribution system that is caused by the use of net metering.

Those concerns are derived from the fact that under NEM, when solar DG is being self-consumed at the host premises, no revenues are being paid by that host to the utility for providing what essentially amounts to a battery to supplement their self-generation. Since the costs of the distribution are fixed and not variable with the use of "behind the meter" generation, net metering results in a delta of revenue that is either made up for by non-solar customers or constitutes a loss for the utility. Neither outcome is likely to be satisfactory to either the utility or the regulators. Inevitably there will be ratemaking consequences. That problem is compounded, of course, by the fact that when the excess output of rooftop solar is being exported into the grid the solar provider is

being paid as if he/she was delivering the energy, a service obviously provided by the distribution utility. Thus, not only are solar hosts not paying their fair share of fixed costs, they are, by the operation of net metering, actually taking revenues away from the entity that actually provides the service. From the standpoint of the utility and of the non-solar ratepayers who have to bear the burden of such uneconomic and inequitable revenue allocation, rate design remedies will be sought.

One likely remedy to be proposed is to modify the fixed/variable ratio in rates. While distributions are indisputably fixed costs, regulators have generally divided the recovery of those costs on a different basis. Some have been recovered on a fixed basis, while others have been recovered on a variable, volumetric basis. There are two critical policy reasons why this has been the case. The first is that fixed charges tend to impose a disproportionate burden on low-income households and on customers whose consumption is relatively light. The other reason is that volumetric-based charges send a signal to end users that the more they consume, the more they pay. Stated succinctly, the price signal promotes the efficient use of energy. If the revenue stream to cover distribution costs is diminished through mechanisms like net metering, utilities concerned about revenue requirements and regulators, concerned about reliability will, almost inevitably, shift more costs into non-by passable fixed charges, thus imposing more of a burden on low-income households and, equally important, diluting price signals for energy efficiency. In short, net metering will almost certainly, at some point, serve to both cause cost recovery to be socially regressive, and to discourage energy efficiency. In effect, net metering will likely become a classic case of anti-green pricing.

The anti-green pricing aspect of net metering is also exemplified by the behavioral pattern it incents among solar hosts. As shown on both the California and New England

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graphs above, solar production slacks off and ultimately disappears as demand reaches its peak. Despite that, solar hosts are never signaled through prices that their consumption is no longer being supported by zero-marginal-cost solar production. Indeed, in most cases net metering determines prices on an average-cost basis, even though solar production, even in the best of circumstances, is only available a fraction of the time period used for averaging. Thus, solar hosts are essentially lulled into a pattern induced by low marginal prices, which continue in periods of peak demand, thereby driving the peak demand even higher, a result that is truly perverse, both economically and environmentally. In short, net metering and energy efficiency are simply not compatible.

D. Net metering and energy efficiency are incompatible

Many experts from all facets of the renewable energy discussion will assert that energy efficiency is an important, if not the most important, means to increase carbon reductions. Assuming those experts are correct, it is important to consider the ways in which net metering impacts incentives for energy efficiency. While solar DG and energy efficiency are not inherently anathema, net metering is not compatible with energy efficiency. As discussed above, net metering is a compensation mechanism that causes utilities and regulators to move costs into the fixed category, thereby diluting the price signals that would encourage energy efficiency.

E. Possible federal preemption

State regulators, in setting prices for solar DG, should also be

conscious of the potential for jurisdictional disputes should DG prices cause any dislocation in wholesale markets. Because of the economic distortions caused by NEM, there are some who are calling for DG to be under the control of the Federal Energy Regulatory Commission (FERC) rather than state public utilities commissions' jurisdiction.[3] Unless states begin to remedy the price distortions inherent in net metering, it would be surprising if many aggrieved wholesale generators did not seek relief from FERC. In a somewhat analogous situation, New Jersey and Maryland sought to use state subsidies/mandates to support the construction of new power plants in order to manipulate and/or bypass the PJM capacity market. FERC, in a decision which was later affirmed by the Third Circuit Court of Appeals, struck down the state program by preemption. State commissions that continue to prop up a net metering regime with no basis in either market-based pricing or cost-of-service regulation may well discover the prospect of preemption hanging over them.[4] Further foreshadowing preemption are several other examples of state net metering programs running contrary to federal pricing regimes.

The Public Utility Regulatory Policies Act (PURPA) places an avoided-cost ceiling on power purchases; net metering evades that ceiling. Under net metering arrangements, not only are purchases of excess power mandated at levels well in excess of avoided costs, but they also include a cross-subsidy from non-solar customers for the distribution costs of solar DG providers. Bulk power renewables are subject to all of the rules of the wholesale market, which may include such costs as congestion costs, ancillary services, penalties for no availability, and others. Under net metering, solar DG providers are subject to none of these disciplines. In addition, some wholesale renewable generators complain that the arbitrarily high prices paid under net metering have the effect of attracting enough solar DG providers to fill up the RPS market, so that they

 1040-6190/, http://dx.doi.org/10.1016/j.tej.2014.11.005

are being effectively squeezed out of the portfolio entirely.

What is particularly ironic about this effect is that, as noted above, distributed, small-scale solar is the least efficient form of commonly used renewable energy sources in the United States. All of these factors indicate that an increasing number of parties are likely to be motivated to ask FERC to preempt net metering and other state-mandated regimes that allow for unreasonably discriminatory and anti-competitive pricing.

IX. Factors Mitigating Environmental Benefits

Expectations of environmental externality benefits may be the biggest motivator for supporting and subsidizing solar DG. Proponents of solar DG note that solar has zero carbon or other harmful emissions from the process of producing energy. Additionally, to the extent that wide deployment of solar PV avoids the need to invest in technologies that do have carbon and other undesirable emissions, there is an environmental benefit that avoids the social costs associated with pollution. In the absence of legal limits on relevant emissions such costs, solar DG advocates correctly point out, are not captured in the internalized costs of the competing technologies. Therefore, solar DG advocates suggest that regulators and policymakers should take these external social costs into consideration in setting prices for various forms of energy.

The use of external social costs, as opposed to solely the internalized economics of various forms of energy is a controversial subject. Many oppose the use of externalities as a factor in pricing because it distorts the market and makes social judgments economic regulators may not be

empowered to make. In the views of such opponents, the only externalities that ought to be incorporated into pricing are those that are internalized by legal mandate. Proponents of incorporating externalities into rates contend that doing so is the only way to accurately reflect all social costs. They also contend that factoring in environmental externalities is a form of insurance against future regulatory requirements. While this article takes no position as to the merits of incorporating externalities into ratemaking, it will address this issue, on the assumption that at least some regulators and policymakers will look at externalities for purposes of assessing the value of solar DG.

Before delving into this issue any further, it is important to note that the United States Environmental Protection Agency (EPA), whose jurisdiction over carbon emissions has been affirmed by the U.S, Supreme Court,[5] has proposed new rules under Section 111(d) of the Clean Air Act that would, if promulgated, internalize the costs of carbon into electricity ratemaking, so the issue of whether or not to consider the costs of carbon would no longer be debatable. Thus, there is a great deal of uncertainty which, in the short term, effectively strengthens the hand of those who contend consideration of carbon emissions would be a form of insurance against future regulation. In the longer term, however, the likelihood that carbon emissions will be internalized gives rise to very serious questions as to the value of including externalities which, over time may run contrary to the economics of internalized carbon costs. It is also worth noting that there are already several states that have adopted controls on carbon emissions. In those states, it is especially important to make certain that renewable policy and pricing enhances efficiency in compliance, as opposed to confusing means and ends. Regardless, the environmental issue, in terms of solar DG, is

  http://dx.doi.org/10.1016/j.tej.2014.11.005

how cost effective such installations are for reducing carbon.

There is little dispute that solar DG is the least efficient of all renewable energy resources in common use in this country. As noted, there is even a consensus, which includes Amory Lovins, that agrees that solar DG is the least efficient renewable resource for reducing carbon. That view is fully supported by the facts in the California duck graph, as well as the ISO-New England and EPRI Value of the Grid data, which demonstrate conclusively that solar DG is consistently off-peak. When priced at net metering levels, it is also the most expensive renewable resource, thereby producing a perverse paradigm that where the least efficient resource costs the most. Therefore, it is evident, without considering any other factors, that solar DG is the least cost-effective use of renewable energy to reduce carbon emissions. There is also the reality that, as a general rule the least efficient and "dirtiest" plants are most likely getting dispatched at times of peak demand. Thus, in the rare instance that solar DG is available at peak in the United States, it is not displacing the most carbon emitting plants. Instead, it is displacing more efficient, less polluting generating units. Moreover, as an intermittent resource, its availability is highly uncertain and fossil plants are often called upon to operate on a less efficient, more carbon-emitting basis than if they were running as pure baseload. Thus solar DG is not only expensive, it is also much more likely to displace low-emitting, more efficient generation than less efficient, dirtier units. In addition, as noted earlier, net metering significantly dilutes the price signals for environmentally benign energy efficiency.

Those conclusions have been borne out by developments in Germany. In that country, where there has been a very dramatic increase in reliance on intermittent energy, prices have risen 37 percent since 2005, and were accompanied by spikes in both carbon emissions and the use of brown coal (lignite). While there are very significant difference between most states and Germany, perhaps most notably that Germany has decided to close down its nuclear plants (although it has replaced much of the domestic nuclear with imported nuclear energy), the experience in that country is very telling.[6] The German example clearly demonstrates that increased dependence on renewable energy resources, particularly intermittent resources, does not, as many solar DG proponents claim, *ipso facto*, mean fewer carbon emissions, and may, in fact, cause the opposite to occur. It also demonstrates that prices will escalate dramatically if the feed in tariffs are as far in excess of market as NEM prices are, as shown by the DTE graph above. The Germans, incidentally, have recognized their miscalculations and are dramatically recalibrating their strategy.

X. Regressive Social Impact

There are social effects beyond the environment that have to be taken into account if externalities are to be factored into ratemaking. Any failure to examine environmental externalities without recognizing that there are other social externalities to be considered as well will yield highly skewed results. Perhaps the most important of those is the social impact.

The social impacts of solar DG are caused by three main factors. First, as noted above, solar DG users have their electricity costs cross-subsidized by their neighbors who completely rely on the grid. Second, some data suggests that solar DG users are unusual electricity users. Third, not everyone can afford to be a solar DG user. To address the second point, unlike typical residential customers, in some regions solar

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DG users use little or no grid power at midday but quickly ramp up demand on peak, when PV production wanes (as is demonstrated by the charts in from the New England and California ISOs). Utilities must be able not only to serve full load on days when solar PV is not performing, but also to ramp up resources quickly to address the peak created by solar DG users. In order to ramp up as needed, utilities will purchase energy at the marginal price and then distribute those costs across all users, not just solar DG users. Thus, users without solar DG may be penalized for the use patterns of their solar DG neighbors. A comparison of residential electricity consumers in the western United States may be found below in **Figure 6**.[7]

Further, the impact of net metering is not simply the creation of a cross-subsidy from non-solar PV customers to solar PV customers but, as has been pointed out in a recent study by E3,[8] it is a cross-subsidy from less affluent households to more affluent ones. Indeed, the average median household income of net energy metering customers in California is 68 percent higher than that of the average household in the state, according to the study. In a recent proceeding, the staff of the Arizona Commerce Commission noted the same consequence.[9] As one wry observer in California noted, net metering is not "Robin Hood" but rather it is "robbin' the hood." In order to install rooftop solar panels, often individuals must be homeowners with high credit ratings or sufficient capital. Leasing arrangements are also widespread, but are generally available only to customers who own their own premises and they require the assignment of most of the rooftop solar benefits to the lessor. Many electricity customers, particularly less affluent ones, do not own homes or lost their homes in the most recent recession. The electricity customers who are unable to afford rooftop solar are forced to subsidize those who are already in a more favorable financial position. Thus, it is entirely fair to characterize NEM as a wealth transfer from less affluent ratepayers to more affluent ones.

Tariffs with a regressive social impact are certainly worthy of consideration from a policy and rate-making perspective. Thus, if externalities are to be weighed in setting pricing for solar DG, then it is important to avoid inordinate cost shifting and, in particular, to avoid adding new burdens to the less affluent in order to provide benefits to those further up on the income scale.

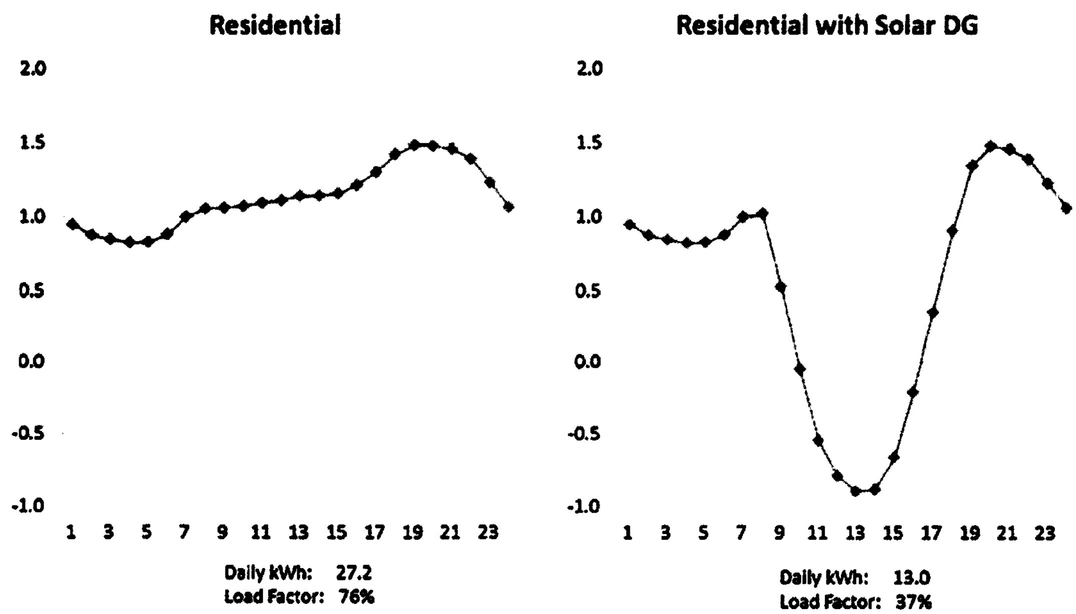

Figure 6: Typical Residential Loads Average Day – Iowa

EXHIBIT DWH -6

XI. Impact on Job Creation

The impact of solar PV on jobs is often cited as an externality benefit. Any analysis of the job impact must be comprehensive and not an effort to cherry pick data. For instance, merely citing the number of solar installers employed does not tell us much. Many aspirations for more jobs manufacturing PV units in the United States have not materialized due to China's capture of the market. Other impacts to be considered are the effect of solar PV on electric rates and the impact of that on the job market, not only in terms of what happens with rates, but also in terms of the rate structure that is implemented as a result of more market penetration by solar DG. For example, it is conceivable that any movements toward more fixed costs could discourage energy efficiency work thus displacing jobs in manufacturing and installing energy efficiency technology.

XII. Conclusion

There is value in solar DG, but that value is severely diminished and placed in peril if its pricing discourages efficiency improvements and distorts critical price signals in the marketplace. It is similarly counterproductive to the future of solar DG if its pricing has socially regressive effects and if it sucks needed revenue away from the essential distribution grid. From an economic point of view solar DG has energy value, the potential for reducing some transmission costs, and perhaps under the right circumstances, some capacity value, and ought to be compensated accordingly. With regard to externalities, it is not entirely clear, when viewed in the entire scope of its impact, that solar DG, has positive environmental value, but it is absolutely

clear that when net metering is deployed, it is simply not a cost-effective means for reducing carbon emissions. In fact, it is possible that solar DG might do more harm than good if it has the effect of removing price incentives for energy efficiency, and if it causes older plants to extend their lives and to operate inefficiently on a ramping basis for which they were not designed. It seems clear that if we are to capture the full value of solar DG, net metering must be discarded and replaced with a market-based pricing system that values the resource appropriately and includes incentives for making it more efficient over the long run.■

Endnotes:

1. Black, John. Update on Solar PV and Other DG in New England. ISO New England (June 2013).

2. *See* Frank, Charles R., Lovins, Amory B., 2014, September. Alternative Energies Debate – The Net Benefits of Low and No-Carbon Electricity Technologies: Better Numbers, Same Conclusions. The Brookings Institution. *See also* Frank, Charles R., 2014. The Net Benefits of Low and No-Carbon Electricity Technologies. The Brookings Institution Global Economy and Development Program, 1939–9383 *see contra* Lovins, Amory B., 2014, July. Sun, wind, and drain. The Economist; Lovins, Amory B., 2014, August. Sowing confusion about renewable energy. Forbes.

3. See e.g. David B. Raskin, The Regulatory Challenge of Distributed Generation, 4 Harv. Bus. L. Rev. Online 38 (2013).

4. 135 FERC 13 61,022, April 12, 2011 *affirmed* New Jersey Board of Public Utilities et al. v. FERC, 744 F.3d 74 (2014).

5. Massachusetts v. U.S. Environmental Protection Agency, 549 U.S. 497 (2007).

6. See Melissa Eddy, *German Energy Push Runs into Problems*. N.Y. Times, March 19, 2014, http://www.nytimes.com/2014/03/20/business/energy-environment/german-energy-push-runs-into-problems.html.

7. Gale, Brent. *A Seven Step Program for Embracing DG/DER*. Berkshire Hathaway Energy (October 2013).

8. Energy and Environmental Economics, Inc. *California Net Metering Draft Cost-Effectiveness Evaluation*. Prepared for California Public Utilities Commission, Energy Division. Sept. 26, 2013.

9. Arizona Commerce Commission. Open Meeting re: Arizona Public Service Company – Application for Approval of Net Metering Cost Shift Solution (Docket No. E-0135A-13-0248). Sept. 30, 2013.

Docket No. E-00000J-14-0023

Ferre-1

TEENA JIBILAN
ASSISTANT CHIEF ADMINISTRATIVE LAW JUDGE
ARIZONA CORPORATION COMISSION (ACC)
1200 West Washington Street
Phoenix, AZ 855007

RECEIVED

2016 APR 14 P 4: 17

AZ CORP COMMISSION
DOCKET CONTROL

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF VALUE AND COST OF DISTRIBUTED GENERATION

Dear Judge Jibilian,

Thank you for your response to my April 11, 2016 Disability EHS Intervener Request.

I am now informed by staff that I can participate as requested and am informed relative to how I can connect via phone, with your meeting on this Friday, at 10 AM.

When ACC staff informed me that as an intervener I had the right to request an Expert Witness, I asked Elizabeth Kelly, Director of Electromagnetic Safety Alliance, Inc., and a director of the International EMF Scientist Appeal campaign. Elizabeth has been associated with the ACC generic Docket E-00000C-11-0328 since its inception and is an intervener on that docket. She and I both consider it appropriate for generic Docket E-00000C-11-0328 to be linked to dockets that may consider the use of controversial wireless technologies, such as E-00000J-14-0023. It is our guess, based on the December 2014 testimony of Mr. Thomas Mumaw, (*that all AZ public service companies that he knew about, require 'smart meters' for solar customers*), that **solar customers may still be dealing with A.R.S.40-334.Discrimination A and B issues.**

We agree that analog meter compliance with A.R.S.40-361.B is desirable for Arizona patrons, employees and the public. A majority of generic E-00000C-11-0328 public comments favor analog meters.

Elizabeth Kelly accepted to serve as an expert witness and sent me the attached document for submission. Elizabeth Kelly states she can attend a meeting to present at the ACC regarding this matter, on either Thursday, April 21, 2016 or Thursday, April 28, 2016. Elizabeth, who lives in Tucson, requests to be finished by 3 PM on the day selected.

Respectfully submitted,

Patricia C. Ferre

Patricia C. Ferre

EXHIBIT
Ferre-1
ADMITTED

Docket #E-00000J-14-0023

April 7, 2016

Arizona Corporation Commissioners
BOB STUMP
BOB BURNS
TOM FORESE
ANDY TOBIN
DOUG LITTLE
And,
Judge Jibilian, Assistant Administrative Law Judge, ACC

1200 West Washington Street
Phoenix, AZ 85007

DOCKET NO. E-000001-14-0023

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF VALUE AND COST OF DISTRIBUTED GENERATION

Notice of Direct Testimony

Dear Commissioners and Judge Jibilian,

I am submitting the direct testimony of Elizabeth A. Kelley, MA., Director of Electromagnetic Safety Alliance, Inc., an Arizona State registered corporation, who also directs the International EMF Scientist Appeal campaign.

Signed,

Patricia C. Ferre

Patricia Ferre

Summary of Direct Testimony of Elizabeth Kelley, MA

I am Elizabeth Kelley, Director of Electromagnetic Safety Alliance, Inc, an Arizona State registered corporation. Since 2011, I have testified at hearings before the Arizona Corporation Commission regarding the environmental impacts of electromagnetic fields and radiofrequency radiation (often referred to as "EMF") on human health and the environment.

The AZCC needs to do better to assure greater health protections from electromagnetic fields and radiofrequency radiation in regulating solar panel technologies

I am an intervener in the generic docket on smart meters (Docket #E-00000C-11-0328) and have submitted many scientific studies, reviews and expert statements on this subject to that docket. In that docket are also dozens of filings of scientific studies, reports and expert statements by others. Also there are many anecdotal reports of harm that has been or is being caused by wireless utility meters (AMR and AMI meters) that transmits pulse modulated radiofrequency signals through the air and "dirty electricity" (pulse modulated radiofrequency radiation signals from wired and wireless sources that couple with electrical wiring in buildings.

On December 12, 2014, I brought Dr. Martin Blank, PhD, of Columbia University, to provide expert witness testimony at a hearing before the Arizona Corporation Commission. Dr. Blank is an internationally known expert who has published peer reviewed studies in scientific journals on EMF biological and health effects.

At that hearing, the Arizona State Department of Health Services presented a report it had been commissioned to do by the AZCC on smart metering. They found that, based on its investigation, smart meters were safe. I testified in opposition to this report as there were many errors and omissions in it and it seems to have been politically influenced to favor the electrical utilities that are regulated by the AZCC.

Docket #E-00000J-14-0023

I highly recommend that Docket #E-00000C-11-0328 "Generic Docket for the Investigation of Smart Meters", opened in 2011" be incorporated by reference into Docket E-00000J-11-0023, as it contributes to the current discussion by providing critically important evidence of environmental costs due to DG of solar energy, namely the potential for environmental harm from wireless utility metering from AMI and AMR meters and solar inverters.

One of the stated purposes of evaluating the value and cost of distributed generation was to evaluate environmental benefits. I think that, as shown in Docket E-00000C-11-0328, that there are also environmental costs involved with solar generation.

The utility meters that utilities are mandating be placed on the buildings of all customers who provide DG through solar panels on their rooftops or nearby to their buildings, are capable of causing harm due to the wireless signals transmitted through the air that are used to transmit energy use date to the utility. AMI and AMR meters time-of-use meters are being used for this purpose. Solar customers have two or more meters installed on their buildings to monitor solar panel operations and to report energy usage.

Adverse health effects are being reported by solar customers and their neighbors due to the signal transmissions from these meters. Use of AMI and AMR meters and solar inverters installed by the solar companies needs to be closely reviewed for safety. The Federal government's health agencies, the U.S. Department of Energy and the FCC are not properly exercising its responsibilities to assure EMF emitting technologies are safe under pre and post market conditions. Under Arizona's Revised State Statues, A.R.S.40-361.B, A.R.S.40-321.A, A.R.S.40-202.C.1 and, A.R.S. 44-1522, the Arizona Corporation Commission is responsible for ensuring a safe environment for workers, building occupants and the general population.

Clearly, it is now well known that solar energy generation, including distributed power generation through solar panels installed on individual homes and commercial buildings, reduces the health impacts of fossil fuels. These benefits have been pointed out in many filings to this docket.

- Western Resource Advocates, 2/14/14
- Clean Power recommends that utility ratemaking give consideration to environmental and societal impacts of their generation sources as "these categories absolutely deserve through discussion and consideration, 2/14/14.
- Steven Olea, former Director of AZCC's Utilities Division, pointed to the environmental benefits of reducing society's reliance on fossil fuels, 1/27/14.
- etc….

The opposite perspective was stated by RUCO (AZCC's Residential Utility Consumer's Office) who advised to "keep it simple", in analyzing costs and benefits as "it is hard to quantify national environmental and health benefits" and would "detract from the main objective of this docket."

I disagree whole heartedly with the narrow approach advocated by RUCO. AZCC's RUCO is charged with assisting consumers in Arizona in getting their concerns addressed in dealing with all corporate entities and their services that are regulated by the AZCC.

International EMF Scientist Appeal to the UN and related agencies signed by 200 scientists from 41 nations

I serve as the Director of EMFscientist.org, which is sponsoring a campaign to bring attention to the International EMF Scientist Appeal. This Appeal was initially signed by 190 scientists from 39 nations and was submitted on May 11, 2015 to the leaders of the United Nations, the World Health Organization and the United Nations Environmental Program. Since then, the number of signatures has increased to 220 signators from 41 nations. Each signator that has signed this Appeal qualifies to sign as they have published peer reviewed studies that demonstrate biological and health effects of EMF. I am one of the signators to this Appeal

The Appeal starts by stating that, "We are scientists engaged in the study of biological and health effects of non-ionizing electromagnetic fields (EMF). Based upon peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to

EMF generated by electric and wireless devices. These include–but are not limited to–radiofrequency radiation (RFR) emitting devices, such as cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, **smart meters**, and baby monitors **as well as electric devices and infra-structures used in the delivery of electricity that generate extremely-low frequency electromagnetic field** (ELF EMF).."

This Appeal is a powerful public statement by concerned scientists that is being reported worldwide by major media outlets, blogs, health, environmental and consumer groups and in testimony to local, national and international bodies. The concerned scientists who are signing it recognize its significance and the inherent risks of doing so. Nevertheless, they are willing to join in common cause in order to increase public awareness about the large body of scientific research that points to serious EMF risks posed by EMF emitting technologies with the hope and expectation that the knowledge gained as a result would inform the public and lead to more protective policies to guide technological innovation and application that involve electromagnetic fields and radiofrequency radiation transmissions.

The complete Appeal is attached under Appendix A and may be found at www.emfscientist.org.

Sincerely,

Elizabeth A. Kelley, MA
Director, EMFscientist.org
Director, Electromagnetic Safety Alliance, Inc.

info@emfscientist.org
lkelley_45@msn.com

Appendix A

International EMF Scientist Appeal, taken from the EMFscientist.org website:

International EMF Scientist Appeal

To: His Excellency Ban Ki-moon, Secretary-General of the United Nations;
Honorable Dr. Margaret Chan, Director-General of the World Health Organization;
Honorable Achim Steiner, Executive Director of the U.N. Environmental Programme;
U.N. Member Nations

International Appeal

Scientists call for Protection from Non-ionizing Electromagnetic Field Exposure

We are scientists engaged in the study of biological and health effects of non-ionizing electromagnetic fields (EMF). Based upon peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices. These include–but are not limited to–radiofrequency radiation (RFR) emitting devices, such as cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors as well as electric devices and infra-structures used in the delivery of electricity that generate extremely-low frequency electromagnetic field (ELF EMF).

Scientific basis for our common concerns

Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines.

Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.

These findings justify our appeal to the United Nations (UN) and, all member States in the world, to encourage the World Health Organization (WHO) to exert strong leadership in fostering the development of more protective EMF guidelines, encouraging precautionary measures, and educating the public about health risks, particularly risk to children and fetal development. By not taking action, the WHO is failing to fulfill its role as the preeminent international public health agency.

Inadequate non-ionizing EMF international guidelines

The various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) established in 1998 the "Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)"[1]. These guidelines are accepted by the WHO and numerous countries around the world. The WHO is calling for all nations to adopt the ICNIRP guidelines to encourage international harmonization of standards. In 2009, the ICNIRP released a statement saying that it was reaffirming its 1998 guidelines, as in their opinion, the scientific literature published since that time "has provided no evidence of any adverse effects below the basic restrictions and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields[2]. ICNIRP continues to the present day to make these assertions, in spite of growing scientific evidence to the contrary. It is our opinion that, because the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, they are insufficient to protect public health.

The WHO adopted the International Agency for Research on Cancer (IARC) classification of extremely low frequency electromagnetic field (ELF EMF) in 2002[3] and radiofrequency radiation (RFR) in 2011[4]. This classification states that EMF is a *possible human carcinogen (Group 2B)*. Despite both IARC findings, the WHO continues to maintain that there is insufficient evidence to justify lowering these quantitative exposure limits.

Since there is controversy about a rationale for setting standards to avoid adverse health effects, we recommend that the United Nations Environmental Programme (UNEP) convene and fund an independent multidisciplinary committee to explore the pros and cons of alternatives to current practices that could substantially lower human exposures to RF and ELF fields. The deliberations of this group should be conducted in a transparent and impartial way. Although it is essential that industry be involved and cooperate in this process, industry should not be allowed to bias its processes or conclusions. This group should provide their analysis to the UN and the WHO to guide precautionary action.

Collectively we also request that:

1. children and pregnant women be protected;
2. guidelines and regulatory standards be strengthened;
3. manufacturers be encouraged to develop safer technology;
4. utilities responsible for the generation, transmission, distribution, and monitoring of electricity maintain adequate power quality and ensure proper electrical wiring to minimize harmful ground current;
5. the public be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies;
6. medical professionals be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity;

7. governments fund training and research on electromagnetic fields and health that is independent of industry and mandate industry cooperation with researchers;
8. media disclose experts' financial relationships with industry when citing their opinions regarding health and safety aspects of EMF-emitting technologies; and
9. white-zones (radiation-free areas) be established.

1) http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
2) http://www.icnirp.org/cms/upload/publications/ICNIRPStatementEMF.pdf
3) http://monographs.iarc.fr/ENG/Monographs/vol80/
4) http://monographs.iarc.fr/ENG/Monographs/vol102/

Release date: May 11, 2015
This version's date: October 15, 2015.

All inquiries, including those from qualified scientists who request that their name be added to the Appeal, may be made by contacting Elizabeth Kelley, M.A., Director, EMFscientist.org, at info@EMFscientist.org.

***Note**: the signatories to this appeal have signed as individuals, giving their professional affiliations, but this does not necessarily mean that this represents the views of their employers or the professional organizations they are affiliated with.*

Signatories

Armenia

Prof. Sinerik Ayrapetyan, Ph.D., UNESCO Chair - Life Sciences International Postgraduate Educational Center, Armenia

Australia

Dr. Priyanka Bandara, Ph.D., Independent Environmental Health Educator/Researcher, Australia; Advisor, Environmental Health Trust and Doctors for Safer Schools

Dr. Bruce Hocking, MD, MBBS, FAFOEM (RACP), FRACGP, FARPS, specialist in occupational medicine; Victoria, Australia

Dr. Gautam (Vini) Khurana, Ph.D., F.R.A.C.S., Director, C.N.S. Neurosurgery, Australia

Dr. Don Maisch, Ph.D., Australia

Dr. Elena Pirogova, Ph.D., Biomed Eng., B. Eng (Hon) Chem. Eng., Engineering & Health College; RMIT University, Australia

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Dr. Tom Hutchinson, Ph.D., Professor Emeritus, Environmental and Resource Studies, Trent University, Canada

Prof. Ying Li, Ph.D., InVitroPlus Labs, Dept. of Surgery, Royal Victoria Hospital, McGill University, Canada

James McKay M.Sc, Ecologist, City of London; Planning Services, Environmental and Parks Planning, London, Canada

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Prof. Michael A. Persinger, Ph.D., Behavioural Neuroscience and Biomolecular Sciences, Laurentian University, Canada

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Prof. Huai Chiang, Bioelectromagnetics Key Laboratory, Zhejiang University School of Medicine, China

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AZ CORP COMMISS
DOCKET CONTROL

BEFORE THE ARIZONA CORPORATION COMMISSION

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF VALUE AND COSTS OF DISTRIBUTED GENERATION.	Docket No.: E-00000J-14-0023 **NOTICE OF FILING OF DIRECT TESTIMONY OF SCOTT NORTHRUP**

Pursuant to the Administrative Law Judge's Procedural Order (p. 4) dated December 3, 2015, Intervenors, the International Brotherhood of Electrical Workers, AFL-CIO, CLC ("IBEW Locals") Local Unions 1116, 387, and 769, by and through undersigned counsel, hereby provide notice of their filing of the attached Direct Testimony of Scott Northrup in this docket.

RESPECTFULLY SUBMITTED this 25th day of February, 2016.

LUBIN & ENOCH, P.C.

Nicholas J. Enoch ET

Nicholas J. Enoch, Esq.
Attorneys for Intervenors

Arizona Corporation Commission
DOCKETED
FEB 25 2016
DOCKETED BY

EXHIBIT
IBEW-1
ADMITTED

Original and thirteen copies of the IBEW Locals' Direct Testimony filed this 25th day of February, 2016, with:
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Phoenix, Arizona 85007-2996

Copies of the foregoing transmitted electronically or mailed this same date to those identified on the attached service list for this docket.

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Q1. Please state your name and business address.

A1. Scott Northrup. My business address is 4601 South Butterfield Drive, Tucson, Arizona 85714.

Q2. Please describe your present position, background, and experience.

A2. I am the Business Manager/Financial Secretary for Intervenor, International Brotherhood of Electrical Workers, Local 1116. The position of Business Manager/Financial Secretary is an elected union position, but due to the recent retirement of my predecessor, Frank Grijalva, I was appointed by our Executive Board to my present position on February 1, 2016.

Because all IBEW Local Unions also have a President, persons outside of our organization commonly believe that the President is the principal officer of the Local. This is not the case. Article 17, §§ 4 and 8 of the Constitution of the International Brotherhood of Electrical Workers, AFL-CIO, provides that the Business Manager/Financial Secretary is the "principal officer" of any IBEW Local Union.

Prior to becoming Business Manager/Financial Secretary, I was employed by TEP for sixteen years in various positions, most recently as a Training Specialist. While employed at TEP, I was an active member of IBEW Local 1116, and previously served as the Local's President for eight years.

Q3. Are IBEW Locals 1116, 387, and 769 separate legal entities?

A3. Yes. Additionally, our International Union and its constituent local unions, including my own, are separate legal entities. However, the various IBEW local unions in the state of Arizona meet on a regular basis to discuss issues of mutual concern. Generally speaking, we are familiar with and supportive of the actions of each other. IBEW Locals 1116, 387, and 769 have chosen to collectively intervene in these proceedings. As a result, I am testifying today on behalf of IBEW Local 1116 as well as IBEW Locals 387 and 769.

Q4. Have you testified in other matters before the Arizona Corporation Commission?

A4. No.

Q5. What is IBEW Local 1116?

A5. IBEW Local 1116 is a labor organization that serves as the exclusive representative for approximately seven-hundred non-managerial Tucson Electric Power ("TEP") employees, including linemen/cablemen, substation electricians, electronics technicians, equipment servicemen, field technicians, designers, heavy equipment and transport operators, maintenance electricians, maintenance mechanics, and meter repairmen. IBEW Local 1116 also represents approximately thirty-seven members working for Trico Electrical Cooperative.

IBEW Local 1116 and TEP's series of collective bargaining agreements ("CBA") date back to November 16, 1937, and its current CBA extends to December 31, 2018. IBEW Local 1116 was a party to the 2008 TEP Rate Case Settlement Agreement, approved in Decision No. 70628, and to the 2012 TEP Rate Case Settlement Agreement, approved in Decision No. 73912, and to the ongoing TEP Rate Case in Docket No. E-01933A-15-0322. IBEW Local 1116 was also involved in the 2009 Trico rate case. *See Trico Electric Cooperative, Inc. General Rate Case*, 2009 Ariz. PUC LEXIS 186 (Aug. 6, 2009).

Q6. What is IBEW Local 387?

A6. IBEW Local 387 is the duly-elected and recognized exclusive bargaining agent for approximately one-thousand-five-hundred employees of the Arizona Public Service Company ("APS"). IBEW Local 387 is also the exclusive representative of employees at Navopache Electric Cooperative, Inc., and of employees working for Unisource Electric Workers in Nogales and for Graham County Electric Cooperative.

IBEW Local 387 and APS have a long series of CBAs dating back to 1945 concerning rates of pay, wages, hours of employment, and other terms and conditions of employment. *See generally Int'l Bhd. of Elec. Workers v. NLRB*, 788 F.2d 1412, 1413 (9th Cir. 1986). IBEW Local 387 intervened in Docket No. E-01933A-11-0224, among many other proceedings before the ACC involving APS and other regulated utilities, and was a party to the APS rate case settlement agreement dated January 6, 2012 and approved in Decision No. 73183.

Q7. What is IBEW Local 769?

A7. IBEW Local 769 represents employees of subcontractors working for virtually all of Arizona's utility companies, large and small. IBEW Local 769 is the exclusive bargaining agent for all IBEW outside line workers in Arizona, and its scope of work also includes teledata, street light, and trenching for APS and throughout the state of Arizona. At any given time, IBEW Local 769 has between five and two-hundred of its bargaining unit employees working for subcontractors of APS.

IBEW Local 769 intervened in Docket No. E-01933A-11-0224, among several other proceedings before the ACC involving APS and other utilities, and was a party to the January 6, 2012 APS rate case settlement agreement approved in Decision No. 73183. IBEW Local 769 is also the exclusive bargaining representative of approximately 80 employees of UNS Electric Corporation in Mohave County.

Q8. What is the purpose of your testimony?

A8. I am testifying to share the position and perspective of our represented utility workers on the cost and value of solar service. I am also testifying in support of the adoption of a new price plan for rooftop solar customers, similar to that implemented by SRP in early 2015.

We believe that our members bring a unique and important perspective to this discussion. As you know, Article XV, § 3 of the Arizona Constitution expressly recognizes the employees of public service corporations as central stakeholders whose interests are on par with those of patrons with respect to any potential Commission action. Specifically, the Arizona Constitution provides that "[t]he corporation commission shall have full power to, and shall . . . make and enforce reasonable rules, regulations, and orders for the convenience, comfort, and safety, and the preservation of the health, of the employees and patrons of [public service] corporations."

Q9. How are utility workers currently being impacted by net-metering?

A9. In the last one-hundred years, utility workers, including those represented by the IBEW Locals, built the North American grid, which has been called by IBEW International President Edwin D. Hill "the largest and most complex machine in human history, the key to our country's economic future." *See* The Electrical Worker Online, *How Will Distributed Generation Change the Grid?*, (May 2015), *available at* http://www.ibew.org/articles/15ElectricalWorker/EW1505/SolarRooftop.0515.html. Distributed generation solar power promises to dramatically change the grid in the near future. How that change occurs will impact the jobs and futures of thousands of IBEW workers, including those in Arizona. The IBEW Locals' principal concern is that solar customers use and rely on the grid without contributing a fair share to the cost of its maintenance, thereby requiring utilities to either absorb or shift the cost to other users, and fundamentally destabilizing the environment in which utility workers do their jobs.

Regardless of how much expansion the solar power field experiences, for it and for all "renewable energy to succeed on a large scale, the grid is indispensable. In truth the grid won't die, but rather must grow exponentially – in function, complexity, and usefulness." *See* Charles Bayless, *The Death of the Grid?*, Fortnightly (Dec. 2014), *available at* http://mag.fortnightly.com/article/The+Death+of+the+Grid%3F+/1886505/238951/article.html. The grid ensures that for solar users, energy is still available at night and in inclement weather and when a solar system is being maintained or fails. It also allows excess energy to flow back to the grid, among other important services. Thus, the grid is essential to solar customers. Indeed, in its antitrust complaint against SRP, SolarCity, America's largest installer of distributed solar energy systems, conceded that "solar customers are unable to completely disconnect from SRP's grid—they still need power in the evening hours and at other times when their energy demands exceed what their solar energy systems produce[.]" *See* Complaint, Case No. 2:15-cv-00374-DLR (Doc. 1, p. 1, ¶ 4) (D. Ariz. March 2, 2015).

Currently however, utilities compensate solar customers for their surplus electricity at full retail value. Thus, they are excused from paying their fair share of the costs derived from their use of the grid, including its maintenance and the transmission and distribution it facilitates. Solar customers are compensated for the energy that they generate, but that compensation does not account for the fact that less than half of the cost of providing energy comes from generating it. *See* The Electrical Worker Online, *How Will Distributed Generation Change the Grid?*, (May 2015), *available at* http://www.ibew.org/articles/15ElectricalWorker/EW1505/SolarRooftop.0515.html. In fact, thirty-seven cents of every dollar charged by utilities goes towards building and maintaining the grid. *Id.* And regardless of the growth of solar, that fact may not change. The Executive Director of the Harvard Electricity Policy Group, estimates that solar does not avoid transmission costs and may actually increase distribution costs. Ashley Brown, *Valuation of Distributed Solar: A Qualitative View*, 27 The Electricity Journal 10 (2014), *available at* http://www.ksg.harvard.edu/hepg/Papers/2014/12.14/Brown%20%20Valuation%20of%20%20Distributed%20Solar%20%2011.14.pdf.

Thus, regardless of how much solar grows, utilities will still need workers to build and maintain the grid. The fact that these utilities will not receive a fair price for their services jeopardizes job stability for utilities workers, and reduces utilities' ability to provide a safe and efficient workplace for these workers. This is obviously an unfavorable outcome for the IBEW Locals' members. The IBEW Locals also posit that this outcome should concern the Arizona Corporation Commission, which is bound by Article XV, § 3 of the Arizona Constitution to protect the employees of public service corporations, as notably opposed to the interests of distributed-solar companies, many of which are actually from California.

Q10. To what degree do intermittency and non-dispatchability affect the value of solar?

A10. In response to this question, posed by Commissioner Stump in his February 19, 2016 letter to the docket, the IBEW Locals assert that these drawbacks of solar not only reduce its value, but also accentuate the benefit, along with the associated cost, of traditional generation through the grid. By way of example, when a storm hits and it is raining and the lines are down, solar customers not only rely on electricity produced by electric utilities, they also rely on the skilled employees of those utilities, or their contractors, to make all necessary repairs to the grid in short order. In other words, the utilities and those working directly for or with them must be, and in fact are, prepared to jump into action and get to work on behalf of everyone tied into the grid. This readiness to work is in itself a costly, albeit necessary, expense that needs to be borne by everyone reliant on the grid. The same cannot be said of those who install distributed solar energy systems.

Q11. Are the IBEW Locals concerned about the regressive social costs currently imposed by net-metering?

A11. Yes. In many cases, the costs that solar customers are excused from paying are reallocated to non-solar customers. Solar customers typically must be able to pay many thousands of dollars for a solar unit, have a single-family home, and possess a good credit score. Those without these abilities, including those living in apartments or multi-unit low-income housing, cannot access rooftop solar power for their home. Thus, the cost shift from solar users to non-solar users is actually a cost shift from affluent families to low-income families. As the bargaining representative for utilities workers supporting working class families in non-managerial jobs, this strikes the IBEW Locals as especially unjustifiable.

Q12. Left unchecked, how do the IBEW Locals estimate that net metering, in its current state, will impact the value of solar power in the long run?

A12. The IBEW Locals support clean energy and efforts to reduce carbon emissions. Currently, however, rooftop solar is the least effective renewable energy source for reducing carbon emissions. Ashley Brown, *Valuation of Distributed Solar: A Qualitative View*, 27 The Electricity Journal 10 (2014), *available at* http://www.ksg.harvard.edu/hepg/Papers/2014/12.14/Brown%20%20Valuation%20of%20%20Distributed%20Solar%20%2011.14.pdf. Preferential pricing for rooftop solar results in solar occupying a disproportionate share of the energy market, making it less likely that other more efficient forms of renewable energy are successful. This result is inconsistent with the IBEW Locals' goal of supporting and advancing renewable energy.

Q13. How would the IBEW Locals prefer that the concerns raised herein be addressed?

A13. The IBEW Locals believe that utilities' mechanisms for pricing solar must accurately account for its benefits. Moreover, they also must account for, as Commissioner Stump referred to it in his February 19, 2016 letter to the docket, the "regressive social costs . . . of solar, given that non-solar utility customers subsidize solar customers." At the same time, any solution must distinguish between value and cost. Value considerations pertinent to solar power, such as environmental benefit, may properly inform policy planning, but should remain separate from costs considerations, which must effectively recover outlays—the actual dollars and cents—expended by a utility. Ultimately, to effectively and safely employ the workforce necessary to deliver cost-effective power to the public, utility rates must be cost-based.

The IBEW Locals support the adoption of a plan similar to SRP's new Customer Generation Price Plan, or E-27 plan. Rather than charging customers for power based on how much energy they use, which fails to reflect an equal share of the fixed energy costs used by a solar customer, the E-27 plan breaks down a customer's energy costs according to the costs incurred by the utility in providing it, such as transmission, distribution, customer service, and more. Solar customers are still able to send their surplus energy back to the grid, and will receive a credit towards their energy charge for doing so.

Q14. Does this conclude your testimony?

A14. Yes.

ORIGINAL

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Attorneys for Intervenors IBEW Locals 387, 1116, and 769

BEFORE THE ARIZONA CORPORATION COMMISSION

IN THE MATTER OF THE COMMISSION'S INVESTIGATION OF VALUE AND COSTS OF DISTRIBUTED GENERATION.	Docket No.: E-00000J-14-0023 **NOTICE OF FILING OF REBUTTAL TESTIMONY OF SCOTT NORTHRUP**

Pursuant to the Administrative Law Judge's Procedural Order (p. 4) dated December 3, 2015, Intervenors, the International Brotherhood of Electrical Workers, AFL-CIO, CLC ("IBEW Locals") Local Unions 1116, 387, and 769, by and through undersigned counsel, hereby provide notice of their filing of the attached Rebuttal Testimony of Scott Northrup in this docket.

RESPECTFULLY SUBMITTED this 7th day of April, 2016.

LUBIN & ENOCH, P.C.

Nicholas J. Enoch, Esq.
Attorneys for Intervenors

Arizona Corporation Commission
DOCKETED
APR 07 2016
DOCKETED BY

EXHIBIT
IBEW-2
ADMITTED

Original and thirteen copies of the IBEW Locals' Rebuttal Testimony filed this 7th day of April, 2016, with:

Arizona Corporation Commission
Docket Control Center
1200 West Washington Street
Phoenix, Arizona 85007-2996

Copies of the foregoing transmitted electronically or mailed this same date to those identified on the attached service list for this docket.

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Q1. Please state your name and business address.

A1. Scott Northrup. My business address is 4601 South Butterfield Drive, Tucson, Arizona 85714.

Q2. Are you the same Scott Northrup whose direct testimony was filed in this docket on February 25, 2016.

A2. Yes.

Q3. What outcome do the IBEW Locals hope to see this Value of Solar docket accomplish?

A3. In short, equity. The IBEW Locals hope that a clear separation between tangible and intangible costs and benefits is established through the Value of Solar docket. This requires a segregation of the utility's cost of service from any societal and/or forward looking benefits that are associated with solar DG. Doing so will facilitate the identification of the revenue streams needed to fairly compensate the utility as well as the customer. Incorporating intangible benefits into this calculation would invite: (i) a high level of subjectivism; (ii) a focus on generalities; (iii) arbitrary and/or policy presumptive determinations regarding what external considerations are more important than others; and (iv) an opening of the door for discrimination. In addition, the IBEW Locals believe that the intangible benefits would be more appropriately addressed through State and local governments providing an economic value or incentive to consumers in the form of some tax benefit. After all, secondary economic impacts are of the greatest benefit to society at large.

Q4. Are you aware of any tangible or quantifiable distribution system costs associated with solar DG that are avoidable?

A4. No. As I understand it, solar DG does not reduce the distribution costs of providing service. The reason for this is due to rooftop solar DG's lack of reliability and its intermittency (as explained in my previous testimony). Because of these factors, rooftop solar customers must still rely on the power provided from the electric grid during the times that the DG unit is not operating or when the DG unit provides insufficient generation to serve the customers' demands. This means that the size of the facilities required to provide service to a customer with DG is exactly the same as a standard customer without DG. That is, the metering, transformer, and service drop at the customer's service location is the same for all similarly situated customers, whether solar DG or not. In fact, Nevada recently faced this exact same issue. In its decision, the Public Utilities Nevada Commission found that DG was no longer economical for new systems, and existing customers who expected modest savings from their solar investments faced substantial added costs for electric services.

Environmental benefits, on the other hand, are non-quantifiable. While enthusiasm for solar DG and other renewable resources is undoubtedly a positive goal, it really has no place in a customer's utility bill. By their very nature, utility bills are designed to recover the costs incurred in the provision of service and utilities to customers. As an economic matter, this gives utilities an opportunity to earn a fair return on their capital (that they are obliged to prudently manage), and as a result, the public has historically invested in them with confidence.

Finally, a quantifiable detriment has been identified – the generation capacity of rooftop solar will proceed to decline as it continues to be added. This is because the typical peak hour for energy commences around 5:00 p.m. (when the workforce begins to arrive at home) and continues into the subsequent hours. The problem is that rooftop solar is contributing less during these peak times, yet the consumption and demand have not declined. Conversely, they have increased, and the demand for energy after sunset will continue to grow. Rooftop solar energy will have a diminishing impact on the capacity needed to meet this demand because any mitigation rooftop solar can offer is only possible until around 5:00 p.m.

Q5. You previously testified about the regressive social costs related to net-metering and solar DG; are you aware of any other related social impediments?

A5. Yes. My previous testimony focused on the impact of solar DG on those living in apartments or multi-unit low-income housing versus those affluent enough to have a single-family home, possess a good credit score, and afford to pay thousands of dollars for a solar unit. In addition to this, most rural areas are serviced by Cooperatives and have a far lower number of customers per mile. The result is that these areas pay a higher distribution cost of providing service per kWh. A higher level of distribution costs means that those serviced by Cooperatives incur a greater amount of fixed costs due to customers with solar DG. Many of the IBEW Locals' members live in these communities and have been financially burdened by this imbalance in cost sharing. With the approval of rates and charges that allow for an equitable recovery of the distribution costs associated with providing service to customers with solar DG, those living in rural areas (which also happen to be the most economically challenged in Arizona) pay only their fair share of the costs. As Theodore Roosevelt explained, "I stand for the square deal . . . But when I say that I am for the square deal, I mean not merely that I stand for fair play under the present rules of the game, but that I stand for having those rules changed so as to work for a more substantial equality of opportunity and of reward for equally good service." A plan similar to SRP's new Customer Generation Price Plan, or E-27 plan will accomplish this goal.

In addition to the negative impact that solar DG has had on rural areas, recent research regarding this issue has shown that subsidies for rooftop solar, over the years, have led to a significant loss in jobs and a decreased wealth for Arizona as a whole.[1] The root of this problem is that money spent on DG depletes the amount of money available to spend in other sectors of the economy. While the opposition may argue that rooftop solar creates additional jobs, these jobs are temporary (only created by the installation of rooftop solar) and worse, they are counteracted by what the ASU Study has referred to as their "long-

[1] Evans, Anthony, Tim James, and Lora Mwaniki-Lyman. "The Economic Impact of Distributed Solar in the APS Service Territory, 2016-2035." Report, L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University, February 16, 2016. (ASU Study).

run/legacy effects." This study predicts that over billions of dollars of lost gross state product and thousands of "job years" (i.e., years of employment) are lost. This is a significant social regression for Arizona and for the members of the IBEW Locals.

There is a further consideration to take into account when dealing with employees of public service corporations, such as the members of the IBEW Locals. According to Article XV, § 3 of the Arizona Constitution, employees of public service corporations are central stakeholders with respect to the Commission's power to "make and enforce reasonable rules, regulations, and orders . . .." This is an added constitutional protection that other types of employees, such as non-utility employees of solar companies, do not have. This additional consideration seems to have been overlooked in the Commission Staff's direct testimony. According to the Staff, "secondary economics should not be considered" and "[c]omparison of local job content can vary between technologies and whether jobs are construction, operations or maintenance, sales and finance." (Direct Testimony of Howard Solganick, pg. 25). Similarly, RUCO seems to have omitted taking this constitutional protection into consideration. According to RUCO, "[f]or the sake of simplicity and rate making, RUCO recommends against attempting to quantify benefits and/or costs related to larger macroeconomic impacts such as job losses or gains." (Direct Testimony of Lon Huber, pg. 26). While this may be true for other types of employment, the Arizona Constitution requires that additional protection be given to employees of public service corporations, and therefore any negative impact on their jobs should be quantified and considered in this matter.

Finally, if non-solar customers are saddled with absorbing the fixed costs for rooftop solar customers, a few problems come to mind. First, what if the non-rooftop solar customers who are projected to absorb the fixed costs move away prior to realizing the absorption? And second, what if the intangible benefits of rooftop solar do not materialize? These two scenarios would result in economic burden shifting to other undeserving groups. This would only serve to intensify the deleterious and inequitable financial impact that solar DG has on Arizona citizens.

Q6. Does this conclude your testimony?

A6. Yes.

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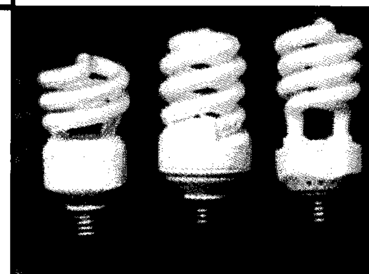

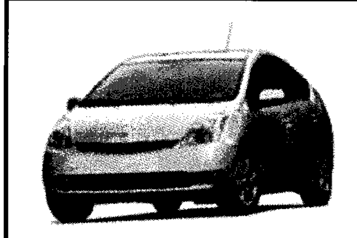

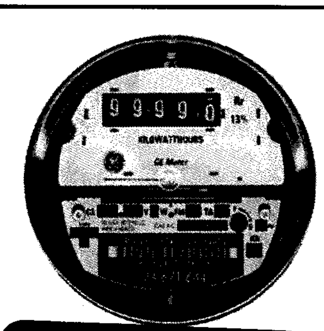

**REPORT OF THE
RENEWABLE AND APPROPRIATE ENERGY
LABORATORY**

Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?

by

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Corrected version published January 31, 2006, including these changes:

1. Authors' e-mail addresses have been updated.
2. Total person-yrs/GWh for O&M and fuel processing, for the Wind 2 technology in Table 2 has been corrected to read 0.03 (instead of 0.78).
3. Employment under Scenario 1 in Table ES-2, Table 3 and Figure 1 has been corrected as follows: O&M and Fuel Processing: 111,136 (instead of 188,317) and Total Employment: 163,669 (instead of 240,850).
4. The contents of Appendix 2 were printed with the Appendix 3 heading in the original publication, giving the impression that Appendix 2 was missing. Appendix 2 has the correct heading in this version.

Cite this report as:

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PUTTING RENEWABLES TO WORK:

HOW MANY JOBS CAN THE CLEAN ENERGY INDUSTRY GENERATE?

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OVERVIEW

Expanding the use of renewable energy is not only good for our energy self-sufficiency and the environment; it also has a significant positive impact on employment. This is the conclusion of 13 independent reports and studies that analyze the economic and employment impacts of the clean energy industry in the United States and Europe. These studies employ a wide range of methods, which adds credence to the findings, but at the same time makes a direct comparison of the numbers difficult. In addition to reviewing and comparing these studies, we have examined the assumptions used in each case, and developed a job creation model which shows their implications for employment under several future energy scenarios.

Energy Technology	Source of Estimate	Average Employment Over Life of Facility (jobs/MWa)		
		Construction, Manufacturing, Installation	O&M and fuel processing	Total Employment
PV 1	REPP, 2001	6.21	1.20	7.41
PV 2	Greenpeace, 2001	5.76	4.80	10.56
Wind 1	REPP, 2001	0.43	0.27	0.71
Wind 2	EWEA/Greenpeace, 2003	2.51	0.27	2.79
Biomass – high estimate	REPP, 2001	0.40	2.44	2.84
Biomass – low estimate	REPP, 2001	0.40	0.38	0.78
Coal	REPP, 2001	0.27	0.74	1.01
Gas	Kammen, from REPP, 2001; CALPIRG, 2003; BLS, 2004	0.25	0.70	0.95

Table ES–1: Average employment for different energy technologies. "MWa" refers to average installed megawatts de-rated by the capacity factor of the technology; for a 1 MW solar facility operating on average 21% of the time, the power output would be 0.21 MWa. References in parentheses and sources refer to the studies reviewed in the text.

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Scenarios	Average employment associated with each scenario (jobs)		
	Construction, Manufacturing, Installation	O&M and Fuel Processing	Total Employment
Scenario 1: 20% Renewable Portfolio Standard (RPS) by 2020 (85% biomass, 14% wind energy, 1% solar PV)	52,533	111,136	163,669
Scenario 2: 20% Renewable Portfolio Standard (RPS) by 2020 (60% biomass, 37% wind energy, 3% solar PV)	85,008	91,436	176,444
Scenario 3: 20% Renewable Portfolio Standard (RPS) by 2020 (40% biomass, 55% wind energy, 5% solar PV)	111,879	76,139	188,018
Scenario 4: Fossil Fuels as Usual to 2020 (50% coal and 50% natural gas)	22,711	63,657	86,369
Scenario 5: 20% Gas Intensive by 2020 (100% natural gas)	22,023	61,964	83,987

Table ES–2: Comparison of the estimated employment created by meeting the equivalent of 20 percent of current U.S. electricity demand via and expansion of fossil or renewables-based electricity generation.

A key result emerges from our work: Across a broad range of scenarios, the renewable energy sector generates more jobs than the fossil fuel-based energy sector per unit of energy delivered (i.e., per average megawatt).

In addition we find that the employment rate in fossil fuel-related industries has been declining steadily for reasons that have little to do with environmental regulation. Finally, we find that supporting renewables within a comprehensive and coordinated energy policy that also supports energy efficiency and sustainable transportation will yield far greater employment benefits than supporting one or two of these sectors separately. While certain sectors of the economy may be net losers, policy interventions can help minimize the impact of a transition from the current fossil fuel dominated economy to a more balanced portfolio that includes significant amounts of clean energy. Further, generating local employment through the deployment of local and sustainable energy technologies is an important and underutilized way to enhance national security and international stability.

INTRODUCTION

It is often assumed that environmental protection inevitably comes at a financial cost. However, an increasing number of studies are finding precisely the opposite is true in the case of renewable energy: that greater use of renewable energy systems provides economic benefits through investments in innovation, and through new job creation, while at the same time protecting the economy from political and economic risks associated with over-dependence on too limited a suite of energy technologies and fuels.

This report reviews the range of recent studies on the job creation potential of the renewable energy industry. We critically analyze the studies with a view to answering four main questions:

- How can one compare and make sense of employment impact numbers derived through different methods, and presented in different units?
- What are the potential regional employment impacts of large-scale growth in the renewable energy sector?
- What would large-scale growth in the renewable energy sector mean for those employed in the fossil fuel energy sector?
- What policy measures would maximize the net positive economic and employment benefits that the renewable energy industry offers?

A summary of all studies reviewed, and methods used therein, is provided in Appendix 1. While a simple analytic comparison across studies is difficult for reasons discussed below, we can still draw a number of clear general conclusions:

- The renewable energy sector generates more jobs per megawatt of power installed, per unit of energy produced, and per dollar of investment, than the fossil fuel-based energy sector.
- Jobs in the fossil fuel sector are declining for reasons that are, for the most part, not related to environmental regulations. Nevertheless, a shift from fossil fuels to renewables in the energy sector, at whatever scale, will create some job losses. These losses can be adequately mitigated/ameliorated/alleviated through a number of policy actions.
- Embedding support for renewables in a larger policy context of support for energy efficiency, green building standards, and sustainable transportation will greatly enhance net positive impacts on the economy, employment and the environment.

RENEWABLE ENERGY AND JOBS: KEY ISSUES

We now return to the four questions, and address each in some detail.

How can one compare and make sense of employment impact numbers derived through different methods, and presented in different units?

The studies reviewed use different basic methods and models, and often report employment impacts in different units, which can make comparison difficult. In this section we discuss: a) different ways to derive employment figures for the energy sector, focusing on methods of analysis, and ways of reporting employment impacts; and b) the framework and format we use to provide comparisons for employment across different technologies.

Calculating employment from renewables: methods of analysis

Table 1 contains a list of the studies reviewed. Additional details on each study are compiled in Appendix I.

Number	Year	Author	Study (model type)
1	2004	The Institute for America's Future, The Center On Wisconsin Strategy and The Perryman Group, Waco TX.	The Apollo Jobs Report: For Good Jobs & Energy Independence New Energy for America (I-O model)
2	2003	Greenpeace/European Wind Energy Association	Wind Force 12. A Blueprint to Achieve 12% of the World's Electricity from Wind Power by 2020. (Analytical model)
3	2003	Environment California Research and Policy Center (Brad Heavner and Bernadette Del Chiaro)	Renewable Energy and Jobs. Employment Impacts of Developing Markets for Renewables in California (Analytical model)
4	2002	CALPIRG (Brad Heavner and Susannah Churchill)	Renewables Work.Job Growth from Renewable Energy Development in California (Analytical model)
5	2001	World Wide Fund for Nature (Study conducted by Tellus Institute and MRG Associates)	Clean Energy: Jobs for America's Future (I-O model)
6	2001	Renewable Energy Policy Project (co-authored by Virender Singh of REPP and Jeffrey Fehrs of BBC Research and Consulting)	The Work that Goes into Renewable Energy (Analytical model)
7	2001	Daniel Kammen and Kamal Kapadia, Energy and Resources Group, University of California, Berkeley	Jobs from Renewables, study for Kerry/Kennedy (Analytical model)
8	2001	Greenpeace	2 Million Jobs by 2020. Solar Generation. Solar Electricity for over 1 billion people and 2 million jobs by 2020. (Analytical model)
9	2001	Environmental Law & Policy Center (study done by the Regional Economics Applications Laboratory: Geoffrey Hewings and Moshe Yanai)	Job Jolt: The Economic Impact of *Repowering the Midwest. A Clean Energy Development Plan for the Heartland (I-O model)*
10	2000	Michael Renner, Worldwatch Institute	Working for the Environment: A Growing Source of Jobs (Worldwatch Paper 152)
11	1999	European Wind Energy Association/European Commission Directorate-General for Energy	Wind Energy: The Facts (Analytical model)
12	1999	European Commission/ALTENER Programme DG for Energy and Transport	Meeting the Targets and Putting Renewables to Work (I-O model)
13	1998	Skip Laitner, Stephen Bernow, John DeCicco	"Employment and other macroeconomic benefits of an innovation-led climate strategy for the United States." *Energy Policy* 26, 5: 425-432. (I-O model)

Table 1: List of studies reviewed.

Studies that focus on calculating the employment impacts of the renewables industry can be divided into two main types: a) those that use input-output (I-O) models of the economy; and b) those that use simpler, largely spreadsheet-based analytical models. Among the studies reviewed and listed in Table 1, reports number 1, 5, 9, 12 and 13 are based on I-O models, and the rest are based on analytical models. Analytical models typically only calculate direct employment impacts. *Direct employment* includes those jobs created in the manufacturing, delivery, construction/installation, project management and operation and maintenance (O&M) of the different components of the technology, or power plant, under consideration. I-O models calculate direct employment but also account for *indirect jobs* that are induced through multiplier effects of the industry under consideration. For example, the task of installing wind turbines is a direct job, whereas manufacturing the steel that is used to build the wind turbine is an indirect job. I-O models capture such multiplier effects, as well as the economic impacts of spending by workers in the new jobs. Both types of models have advantages and disadvantages.

I-O models provide the most complete picture of the economy as a whole. They capture employment multiplier effects, as well as the macroeconomic impacts of shifts between sectors; that is to say, they account for losses in one sector (e.g. coal mining) created by the growth of another sector (e.g. the wind energy industry). Analytical models generally ignore these multiplier effects, and are more likely to under-report overall employment impacts.

The disadvantage of I-O models is that they can be opaque, and make a number of assumptions in order to reach a high level of aggregation. All the I-O based studies we reviewed model the impacts of an entire suite of clean energy policies – including renewable portfolio standards, energy efficiency programs, and policies for sustainable transportation – and present impacts on the economy as aggregated net results. Only in one case (the Apollo Jobs Report; see study **1** in Appendix 1) are the employment and economic impacts attributed to separate policy categories such as "strengthening the renewables market," "bio-energy resource development" and "fuel cell R&D and deployment." Even in this report, however, each of these categories includes a suite of specific policies, whose individual impacts are impossible to discern. It is also generally impossible to calculate employment generated by different technology types such as solar PV and wind energy within a larger I-O model, nor are there employment numbers for the fossil fuel industry to draw comparisons with.

Further, all of the studies model only one "idealized" scenario. This makes it is impossible to gauge the effects of alternative policy scenarios (short of actually getting hold of the model itself), or the impact of even slight deviations from the reported scenario. For example, in the WWF study[1], while all states are net winners under the scenario they present, some states are projected to gain as few as 2,600 jobs (in North Dakota) by 2020 (despite being a state with a tremendous wind-energy resource). It is entirely possible that small differences in only a few parameters could turn these job gains to net losses. It is not possible to know which specific set of policies are creating those jobs for each state, nor can one tell what would happen to projected employment in a particular state should one or more policies be implemented in a different form from what is recommended in the report. In comparison, the analytical models are much more transparent. The assumptions are clear, and it is possible for the reader to conduct sensitivity analyses (like changing the nature and types of policy support to see how impacts may change) on their results.

[1] See study **5** in Appendix 1

Reporting employment impacts

Distinguishing between jobs in manufacturing, construction and installations vs. jobs in operations and maintenance, fuel production, extraction and processing

Most of the reports summarized here distinguish between employment in manufacturing/construction and in O&M/fuel processing. However, none of them discuss the policy implications of the different kinds of jobs created by different energy technologies or facilities, which we believe to be important. While the majority of jobs in the fossil fuel industry are in fuel processing, and operations and maintenance (O&M) (see Table 1), the majority of jobs created in the renewable energy industry are in manufacturing and construction. Biomass energy is an exception, where the majority of jobs are also in fuel production and processing (in agriculture), and O&M.

Paying attention to the types of jobs created is especially important for regional and state-level policy. For a particular state or region, even if total person-yrs lost in the fossil fuel energy sector are counterbalanced by total person-yrs gained in the renewable energy industry, the actual shift may be from jobs in O&M, to jobs in manufacturing. It is important to know therefore what *type* of jobs are being lost, and what type created, to determine what sorts of retraining and retooling programs one would need to make sure that jobs remain in the state.

Making the distinction between these two kinds of jobs is also important because the categories 'scale' differently as the industry expands. For example, an expansion of the U.S. PV industry could also lead to the manufacture of more renewable energy system components for export. This would create additional jobs in manufacturing, but no corresponding jobs in O&M.

Most studies report jobs in manufacturing and construction in terms of "person-years per MW," i.e., the amount of labor required to manufacture equipment or build a power plant which can deliver a maximum of one megawatt of power[2]. In contrast, jobs in O&M and fuel processing are usually reported in terms of "jobs per MW," i.e., the number of people who will need to be employed continuously to provide for the ongoing operation of a plant with a maximum output of one megawatt.

In order to calculate the total employment associated with each energy technology, it is necessary to put these job numbers on a common basis and add them together. To do this, we converted the manufacturing and installation jobs (person-years per MW) into jobs per MW by averaging this type of employment over the life of the facility. For example, if it takes 32.3 person-years to make and install one megawatt of solar photovoltaic modules[3], and the modules last 25 years, then this technology will give employment to an average of $32.3 \div 25 = 1.3$ persons in the manufacturing and installation sector over the lifetime of the modules. In reality, manufacturing and installation jobs are concentrated at the beginning of the life of each facility; however, if many facilities of a given type are being built (and eventually replaced) throughout the economy, then this average employment number will indicate the ongoing manufacturing and installation employment that results from these facilities. Once manufacturing and installation jobs have been converted to average values over the life of the energy equipment (in job-years per MW-year, or jobs per MW), it is a simple matter to add to this the ongoing employment required to fuel and operate the equipment (also measured in jobs per MW). The total

[2] This is a simplification. Most commercial power plants have peak outputs of hundreds of megawatts. In that case, the total labor used to build the larger plant is divided by the maximum output of the plant.

[3] Source: REPP Report. See study **6** in Appendix 1.

employment values which we then report can be seen either as the simple average employment over the life of the first set of energy facilities built under a given policy scenario, or as the steady-state employment that will result from installing (and eventually replacing) those facilities in perpetuity.

Jobs per peak megawatt vs. jobs per average megawatt

Another important issue in reporting employment across different energy technologies has to do with whether one calculates jobs per peak (or nameplate) megawatt (MWp), or jobs per average megawatt (MWa). None of the studies surveyed treat this issue adequately. Once again, understanding the differences between these two ways of reporting employment holds implications for policy. This is especially relevant when we are trying to compare employment across different energy technologies.

Suppose we are interested in implementing a policy under which 20% of the electricity ***produced*** in the United States comes from renewable energy sources. This is not the same as saying that 20% of the ***installed energy capacity*** should be renewable. Since it is the actual production of energy that causes environmental problems like global warming or acid precipitation, it makes more sense to think of the renewables/fossil fuel mix in terms of energy produced rather than energy capacity installed. But one megawatt of installed coal capacity does not produce the same amount of electricity as one megawatt of installed solar panels, for instance. A coal power plant is likely to operate for 80% of the time (the rest of the time it is likely to be shut down for maintenance), so one megawatt of installed coal capacity will produce 1MW x 0.8 x 24 hrs/day = 19.2 megawatt-hours (MWh) of electricity over one day. In comparison, a solar array of 1MW capacity will only operate for as many hours as the sun shines. On average, there is the equivalent of five hours of peak sunshine in one day in the US. So the capacity factor for solar PV is 5hr/24hrs = 21%. One megawatt of solar PV will therefore produce on average 1 MW x 0.21 x 24hrs/day = 5 MWh of electricity in one day. In other words, the same nameplate (or peak) capacity of coal and solar PV (1MWp) will produce very different amounts of electricity over a day; the coal facility will produce 19.2MWh, while the solar PV panel will produce 5 MWh per day.

Therefore, to get the same amount of electricity from a solar PV module as from a coal facility, we need about four times more capacity (MWp) of solar PV (i.e. 19.2MWh/5MWh) than of coal capacity (MWp). To account for this, we convert nameplate or peak capacities (MWp) for each energy technology into an average capacity value (MWa), which indicates the average power output that can be expected from that technology over the course of a year. The average megawatt rating puts all technologies on an equal footing. Peak capacities (MWp) are converted to average capacities (MWa) by multiplying the MWp rating by the capacity factor for the technology under consideration (e.g., a 1 MWp solar plant would be counted as 0.21 MWa, while a 1 MWp coal plant would be counted as 0.80 MWa). Conversely, employment per MWp can be converted to employment per MWa by *dividing* by the capacity factor (since power appears in the denominator of these calculations).

It is not possible to directly compare jobs per MWp or jobs per MWa across all the studies, since the assumptions, and types of scenarios modeled vary significantly. Some studies only include direct jobs while others include both. Further, most studies do not report jobs by individual technology type. Given these limitations, we need a more consistent method to understand how jobs from renewables compare with jobs from the fossil fuel sector across technologies, and between manufacturing, construction and installation, and operation, maintenance and fuel extraction and processing.

The numbers provided in three reports (REPP, 2001; Greenpeace, 2001 and Greenpeace/EWEA, 2003[4]) allow us to develop simple scenarios to accomplish this. The results presented in Table 2 demonstrate that:

a) Every technology in the renewables industry generates more jobs per average megawatt of power in the construction, manufacturing and installation sectors, as compared to the coal and natural gas industry.
b) There is not such a clear distinction between fossil-fuel and renewable technologies in the number of jobs created in O&M and fuel processing. Reliable, low-maintenance wind turbines are estimated to require fewer jobs to operate than are needed to fuel and operate coal and gas plants. However, more jobs are created in O&M of PV systems than in the O&M and fuel processing for coal and gas plants, while biomass plants may create more or fewer jobs in O&M and fuel processing than do coal or gas plants, depending on the way biomass collection is organized.

Table 2 allows for a simple comparison between the jobs created per unit of power delivered from each energy technology. However, it is unlikely that the nation's electricity supply will ever rely on any single technology. So a better way to compare employment generation across technologies is to create scenarios that allow us to compare a range of realistic and feasible combinations of renewable and fossil fuel energy sources.

To do this, we have built five scenarios. In scenarios 1–3, we assume a 20 percent Renewable Portfolio Standard (RPS) will be achieved by 2020. The mix of renewables (exclusive of hydro) used to meet the RPS in these scenarios is varied as follows:

Scenario 1: The renewables mix stays approximately the same as it is in 2002; biomass energy (wood and waste electricity) makes up 85% of the RPS, wind energy contributes 14%, and solar PV 1%.

Scenario 2: The proportion of biomass energy is decreased from its current contribution to 60% of the RPS, wind energy constitutes 37%, and solar PV 3% of the RPS.

Scenario 3: We decrease the contribution from biomass energy even further to 40% of the RPS, wind energy now dominates at 55%, and solar PV is at 5% of the RPS.

In scenarios 4 and 5, we assume that all the electricity that would be produced by renewables under a 20 percent RPS by 2020 is produced instead by fossil fuels. We include two scenarios:

Scenario 4: Coal-powered electricity contributes 50% to the mix, and natural gas the other 50%. (i.e., coal makes up 50% and gas the other 50% of the 20% of the total electricity generated in 2020 that we previously assumed to come from renewables)

Scenario 5: Natural Gas constitutes 100% of the electricity mix (i.e., 100% of 20% of the total electricity generated in 2020 that we previously assumed to come from renewables).

[4] Studies **6, 8** and **11** in Appendix 1.

To facilitate comparison, we have considered jobs in the manufacturing, construction and installation sector, as well as jobs in the O&M and fuel-processing sector. A summary of results of the modeling exercise are presented in Table 3, and represented graphically in Figure 1. In Appendix 2, we provide a more detailed discussion of the assumptions and sources used in this modeling exercise. However, two of these assumptions bear mention here:

a) Our RPS is highly simplified, assuming that electricity production in 2020 is the same as in 2002. One interpretation of this assumption could be that energy efficiency measures will offset any growth in total electricity demand.
b) Our scenarios do not account for learning effects that may occur in these industries, nor for employment that may result from manufacturing energy equipment for export.

We believe these assumptions are compatible with the purpose of this model, which is to compare ***indicative*** employment figures across technologies, in terms of ***average employment over the lifetime of facilities***.

The results show that that in all cases, the RPS produces more jobs in manufacturing, construction and installation, as well as in O&M and fuel production and processing, than the corresponding fossil-fuel scenarios.

work-hrs per year	2000			Employment Components			Average Employment Over Life of Facility					
							Total jobs/MWp		Total jobs/MWa		Total person-yrs/GWh	
Energy Technology	Source of Numbers	Capacity Factor	Equip-ment lifetime (years)	Construction, Manufac-turing and Installation (person-yr/MWp)	Operation and Maintenance (jobs/MWp)	Fuel extraction and processing (person-yrs/GWh)	Construction, Manufac-turing, Installation	O&M and fuel processing	Construction, Manufac-turing, Installation	O&M and fuel processing	Construction, Manufac-turing, Installation	O&M and fuel processing
PV 1	REPP, 2001	21%	25	32.33	0.25	0	1.29	0.25	6.21	1.20	0.71	0.14
PV 2	Greenpeace, 2001	21%	25	30.00	1.00	0	1.20	1.00	5.76	4.80	0.66	0.55
Wind 1	REPP, 2001	35%	25	3.80	0.10	0	0.15	0.10	0.43	0.27	0.05	0.03
Wind 2	EWEA/Green-peace, 2003	35%	25	22.00	0.10	0	0.88	0.10	2.51	0.27	0.29	0.03
Biomass – high estimate	REPP, 2001	85%	25	8.50	0.44	0.22	0.34	2.08	0.40	2.44	0.05	0.28
Biomass – low estimate	REPP, 2001	85%	25	8.50	0.04	0.04	0.34	0.32	0.40	0.38	0.05	0.04
Coal	REPP, 2001	80%	40	8.50	0.18	0.06	0.21	0.59	0.27	0.74	0.03	0.08
Gas	Kammen, from REPP, 2001; CALPIRG, 2003; BLS, 2004	85%	40	8.50	0.10	0.07	0.21	0.60	0.25	0.70	0.03	0.08

Table 2: Comparison of jobs/MWp, jobs/MWa and person-yrs/GWh across technologies.

Scenarios	Average employment associated with each scenario (jobs)		
	Construction, Manufacturing, Installation	O&M and Fuel Processing	Total Employment
Scenario 1: 20% Renewable Portfolio Standard (RPS) by 2020 (85% biomass, 14% wind energy, 1% solar PV)	52,533	111,136	163,669
Scenario 2: 20% Renewable Portfolio Standard (RPS) by 2020 (60% biomass, 37% wind energy, 3% solar PV)	85,008	91,436	176,444
Scenario 3: 20% Renewable Portfolio Standard (RPS) by 2020 (40% biomass, 55% wind energy, 5% solar PV)	111,879	76,139	188,018
Scenario 4: Fossil Fuels as Usual to 2020 (50% coal and 50% natural gas)	22,711	63,657	86,369
Scenario 5: 20% Gas Intensive by 2020 (100% natural gas)	22,023	61,964	83,987

Table 3: Comparison of the estimated employment created by meeting the equivalent of 20 percent of current U.S. electricity demand via an expansion of fossil- or renewables-based electricity generation.

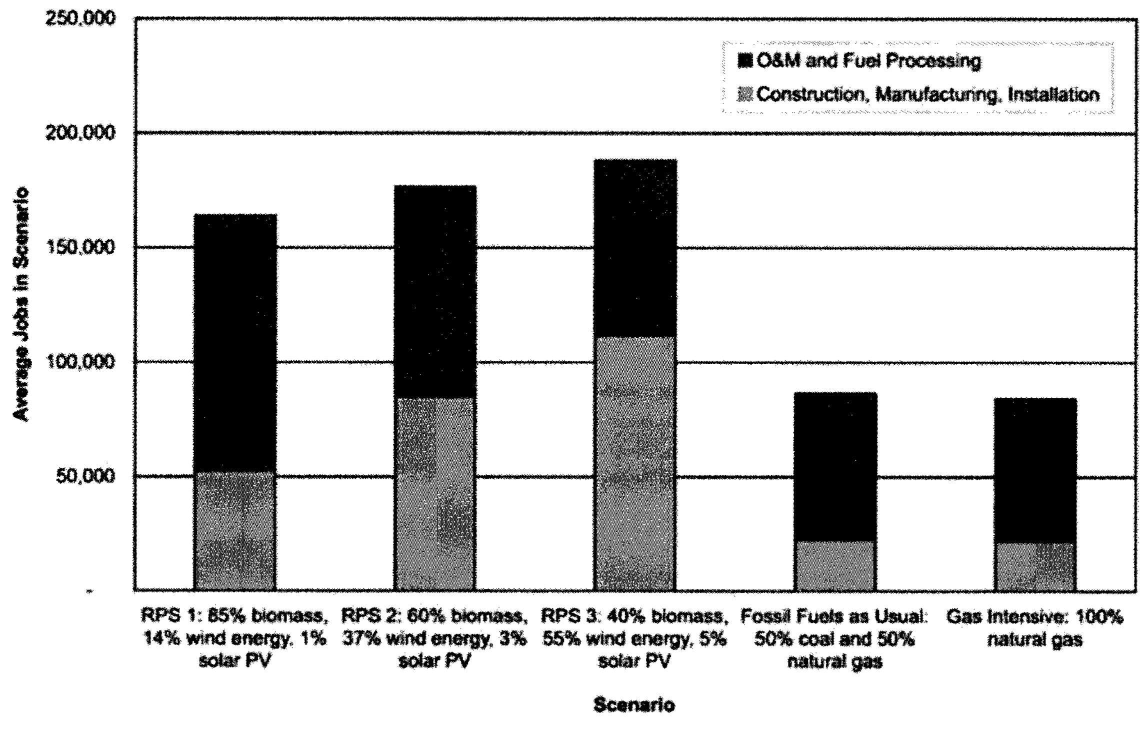

Figure 1: Comparison of average employment from five electricity generation scenarios.

What would large-scale growth in the renewable energy sector mean for those employed in the fossil fuel sector? What are the potential regional employment impacts of large-scale growth in the renewable energy sector?

These two questions are linked, so we address them together. There is little doubt that shifting our energy dependency from fossil fuels to renewables will affect jobs in the fossil fuel sector. The Worldwatch Institute rightly notes that in a shift from fossil fuels to clean energy, while "...the losers are likely to be far outnumbered by the winners, some workers will be hurt in the economic restructuring toward sustainability—primarily those in mining, fossil fuels, and smokestack industries."[5] The "winners" versus "losers" debate also depends critically on the state of the overall energy economy. When demand for energy is rising, as it is now, there is more room for all new suppliers to benefit. A recession, or economic or policy drivers of a shift from one technology to another – such as a shift away from coal that could result from a carbon tax – changes the equation dramatically.

However, it is essential to put the issue of job losses in the fossil fuel industry in perspective:

Overall, the renewable energy industry generates more jobs per MWa than the fossil fuel-based industries (mining, refining and utilities)

Our analysis in the previous section demonstrates that for a variety of feasible scenarios, the renewables industry consistently generates more jobs per MWa in construction, manufacturing and installation, and in O&M and fuel processing, than the fossil fuel industries.

Investment in renewables also generates more jobs per dollar invested than the fossil fuel energy sector. The REPP study[6] calculates that the solar PV industry generates 5.65 person-yrs of employment per million dollars in investment (over 10 years) and the wind energy industry generates 5.7 person-yrs of employment per million dollars in investment (over 10 years). In contrast, every million dollars invested in the coal industry generates only 3.96 person-yrs of employment, over the same time period.

Supporting the renewable energy industry will benefit sectors of the economy and states that currently suffer from high unemployment

The renewable energy industry creates comparatively more jobs in manufacturing than in services and O&M, which will provide a boost to US manufacturing. The results of our model indicate that as we build a clean energy future, jobs in the energy sector are likely to shift from mining and related services to manufacturing, construction and agriculture (if biomass energy forms a large part of the renewables mix). This shift would benefit sectors of the economy suffering from very high unemployment. As Table 4 demonstrates, while unemployment rates in manufacturing and mining are somewhat on par, unemployment rates in construction and agriculture are currently extremely high.

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[5] World Watch Study, page 30; study **10** in Appendix 1
[6] Study **6** in Appendix 1

Sector of the Economy	National Annual Average Unemployment Rate (%) 2002	National Annual Average Unemployment Rate (%) 2003
Mining	6.3	6.7
Construction	9.2	9.3
Manufacturing	6.7	6.6
Agriculture	10.1	10.2

Table 4: Unemployment rates in February 2003 and February 2004. Source: *Bureau of Labor Statistics, 2004*[7].

Our model also does not include jobs that may be generated if the US develops a renewable energy industry for export. The study by the Research and Policy Center of Environment California[8] shows that for California alone, a renewable energy industry servicing the export market can generate up to *16 times more employment* than an industry that only manufactures for domestic consumption (see Table 5). Of course, manufacturing for export means producing at an internationally competitive cost, which can be achieved all the easier if the domestic market creates sufficient demand to bring renewables rapidly down the cost curve.

Technology	Construction Employment for International Market	Construction Employment for In-State Market	Operating Employment for In-State Market	Total
Wind	28,900	1,490	18,930	49,320
Geothermal	800	1,230	59,030	61,070
Biomass	na	540	38,070	38,610
Solar PV	20,300	1,120	1,540	23,000
Fuel Cells	28,100	na	na	28,100
Solar Thermal	na	390	550	940
Total	**78,100**	**4,770**	**118,120**	**201,040**

Table 5: Total California employment growth from renewable energy development (person-years). Source. *Environment California, 2003.*

It is not just states suffering from high unemployment in manufacturing that stand to benefit. The Midwest, for instance, is particularly well suited for wind energy development, with the best wind power resources in the United States. According to Greenpeace-USA, North Dakota alone has enough wind power to produce 1.2 million gigawatt-hours of electricity each year[9], which amounts to 32 percent of total U.S. electricity consumption in 2002. The Environmental Law and Policy Center estimates that a renewable energy portfolio standard of 22 percent can generate 36,800 jobs by 2020 in the ten mid-western states, of which over 52 percent will be in the wind energy industry.

[7] Bureau of Labor Statistics website http://www.bls.gov/webapps/legacy/cpsatab11.htm, accessed on 03/19/04.
[8] Study **3** in Appendix 1
[9] Greenpeace USA website. http://www.greenpeaceusa.org/media/publications/losing_racetext.htm. Accessed on 3/3/04.

Extractive industries and utilities provide declining number of jobs, for reasons that have little or nothing to do with environmental regulations

According to the Worldwatch Institute, jobs in extractive industries are on the decline, as mechanization and mergers lead to continuous layoffs. While coal production in the US increased 32 percent between 1980 and 1999, coal-mining employment declined 66 percent, from 242,000 to 83,000 workers. Further, jobs in the coal industry are expected to fall by 36,000 workers between 1995 and 2020, even without any greenhouse gas–reducing policies, such as carbon caps or taxes, in place. In the oil industry, over 40 percent of US oil-refining jobs were lost between 1980 and 1999. Petroleum refining and wholesale distribution account for only 0.3 percent of all US employment in 2000. Further, commodity prices' boom-bust cycles make these industries, and employment in them, very volatile.[10]

Contrary to popular belief, very few of these job losses are caused by environmental regulations. The Worldwatch Institute reports: "A survey of 224 permanent plant closings in 1980–86 by the Oil, Chemical, and Atomic Workers' Union found that just 12 plants listed environmental reasons as a *partial* motive for closure. And surveys conducted by the U.S. Bureau of Labor Statistics from 1987–92 and again from 1995 on show that environment–related reasons for layoffs were of minute significance: 0.14 percent of all layoffs in 1995–97 (the surveys cover layoffs of 50 people or more for a month or longer). All in all, annual layoffs from plants shut down due to environmental regulation have averaged 1,000–3,000 in the United States since the 1970s. Relative to economy-wide layoffs of typically more than 2 million workers each year, this is less than one tenth of 1 percent."[11]

The Worldwatch study also demonstrates that mining and utility companies are responsible for substantial toxic pollution. In 1998, the Environmental Protection Agency revealed that 48 percent of the 7.3 billion pounds of toxic pollutants tracked by its Toxic Release Inventory, are released by mining companies (a category which includes extraction of metals, coal, oil and gas). Another 15 percent of TRI releases were attributed to the utility sector. Although these two sectors were responsible for 63 percent of the toxic releases tracked by the EPA, together they provided only 1.4 million jobs, or 1.3 percent of all private enterprise jobs in the United States in that year.[12]

The fossil fuel industry provides little overall new employment, but generates huge economic externalities through pollution that somebody has to pay to clean up, or has to endure. These externalities become manifest in the loss of productive work days caused by illness due to pollution exposure, costs borne by industry (and eventually consumers) to clean up pollution, or costs borne directly by taxpayers for clean-up.

Although winners will outnumbers the losers, some sectors and regions will clearly be hurt by restructuring the energy industry away from fossil fuels and towards renewables

A net gain to the economy and to employment still means that some people will lose jobs, whatever the state of the fossil fuel industry. It is possible, as already discussed, that people employed in fossil fuel–based industries may not have the required skills for new jobs, and will

[10] Worldwatch Study, pages 33-34; study **10** in Appendix 1
[11] Worldwatch Study, pages 26-27; study **10** in Appendix 1
[12] Worldwatch Study, pages 22-23; study **10** in Appendix 1

need retraining. It is also likely that new jobs may arise in other locations. According to the WWF study[13], even under an optimistic scenario in which all states benefit economically and in terms of net employment by implementing a suite of clean energy policies, some states gain more than others. For example, while California is projected to gain 141,400 new jobs, and Texas 123,400 by 2020, West Virginia is expected to gain only 6,000 new jobs. Controlling for population, this means that Texas will gain almost 70% more jobs than West Virginia by 2020[14].

	Net gain/loss in jobs by 2020
Overall for all sectors of the economy	+ 1,314,000
Coal mining	– 23,900
Oil and gas mining	– 61,400
Oil refining	– 6,300
Electric Utilities	– 35,100
Natural Gas Utilities	– 26,200

Table 6: Net projected losses by sector of the economy in comparison to overall projected net gains. Source. *Worldwide Fund for Nature. Listed as study* ***5*** *in Appendix 1.*

According to the same study, certain sectors will be net losers, as shown in Table 6.

The fact that there will be some losers does not take away from the case for making a shift in the energy economy towards clean technologies. Perpetuating a region's dependence on volatile and polluting industries with low and steadily declining employment rates is bound to negatively affect that region's development in the long run. This would be especially tragic when we have the option to switch to supporting the growth of a sustainable new sector, which will generate substantial employment.

Of course, negatively impacted people and communities must be adequately compensated. They will need retraining to develop the new skills needed in the clean energy industry. Locally relevant programs will be needed for retooling and retraining, and for attracting new industries. As the Worldwatch study states, "as with any fundamental economic transformation, the transition will require attention. The question facing society today is whether this change can be shaped so that the vast majority of people benefit, and so that social pain during the transition is kept to a minimum."[15]

It is also worth noting that there are energy companies based today largely on fossil-fuels which are well prepared to make a substantial shift in their energy business. Both British Petroleum (BP) and Shell, for instance, own two of the world's three largest solar energy companies. In 2002, BP Solar supplied 14 percent of global PV shipments, and Shell Solar 10 percent.

The United States has a lot of catching up to do. For instance, in 2003, total US production of solar PV modules amounted to 121 MWp (21 percent of global solar PV production). This was less than half of Japan's 251 MWp (45 percent of global production) and also less than Europe's 135 MWp (24 percent of global production) that same year[16]. Of the top ten solar PV module

[13] Study **5** in Appendix 1
[14] Assuming that the ratio of population distribution between states remains the same as today.
[15] Worldwatch Study, pages 9-10; study **10** in Appendix 1
[16] *PV News*, 22(3), March 2003

producers in 2002, only one was an American company (Astropower), although some of the others manufacture (and thus generate jobs) in the United States (for example, BP Solar and Shell Solar both have manufacturing plants in the US).

What policy measures would maximize the net positive economic and employment benefits that the renewable energy industry offers?

There are a suite of policy instruments that can be used to promote renewable energy technologies. These range from financial instruments like tax credits and bond measures to renewable portfolio standards, and support for R&D. Since the focus of this report is the employment dimension of renewables, we will not provide here a complete run-through of policy options. This has been done elsewhere[17], and a set of recommended highest-priority policies is listed in brief in Appendix 3. This section focuses instead on policy requirements to maximize employment benefits while minimizing the negative impacts on people employed in the fossil fuel energy sector. We identify two key areas of intervention, discussed below.

Placing support for renewables in a broader context of support for clean energy measures, including energy efficiency and sustainable transportation will greatly augment economic and employment benefits

Renewable energy, energy efficiency and sustainable transportation are complementary sectors that support and enhance each other. For example, using a solar PV system in the most economic way possible requires that all the appliances being used are energy efficient. Measures that make it easy for an electricity customer to install a solar PV system and retrofit his or her building to be energy efficient will enhance the likelihood of that customer doing both. Consider the market for biomass energy fuels: bio-fuels like ethanol or bio-diesel require that bio-fuel powered cars are easily available, supported by an infrastructure of fuelling stations. In other words, the growth of a particular segment of the clean energy family – be it renewable energy, energy efficiency or sustainable transportation – is often partly dependent on growth in other parts of the energy industry.

This is not to say that a certain sector cannot grow by itself (for instance, a renewable portfolio standard is a good idea irrespective of the presence of other complementary policies). However, it is likely that the renewables sector, and jobs in it, will grow much more quickly if complementary policy measures are in place. This is partly why some of the studies reviewed model an array of policies in all clean energy sectors together. For example, the Apollo Jobs study[18] models a comprehensive scenario of policy and program support in which federal investment of $300 billion is made over 10 years in four categories: increasing energy diversity, investing in industries of the future, promoting high performance buildings, and rebuilding public infrastructure. In this scenario, supporting renewables alone is projected to create 459,189 jobs, while the total investment is projected to yield over 3.3 million jobs.

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[17] Testimony of Daniel M. Kammen for the U. S. Senate Commerce, Science and Transportation Committee, "Technology and Policy Options to Address Climate Change". July 10, 2001. Senator John Kerry (D-MA), Chair. Testimony adapted and published in journal form as: Herzog, A. V., Lipman, T., Edwards, J. and Kammen, D. M. (2001) "Renewable Energy: A Viable Choice", *Environment*, 43 (10), 8–20. Note that most of the studies reviewed also provide detailed lists of policy prescriptions for spurring the development of the clean energy sector.

[18] Study 1 in Appendix 1

Programs are needed to retool and retrain those who stand to lose their jobs in the fossil fuel industry

As discussed above, workers who lose their jobs in the fossil fuel industry should have the opportunity to retrain themselves for employment in the clean energy industry. Programs could include:

- Free or low-cost training and certification courses in installation and maintenance of renewable energy systems
- Financial/tax incentives for renewable energy companies which absorb and train unemployed workers
- Support for community colleges and schools that offer training and certification programs in renewables and energy efficiency

Conclusion – Clean Energy for a Sustainable and Prosperous Future

Transitioning from a fossil fuel–based economy to a renewably powered one will spur economic growth and provide considerable employment. A review of 13 studies and our own analysis concur with this conclusion. The national and international security implications of spurring employment through local, sustainable energy generation are compelling. The United States needs to regain its international position as a technology leader, and the technologies of the future are in clean energy. The time is ripe to move beyond studies to action.

Author Biographies

Matthias Fripp is a PhD student in the Energy and Resources Group (ERG) at UC Berkeley. He is studying the integration of renewables into the US electric grid. Matthias holds an M.S. from ERG and a B.A. in environmental studies from Lewis & Clark College in Portland, Oregon. Before coming to Berkeley, he worked for Trexler and Associates, Inc. (a consulting firm specializing in in climate-change mitigation), and was a researcher at the Renewable Northwest Project, both located in Portland.

Daniel M. Kammen directs the Renewable and Appropriate Energy Laboratory (RAEL) at the University of California, Berkeley, where he a professor in the Energy and Resources Group, the Goldman School of Public Policy, and the Department of Nuclear Engineering. Kammen's research is focused on solar, wind, and biomass energy supplies, clean water for developing nations, and on the production and use of hydrogen and fuel cells for stationary power production and for vehicles. Kammen is involved in national and international energy policy analysis and debates, which includes issues of energy resources for both developed and developing nations, and on global and regional climate change. He has testified in front of House and Senate Committees, served as a technical reviewer for the Global Environment Facility, and is a permanent member of the African Academy of Sciences. He is the author of over 150 research papers and reports, and six books, including *Should We Risk It?* (Princeton University Press, 1999). Copies of Professor Kammen's publications, and information on the activities of the Renewable and Appropriate Energy Laboratory can be accessed on the website: **http://socrates.berkeley.edu/~rael/.**

Kamal Kapadia is a PhD student in the Energy and Resources Group (ERG) at UC Berkeley. Her research examines renewable energy technologies use in developing countries. Kamal holds an M.A. from ERG and an M.S. in Environmental Change and Management from the University of Oxford, UK. Before coming to Berkeley, she worked for solar energy companies in the UK, Sri Lanka and India.

APPENDIX 1: SUMMARY OF STUDIES REVIEWED

Number	Year	Author	Study	Method	Scenarios used
1	2004	The Institute for America's Future, The Center On Wisconsin Strategy and The Perryman Group, Waco TX.	The Apollo Jobs Report: For Good Jobs & Energy Independence New Energy for America	Presents scenarios based on a model in which $300 Billion of federal investment is made over 10 years in 4 categories: increasing energy diversity, investing in industries of the future, promoting high performance buildings, rebuilding public infrastructure.	$300 Billion of recommended federal investment includes: 1. $30 Billion support for strengthening the renewables market to get 15% renewables in electricity mix by 2015, and 20% by 2020. 2. $6 Billion for bio-energy resource development 3. $6.5 Billion for hydrogen fuel cell R&D and deployment.
2	2003	Greenpeace/European Wind Energy Association	Wind Force 12. A Blueprint to Achieve 12% of the World's Electricity from Wind Power by 2020.	Uses data from comprehensive study on wind and employment by the Danish Wind Turbine Manufacturers Association (DWTMA) in 1996, updated in 1998. Methodology used by the DWTMA is to break down the manufacturing activities into different sectors – metalwork, electronics, etc and add together individual employment contributions. Results cover three areas – direct and indirect employment from wind turbine manufacture, the direct and indirect employment effects of installing wind turbines, and the global employment effects of the Danish industry's exports business. To allow for greater efficiencies in design, manufacture and installation – resulting in a reduction in employment labour consumption is assumed to follow total value of wind energy installation, a decreasing value over time.	Calculates the employment effect of the 12% global wind energy scenario. For OECD-North America, this means 310,000 MW of wind installed by 2020, for USA alone, 250,000MW.
3	2003	Environment California Research and Policy Center (Brad Heavner and Bernadette Del Chiaro)	Renewable Energy and Jobs. Employment Impacts of Developing Markets for Renewables in California	Uses numbers from above study, based on which authors calculate jobs in California from foreign RET markets, assuming California has 5% market share of geothermal, and 10 % of other technologies.	20% renewables in electricity mix by 2010 in California, which involves addition of 5,900MW renewables, where California has 30% of construction/manufacturing jobs to meet in-state RPS, and 90% of O&M jobs for all technologies. In addition, California also has 10% of manufacturing/construction jobs for foreign markets for renewables (all except geothermal, where California construction job share is 5%)
4	2002	CALPIRG (Brad Heavner and Susannah Churchill)	Renewables Work. Job Growth from Renewable Energy Development in California	Study focussed on California only. Reviews several other studies. Study also collected primary data from renewables industry and natural gas utilities on direct and indirect jobs, and reported results as employment from construction and eployment from operation and maintenance, by technology.	20% renewables in electricity mix by 2010 in California, which involves addition of 5,900MW renewables in ratio of 11% wind, 7% geothermal, 0.2% solar PV, 1% solar thermal, 1% landfill gas.
5	2001	World Wide Fund for Nature (Study conducted by Tellus Institute and MRG Associates)	Clean Energy: Jobs for America's Future	Study models employment, macroeconomic, energy and environmental impacts of an entire range of clean energy policies called "Climate Protectio Scenario". Includes variety of policies measures in building and industry sector, electric sector, transport sector. Uses I-O Model (IMPLAN) tracing linkages in the economy. Policies were compared to base case as given in IEA Annual Energy Outlook 2001. Since macroeconomic impacts are only reported by sector of economy (e.g. agriculture, finance etc), it is not possible to tease out employment impact of renewables alone from the study itself.	For renewables - a US-wide RPS of 15% renewables in the electricity mix by 2020. Total investment needed not specified, however, net impact of all policies in the model predicted to have net positive impact on GDP of $(1998) 23,220 Million by 2010 and $ (1998) 43,860 Million by 2020.
6	2001	Renewable Energy Policy Project (co-authored by Virender Singh of REPP and Jeffrey Fehrs of BBC Research and Consulting)	The Work that Goes into Renewable Energy	Study calculates jobs in person-yrs/MW and person-yrs/$ invested. Uses a simple model, does not take into account multiplier effects as an I-O model would. Authors collected primary employment data from companies in the solar PV, wind energy and coal sectors, and used project scenario numbers for biomass energy. Study takes in account jobs in manufacture, transport and delivery, construction and installation, and O&M.	None

APPENDIX 1: SUMMARY OF STUDIES REVIEWED

Number	Year	Author	Study	Method	Scenarios used
7	2001	Dan Kammen and Kamal Kapadia, Energy and Resources Group, University of California, Berkeley	Jobs from Renewables, Study for Kerry/Kennedy committee	Analysis based on combining industry data with median values of economic models produced by others.	Scenario of 10% US-wide RPS, where 5% of total electricity in 2010 would come from solar PV, 60% from biomass energy and 35% from wind energy.
8	2001	Greenpeace	2 Million Jobs by 2020. Solar Generation. Solar Electricity for over 1 billion people and 2 million jobs by 2020.	Based on employment information provided by the industry, jobs for each world region have been calculated for scenario of 207GWp of installed PV by 2020 . It is ssumed that between 2000 and 2010, 20 jobs are created per MWduring manufacture, decreasing to 10 Jobs per MW between 2010 and 2020. About 30 jobs generated per MW during installation, retailing and providing other local services between 2000 and 2010, going down to 26 jobs per MW between 2010 and 2020. For maintenance, it is assumed that after accunting for economies of scale and other efficiency gains, 1 job will be created per installed MW. Since developing world markets will play a more significant role beyond 2010, proportion of maintenance work is assumed to steadily increase up to 2 jobs per MW by 2020.	By 2020, the goal is to install 207GWp of solar PV globally. Average annual growth rate in PV markets worldwide up to 2009 is projected to be 27% and then rising to 34% between 2010 and 2020. Although initial growth is expected to be fastest in the grid-connected sector, by 2010 this will be replaced by the emerging off-grid rural sector.
9	2001	Environmental Law & Policy Center (study done by the Regional Economics Applications Laboratory: Geoffrey Hewings and Moshe Yanai)	Job Jolt" The Economic Impact of *Repowering the Midwest. A Clean Energy Development Plan for the Heartland*	Regional econometric input-output models developed by REAL to forecast local impacts of changing economic conditions and policies. Using primarily U.S. Census data, REAL's dynamic models track employment, income and output data across 53 industrial sectors, factoring in 13 demand variables (consumption, investment, government expenditures, etc.) and eight demographic variables (age, sex, migration, etc).	Clean Energy Development Plan for 10 mid-western states as outlined in related report *Repowering the Midwest. A Clean Energy Development Plan for the Heartland* . Policies include portfolio of policies in energy efficiency, and an 8% RPS by 2010, 22% by 2020
10	2000	Michael Renner, Worldwatch Institute	Working for the Environment: A Growing Source of Jobs (Worldwatch Paper 152)	Discussion paper on employment impacts of environmental policies and programs. Includes discussion of impacts of environmental programs on employment in the fossil fuel industry, and a section on employment benefits of the renewable energy industry.	NA
11	1999	European Wind Energy Association/European Commission Directorate-General for Energy	Wind Energy: The Facts	Numbers based on 2 prior studies/surveys carried out to determine exisiting employment in wind industry in Europe - Danish Wind Turbine Manufacturers Association and Danish Counties and Municipalities Research Institute (Society Value of Wind Power).	100,000MW of wind energy in the European Comission member countries NOTE: AWEA Wind Energy Fact Sheet (Wind Energy and Economic Development: Building Sustainable Jobs and Communities) refers to EWEA employment figures.
12	1999	European Commission/ALTENER Programme DG for Energy and Transport	Meeting the Targets and Putting Renewables to Work	Uses SAFIRE Energy Model to predict market penetration for RETs and displacement of other technologies for different scenarios. Then RIOT (renewables enhanced input-output tabes) I-O Model is used to calculate employment impact. Model is based on calculation of production funcions that represents the value of inputs (including employment) from different sectors of economy needed to produce a unit of energy from different technologies. Models predict direct and indirect jobs and jobs from agriculture, minus potential losses in conventional energy sector and support mechanisms leading to lower spending elsewhere in the economy.	2 scenarios are modelled - current EU policies, or "CP" scenario, where renewables make up 20.4% of gross European electricity consumption by 2020, and advanced renewable strategy or "ARS" scenario, where renewables make up 27.6% of gross electricity consumption by 2020.
13	1998	Skip Laitner, Stephen Bernow, John DeCicco	"Employment and other macroeconomic benefits of an innovation-led climate strategy for the United States." *Energy Policy* 26, 5: 425-432.	Study used IMPLAN ("Impact analysis for Planning"), I-O model to evaluate impact of "the Innovation Path" scenario Macroeconomic impact calculated for all major sectors of economy. Not possible to tease out impact of renewables only from paper.	"The Innovation Path" scenario, includes policies in residential, commercial, industrial, transportation, and electricity generation secors, to reduce carbon intensity of the US economy by 25.5% by 2010. Policies include variety of energy efficiency measures, renewables development, and development and deployment of near-commerical technologies.

APPENDIX 2: ASSUMPTIONS AND SOURCES FOR OUR MODEL AND SCENARIOS

The results in our scenarios are only indicative. Comparing jobs/MWa figures from different sources is very difficult, since each study and method draws boundaries at different points in terms of the direct and indirect jobs to include.

Sources and Assumptions for Employment Figures in Table 2 (page 10)

1. For solar PV, wind energy, biomass energy and coal, we have used data from the REPP Report (study 6 in Appendix 1), the Greenpeace Solar Energy Report (study 8 in Appendix 1), and the Greenpeace/EWEA Wind Energy Report (study 11 in Appendix 1), as specified in the table.
2. For wind energy, as the Greenpeace/EWEA study has not specified employment from O&M, we have used the employment figure from the REPP study for both wind energy cases cited.
3. For biomass energy, the high-estimate figures for jobs in O&M and fuel extraction and processing, are based on the upper-end of estimates provided for switchgrass cultivation, and the low estimates are based on the low-end of estimates provided for energy from urban wood waste. As no numbers were supplied in the REPP Report for the manufacture, construction and installation of the energy facility per se, we have assumed that the energy facility would be similar to a coal-fired power plant, and used employment figures for "making coal plant components and for on-site activities, not including O&M" as provided in the REPP report in Appendix B (page 25).
4. For natural gas-based electricity, we have used three different sources:
    a. Manufacturing and construction of the power plant facility is assumed to be the same as for a coal-powered facility, as given in the REPP study. The CALPIRG Study (no. 4 in Appendix 1) also provides employment figures for construction of natural gas facilities, but not for manufacturing the components.
    b. O&M employment figures for the natural gas industry have been taken from the CALPIRG study.
    c. Employment from natural gas extraction and distribution is calculated from data from the Bureau of Labor Statistics and the Energy Information Agency (EIA). The Bureau of Labor Statistics reports 112,510 jobs in 2002 in Natural Gas Distribution and 119,130 jobs in 2002 in Oil and Gas Extraction (http://www.bls.gov). In 2002, natural gas provided 61 percent of the total energy delivered by oil and gas extracted in the U.S., so we assigned 61 percent of the oil and gas extraction jobs (72,900 jobs) to natural gas. Taken with the gas distribution jobs, this yields a total of 185,400 people employed in gas extraction and distribution in the U.S. in 2002. In the same year, 24.7 percent of natural gas consumed in the U.S. was used for electricity production, so we estimate that 45,900 people were employed in the U.S. to extract and deliver natural gas for the electricity sector. The EIA also reports that 685,800 GWh of electricity were produced from natural gas in the U.S. in 2002, so we calculate that each GWh of electricity produced from natural gas requires 0.067 person-years of employment in gas extraction and distribution. (*Source:* Tables 6.5 and 8.2a of the EIA *Annual Energy Review 2002*, available on-line at http://www.eia.doe.gov/emeu/aer/)
5. We have not included any numbers for nuclear energy, as we have been unable to locate data sources.

APPENDIX 2: ASSUMPTIONS AND SOURCES FOR OUR MODEL AND SCENARIOS

Sources and Assumptions for Scenarios 1–5 (page 11)

1. All electricity generation figures are taken from the EIA *Annual Energy Review 2002*, available on-line at http://www.eia.doe.gov/emeu/aer/.
2. Total electricity generated in the US in 2002 was 3,858,452 GWh. We assume this figure stays constant till 2020, as efficiency gains accompanying a large-scale renewable energy deployment offset the current rate of increase in electricity demand of 2–3 percent a year. This assumption will almost certainly prove to be incorrect, but it does provide a consistent way to compare policies, and our comparative findings will continue to hold even with different assumptions about growth of the electricity supply.
3. We have not included hydro-power as a renewable energy source, as the environmental impact of large hydro facilities is a point of considerable contention. Further, we do not anticipate any substantial increase in hydropower capacity in the country, nor is it a large employer within the energy industry (as there is no ongoing manufacturing, nor fuel extraction involved).
4. Our scenarios are scaled around the current existing mix of renewables in electricity, in which 85% is from biomass energy (wood and waste fuel), 14% from wind energy, and 1% from solar PV.
5. In cases where we have low and high estimates for jobs (solar PV, wind energy and biomass energy), we have averaged the two estimates.

APPENDIX 3: POLICY RECOMMENDATIONS FOR ACCELERATING THE DEPLOYMENT OF RENEWABLES

Rapidly but efficiently expanding the renewable energy sector is the most important single step to achieve energy independence, job growth, and meaningful environmental protection. To achieve this goal, markets must be opened for new, clean renewable energy and energy efficiency innovations. In our view, the Renewable Portfolio Standard provides the best near-term mechanism and framework for growth of the solar, wind, biomass, and geothermal generating sectors. A variety of other mechanisms are needed to spur innovation and implementation of clean energy options, but the RPS provides the most natural framework.
We find that a 20% RPS – either as a federal standard or as a federally-supported patchwork of state measures – by 2020 is not only achievable, but would provide a major economic boom to the U.S. economy through job creation and through the export markets we could then address.

By 2050 our energy economy could be driven by over 40 percent renewable energy sources, with higher levels quite plausibly – technologically, economically, and environmentally possible.

The critical move is the first step. A suite of recommended policies would include the following measures, most of which were first proposed by Professor Kammen at the July 10, 2001 Senate Committee on Science, Commerce and Transportation chaired by Senator Kerry.[19]

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[19] Kammen, D. M. (2001) Testimony for the Hearing on 'Technology and Policy Options for Climate Change' for the U. S. Senate Committee on Commerce, Science, and Transportation, July 10 (United States Senate: Senate Committee on Commerce, Science, and Transportation). URL http://www.senate.gov/~commerce/

Appeared in revised form as: D. M. Herzog, A. V., Lipman, T., Edwards, J. and Kammen, D. M. (2001) "Renewable Energy: A Viable Choice", Environment, 43 (10), 8 – 20.

APPENDIX 3: POLICY RECOMMENDATIONS FOR ACCELERATING THE DEPLOYMENT OF RENEWABLES

Energy Policy Recommendations

- **Increase Federal R&D Funding for Renewable Energy and Energy Efficiency Technologies**

Federal investment in renewable energy and energy efficient technologies has been sparse and erratic[20], with each year producing an appropriations battle that is often lost. A combination of a federal program for steadily increasing funding and active political leadership would transform the clean energy sector from a good idea to a pillar of the new economy.

- **Provide Tax Incentives for Companies the Develop and Use Renewable Energy and Energy Efficiency Technologies**

Support for the production and further development of renewable fuels, all found domestically, would have a greater long-term effect on the energy system than any expansion of fossil-fuel capacity, with major health and environmental benefits as an added bonus. We should extend the existing production tax credits (PTC) for electricity generated from wind power and closed loop biomass for five years. Also, this production credit should be expanded to include electricity produced by open loop biomass (i.e., agricultural and forestry residues but excluding municipal solid waste), geothermal energy, and landfill gas. The same credit should be provided to closed loop biomass co-fired with coal, and a smaller credit (one cent per kWh) should be provided for electricity from open-loop biomass co-fired with coal. We support a minimum of a 15 percent investment tax credit for residential solar electric and water heating systems. In addition, we recommend a 30 percent investment tax credit for small (75 kW and below) wind power systems.

- **Improved Federal Standards for Vehicle Fuel Economy and Increased Incentives for High Fuel Economy Vehicles**

We need to first remove the separate fuel economy standards for cars and light trucks (i.e., close the light truck 'loophole' as proposed in 2001 by Senators Feinstein and Snowe and by Rep. Olver). We then believe that a 40 mpg combined car and light truck fuel economy standard could be accomplished in the 2008 to 2012 timeframe with negligible net cost. We support tax credits of up to $5,000 for hybrid electric vehicles, up to $6,000 for battery electric vehicles, and $8,000 for fuel cell vehicles, and an incentive scheme for energy-use performance that rewards both fuel savings and lower emissions.

- **A Federal Renewable Portfolio Standard (RPS) to Help Build Renewable Energy Markets**

We support a 20 percent RPS by 2020. A number of studies indicate that this would result in renewable energy development in every region of the country with most coming from wind, biomass, and geothermal sources. A clear and properly constructed federal standard is needed to set a clear target for industry research, development, and market growth. We recommend a renewable energy component of 10 percent in 2010 and 20 percent by 2020 that would include wind, biomass, geothermal, solar, and landfill gas.

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[20] Margolis, R. and Kammen, D. M. (1999) "Underinvestment: The energy technology and R&D policy challenge", *Science*, **285**, 690 - 692

APPENDIX 3: POLICY RECOMMENDATIONS FOR ACCELERATING THE DEPLOYMENT OF RENEWABLES

- **Federal Standards and Credits to Support Distributed Small-Scale Energy Generation and Cogeneration (CHP)**

Small scale distributed electricity generation has several advantages over traditional central-station utility service, including reducing line losses, deferring the need for new transmission capacity and substation upgrades, providing voltage support, and reducing the demand for spinning reserve capacity. In addition, locating generating equipment close to the end use allows waste heat to be utilized to meet heating and hot water demands, significantly boosting overall system efficiency. We support at least a 10 percent investment tax credit and seven-year depreciation period for renewable energy systems or combined heat and power systems with an overall efficiency of at least 60-70 percent depending on system size.

- **Enact New and Strengthen Current Efficiency Standards for Buildings, Equipment, and Appliances**

Significant advances in heating and cooling systems, motor and appliance efficiency have been made in recent years, but more improvements are technologically possible and economically feasible. A clear federal statement of desired improvements in system efficiency is needed to remove uncertainty and reduce the economic costs of implementing these changes. Under such a federal mandate, efficiency standards for equipment and appliances could be steadily increased, helping to expand the market share of existing high efficiency systems.

- **Institute a National Public Benefits Fund**

We recommend a public benefits fund financed through a $0.002/kWh charge on all electricity sales. Such a fund could match state funds to assist in continuing or expanding energy efficiency, low-income services, the deployment of renewables, research and development, as well as public purpose programs the costs of which have traditionally been incorporated into electricity rates by regulated utilities.

- **Investigate and Work Towards a Carbon Tax**

A diverse range of analyses – environmental, economic, and from an energy policy perspective – all support the notion that a carbon tax provides one of, if not the, most effective means to efficiently and cost-effectively safeguard the environment while encouraging economic growth. We strongly support the notion of a carbon tax, and would welcome the public discussion and exchange that high-level recognition of this vehicle would engender. A carbon tax could be gradually implemented, beginning at a token level, and could be managed to work effectively between mobile and stationary sources of emission

Cite this report as:

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The Solar Foundation® (TSF) is a national 501(c)(3) nonprofit organization whose mission is to increase understanding of solar energy through strategic research and education that transform markets. In 2010, TSF conducted its first *National Solar Jobs Census* report, establishing the first credible solar jobs baseline and verifying that the solar industry is having a positive impact on the U.S. economy. Using the same rigorous, peer-reviewed methodology, TSF has conducted an annual Census in each of the last six years to track changes and analyze trends.

This *Arizona Solar Jobs Census 2015* report is an offshoot of TSF's *National Solar Jobs Census 2015* effort. Research partners for the *Census 2015* effort include the Arizona State University Energy Policy Innovation Council for providing editorial guidance and peer review, the George Washington University Solar Institute for providing assistance and support in reviewing and validating report results and analysis; the Solar Energy Industries Association (SEIA) for use of its National Solar Database and peer review; and GTM Research/SEIA for providing survey respondents with the U.S. Solar Market Insight: 2014 YIR report.

Sponsors of this year's *Census* effort include: Energy Foundation, William and Flora Hewlett Foundation, Tilia Fund, George Washington University Solar Institute, SEIA, Recurrent, SolarCity, First Solar, Sol Systems, E.ON, Trina Solar, State of Minnesota Department of Commerce, State of New Mexico Energy Minerals and Natural Resources Department, Utah Governor's Office of Energy Development, sPower, Standard Solar, CALSEIA, All Earth Renewables, and groSolar.

Finally, we want to thank all the Arizona employers that participated in the survey. Your responses were critical in providing us with accurate and timely data.

For questions or comments about this report, please contact either:

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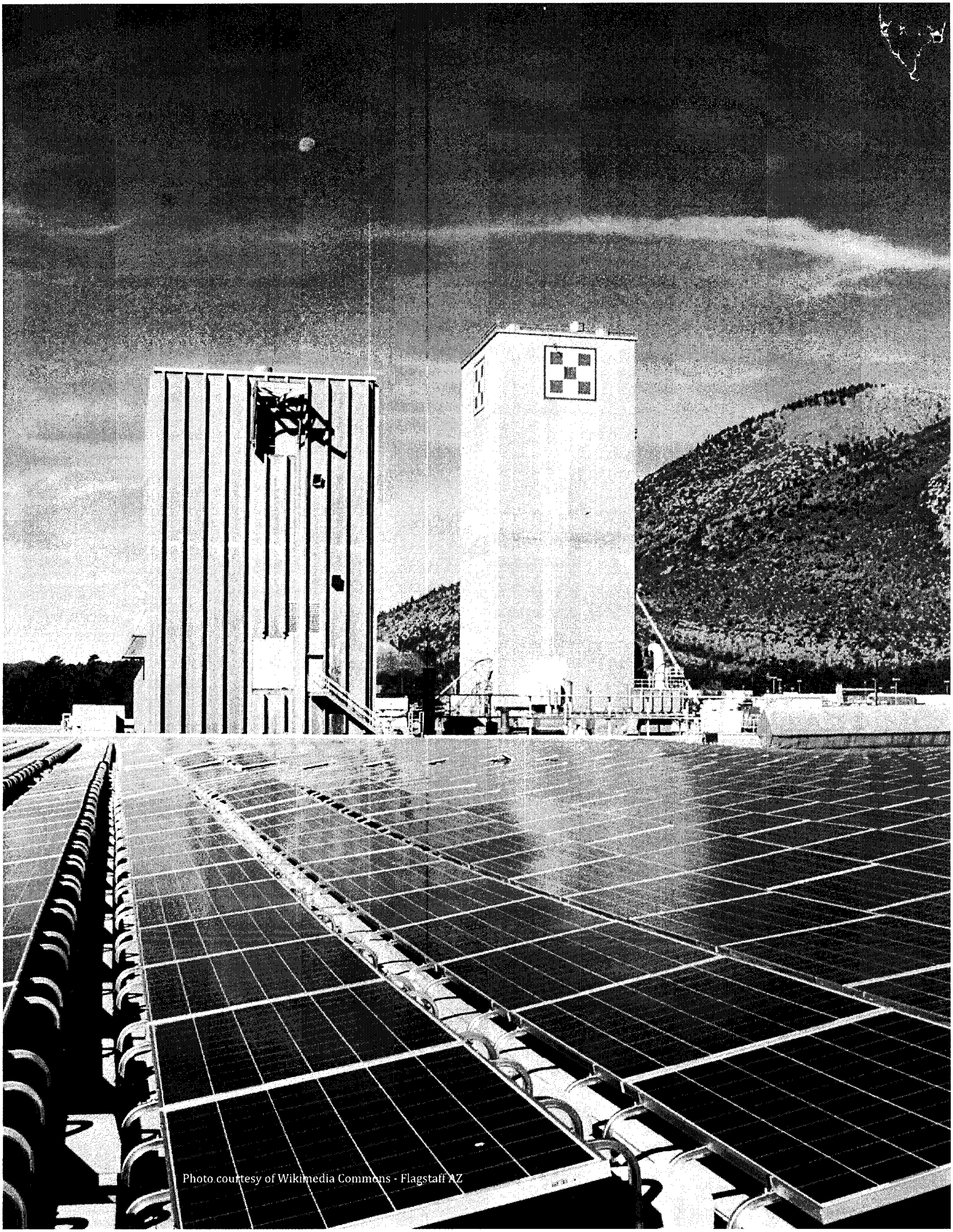
Photo courtesy of Wikimedia Commons - Flagstaff AZ

The Arizona solar workforce is generally less diverse than the state's workforce as a whole, with women (29.5%), African-Americans (3.0%), Asian or Pacific Islanders (1.9%), and Latinos (12.5%) all relatively underrepresented. However, many of these otherwise underserved demographics – women, Latinos, older workers, and veterans – are represented in the state solar workforce at higher rates than their counterparts in the solar industry nationwide.

	ARIZONA SOLAR WORKFORCE	ARIZONA OVERALL EMPLOYMENT[17]	U.S. SOLAR WORKFORCE
Women	29.5%	46.1%	23.8%
African-American	3.0%	4.6%	5.1%
Asian or Pacific Islander	1.9%	4.0%	8.6%
Latino or Hispanic	12.5%	33.7%	11.3%
Older Workers (55+)	28.2%	20.6%	18.6%
Union Members	-	-	5.5%
Veterans of the U.S. Armed Forces	11.5%	9.3%	8.1%

Veterans of the U.S. Armed Forces represent a uniquely valuable source of human capital for solar employers. With a proven work ethic and practiced discipline, veterans bring a wealth of readily transferable skills and leadership acumen to the industry. Through the Solar Ready Vets program, the U.S. Department of Energy is helping the industry capitalize on this resource by facilitating the transition from military service to employment in the civilian solar workforce.[18] Arizona solar firms clearly understand this value proposition, **with veterans comprising 11.5% of the state's solar workforce, compared to just 9.3% of the state's total workforce and 8.1% of the solar workforce nationally.**

Position	Arizona Median Wage	Mountain Division Median Wage	U.S. Median Wage
Solar Installer	$18.00	$20.00	$21.00
Solar Sales Representative	$36.06	$33.65	$28.85
Solar System Designer	$22.00	$25.50	$26.92
Solar Assembly Worker	-	-	$18.00

Wages paid by firms in the Arizona solar industry differ slightly from those paid by solar employers across the other states in the U.S. Census Bureau's Mountain Division[19] and the industry nationwide. Solar installers in the state are among the lowest paid in the country, at $18.00 per hour, but solar sales representatives are better paid than their counterparts nationally.

Solar employers in Arizona experience a slightly higher level of difficulty on average finding qualified candidates to fill openings on their payrolls than other solar firms across the country. Solar employers in Arizona and the Mountain Division require greater work experience and less education than reported by firms nationally. Arizona firms required related work experience for nearly 86% of positions hired. In contrast, they required a bachelor's degree or more for only 12.1% of positions.

Difficulty Hiring in Arizona