ORIGINAL OPEN MEETING AGENDA ITEM

aps

0000140878

Mail Station 9708
PO Box 53999
Phoenix, Arizona 85072-3999
Tel 602-250-2661
Jeffrey.Johnson@aps.com

December 6, 2012

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

RE: Arizona Public Service Company (APS) Renewable Energy Standard (RES)
2013 RES Implementation Plan
Docket No. E-01345A-10-0394 and E-01345A-12-0290

Attached please find the "Net Metering Bill Impacts and Distributed Energy Subsidies" report prepared by Navigant Consulting that was referenced on page 9 of APS's Comments to Staff's Recommended Opinion and Order filed in this docket on November 15, 2012.

This report is intended to provide background for the upcoming multi-session technical conference discussed in the recent APS filing. Navigant provides information regarding the impact of net metering and other distributed energy (DE) subsidies on customers without solar installations. The information is intended to supplement and provide further detail on APS's comments but not provide solutions. APS's proposed technical conferences will allow interested parties to understand and discuss both the costs and benefits associated with DE.

As discussed in the Company's comments, a sustainable solar future in Arizona means that all stakeholders have a responsibility to understand the true costs and benefits of DE. APS believes that a sustainable DE policy must include an equitable distribution of costs and benefits across all customers. The technical conference is designed to foster collaborative discussions on these issues.

If you have any questions regarding this report, please contact Jeff Johnson at (602)-250-2661.

Sincerely,

Jeffrey W. Johnson

JJ/bgs

cc: Terri Ford
Ray Williamson
Parties of Record

Copies of the foregoing delivered
this 6th day of December, 2012 to:

Janice Alward
Arizona Corporation Commission
1200 W. Washington
Phoenix, AZ 85007

Patrick Black
Fennemore Craig
3003 N. Central Avenue, Suite 2600
Phoenix, AZ 85012-2913

C. Webb Crockett
Fennemore Craig
3003 N. Central Avenue, Suite 2600
Phoenix, AZ 85012-2319

Lyn Farmer
Arizona Corporation Commission
1200 W. Washington
Phoenix, AZ 85007

Michael Neary
AriSEIA
111 West Renee Dr.
Phoenix, AZ 85027

Steve Olea
Arizona Corporation Commission
1200 W. Washington
Phoenix, AZ 85007

Greg Patterson
Munger Chadwick
2398 E. Camelback Road, Suite 240
Phoenix, AZ 85016

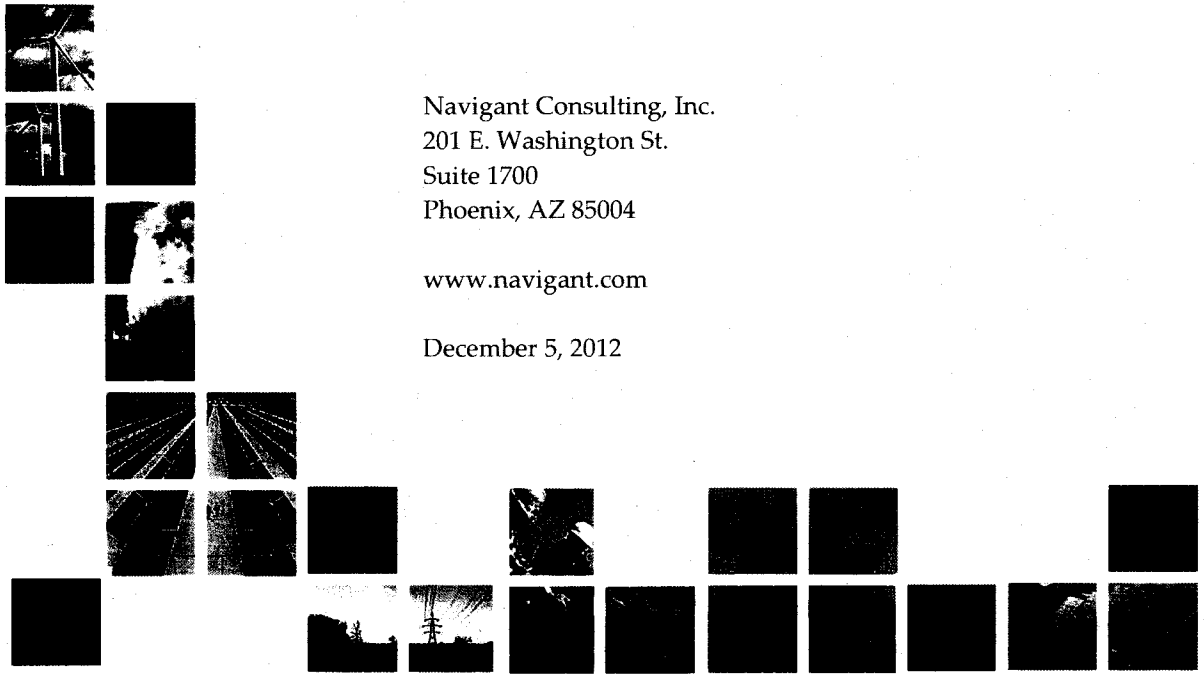
Court Rich
Rose Law Group, P.C.
202 E. McDowell Road, Suite 153
Phoenix, AZ 85250

NAVIGANT

Net Metering Bill Impacts and Distributed Energy Subsidies

Prepared for:

aps



Navigant Consulting, Inc.
201 E. Washington St.
Suite 1700
Phoenix, AZ 85004

www.navigant.com

December 5, 2012

NAVIGANT

Table of Contents

NAVIGANT

List of Figures

NAVIGANT

List of Tables

NAVIGANT

Disclaimer

This white paper was prepared for Arizona Public Service (APS) on terms specifically limiting the liability of Navigant Consulting, Inc. (Navigant). Navigant's conclusions are the result of the exercise of Navigant's reasonable professional judgment, based in part upon materials provided by APS and others.

The work presented in this report represents our best efforts and judgments based on the information available at the time this report was prepared. Navigant makes no claim to any government data and other data obtained from public sources found in this report (whether or not the owners of such data are noted in this report), and makes no express or implied warranty, guaranty, or representation concerning the information contained in this report, its merchantability, or its fitness for a particular purpose of function.

Any reference to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply an endorsement, recommendation, or favoring by Navigant.

Navigant does not assume, and hereby disclaims, any liability that may result from any reliance on or use of any information contained in this report, or for any loss or damage caused by errors or omissions in this report.

NAVIGANT

Executive Summary

Background

To promote the growth of distributed renewable generation to help meet Renewable Energy Standard (RES) targets,[1] Arizona adopted several policies that provide financial benefits to customers that install and operate solar and other renewable generation equipment. Some key features of the renewable policies[2] include:

- Rebates that offset the cost of purchasing and installing renewable generation systems, including solar PV generation,
- Monthly bill savings resulting from the solar generation supplying a portion of the customer's energy needs, and
- Additional bill savings from net metering which allow excess generation in one hour, when the solar generation exceeds the customer's load, to be netted against consumption in another hour, or in essence credited at the full retail ($/kWh) rate.

Arizona Public Service (APS) asked Navigant Consulting (Navigant) to prepare this brief white paper describing the cross-subsidies provided to APS customers with solar generation due to monthly bill savings and net metering. The paper uses several hypothetical, but typical, solar distributed energy customers (DE customers) as examples to illustrate the magnitude of the subsidies that result from the bill reductions. The paper also describes why those subsidies would result in higher rates and, consequently, higher costs for customers without distributed solar generation (non-DE customers).

It is important to note that this white paper is not a societal cost-benefit analysis, but rather a billing gap study to assess the difference between the reductions in the bills of DE customers and the utility costs avoided by the solar generation and capacity of DE customers. In the case of each of these hypothetical customers, the difference causes non-DE customers to pay higher rates to provide cross-subsidies to DE customers. This analysis does not include solar incentives that are not funded by APS, such as tax credits and incentives that offset solar costs. It also excludes other societal benefits not directly reflected in utility rates, such as environmental or health impacts.

Case Study Results

This white paper uses three hypothetical customers as examples to illustrate the basis for the conclusions. Navigant examined the annual bill reductions and avoided costs for each hypothetical DE customer.[3] The results show that the reductions in the annual bill of each DE customer exceed the

[1] Arizona's Renewable Energy Standard (RES) targets were established by ACC R14-2-2301 et seq. The RES targets are described in Appendix A.

[2] See also: ACC R14-2-2301 et seq.

[3] Data sourced using APS data, November 2012.

annual utility costs avoided by the DE customer solar generation. This result is based on the assumption that the rates for each DE customer are set at a level that is intended to recover the fixed and variable costs associated with serving that customer, in the absence of those bill reductions, and APS's annual revenue requirement. The results for the three case studies are summarized in the following table and figures.

Table 1. Bill Reductions vs. Avoided Costs: Subsidy Provided to Three Hypothetical Customers

		Residential Customer on ET-2 Rate	Residential Customer on E-12 Rate	Medium Size Commercial Customer on E-32M Rate
[1]	Annual Bill w/o Behind the Meter Solar Generation	$ 1,833	$ 2,119	$ 71,222
[2]	Annual Bill w/ Behind the Meter Solar Generation & Net Metering	$ 573	$ 600	$ 51,049
[3] (=[1]-[2])	Reduction in Annual Bill	$ 1,260	$ 1,519	$ 20,173
[4]	Annual Avoided Costs	$ 410	$ 410	$ 11,539
[5] (=([1] -[4])	Annual Bill if Bill Reduction Equaled Avoided Costs	$ 1,424	$ 1,709	$ 59,683
[6] (= [3]- [4])	Annual Cross-Subsidy	$ 851	$ 1,109	$ 8,634
[7] (=[3]/[4])	Reduction in Annual Bill as % of Avoided Costs	307.8%	370.9%	174.8%

Source: Appendix B, Table 7 and Appendix B, Table 12

Figure 1. Bill Reductions vs. Avoided Costs: Subsidy Provided to Hypothetical Residential Solar PV Customer on ET-2 Rate

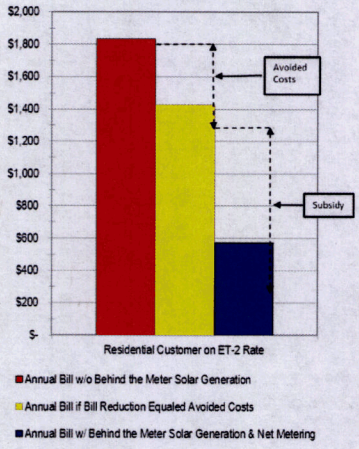


Figure 2. Bill Reductions vs. Avoided Costs: Subsidy Provided to Hypothetical Residential Solar PV Customer on E-12 Rate

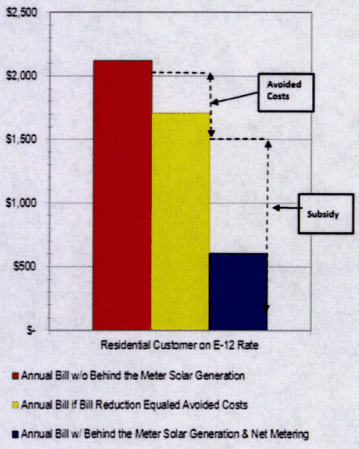
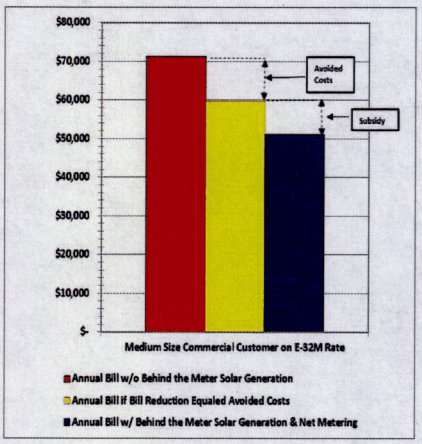


Figure 3. Bill Reductions vs. Avoided Costs: Subsidy Provided to Hypothetical Medium-Size Solar PV Commercial Customer on E-32M Rate



Source: Table 1

Summary of Key Findings

Based on the case studies examined by Navigant, the key findings include the following:

1. DE customers appear to be cross-subsidized by non-DE customers because:
    - The amounts DE customers pay for electricity after bill reductions due to self-generation are below the cost of serving those customers,

- APS must charge other customers higher rates to recover the fixed costs that DE customers would have paid in the absence of self-generation bill reductions, and
- The amounts non-DE customers pay for electricity as a result are above the cost of serving those customers.

2. DE customers not only avoid the additional variable power production costs and some generation capacity costs that APS would otherwise incur, but also avoid paying for the actual costs incurred due to their use of APS' services, including fixed costs resulting from:
   - Distribution wires,
   - Transformers,
   - Substations and other delivery service costs,
   - Transmission lines and related equipment,
   - A portion of the generation capacity costs and standby generation costs,
   - Public policy program funding such as low income discounts and energy efficiency programs,
   - Funding for the Residential Utility Consumer's Office and the Arizona Corporation Commission, and
   - Various other costs (e.g., environmental remediation, storage of spent nuclear fuel, and decommissioning programs.
3. The degree of cross-subsidization differs depending on the customer type and rate schedule:
   - The cross-subsidy is especially pronounced for residential customers, whose volumetric ($/kWh) charges typically account for over 90% of their annual electricity bills,
   - The cross-subsidy is lower for medium and large business customers where many other costs are recovered through demand ($/kW) charges versus volumetric energy (kWh) charges,
   - All other things being equal, the difference between bill reductions and avoided costs is likely to be greater among customers on an inclining block rate structure, because the kWh bill credits those customers receive offset electricity consumption at the highest tier rate.
4. The cross-subsidy is exacerbated by net metering because:
   - Excess generation in any hour that flows back to the grid is credited at the entire retail ($/kWh) rate and offset against future consumption, in effect using APS's grid as a "virtual battery".
   - DE customers are not required to pay charges for the standby generation capacity needed to back up the PV system when it is not producing electricity because of issues such as cloud cover, system downtime or loss of sunlight.
5. Currently there is no limit on the total solar capacity participating in net metering. Therefore, there is also no upper limit on the total amount of cross-subsidization of solar DE customers by other customers as the market penetration of distributed solar PV continues to increase.

Net Metering

Arizona net metering rules were implemented in May 2009.[4] Net metering is available to customers that generate electricity on-site using solar, wind, hydroelectric, geothermal, biomass, biogas, combined heat and power (CHP), or fuel cell technologies.[5] Customers that participate in net metering receive bill credits in each billing period for PV generated electricity that exceeds the amount they consume during the billing period. Any bill credits that exceed a customer's consumption in that billing period are either netted against future consumption within that same month or "banked" at the end of the month and used to offset charges in future months for actual customer consumption of APS-provided electricity. As a result, PV customers' credits are conceptually equivalent to selling excess generation back to the grid at the retail rate that APS would have charged them for that electricity.[6]

The fact that these customers are producing energy at one point in time, and then using bill credits to offset the kWh for which they would have otherwise been charged later on, is often described as allowing those customers to use APS's grid as a virtual battery.

The PV capacity a customer can install to be eligible to participate in the net metering program cannot exceed 125 percent of that customer's total connected load. If no load data are available for that customer, in order to be eligible for net metering, the capacity of the customer's PV system cannot exceed that customer's electric service drop.[7] The Arizona Corporation Commission (ACC) has not set a limit on the aggregate capacity of all net metered systems in a utility's territory.

The single bi-directional meter used to implement net metering registers both net energy in-flow and out-flow for on- and off-peak PV generation on a net basis.[8] Any net excess generation (NEG) that a customer produced in a billing period is carried over to the customer's next bill at that customer's retail rate, as a kilowatt-hour (kWh) bill credit. The way that is done depends upon the structure of the rates under that customer's retail rate. Those retail rates fall into two categories:

---

[4] See: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=AZ24R&re=0&ee=0

[5] Net metering is available to the commercial, industrial, residential, nonprofit, schools, local government, state government, and institutional customers of investor-owned utilities and electrical cooperatives.

[6] Unused kWh bill credits at the end of each month are banked, and used to reduce the kWh for which a customer would have otherwise been charged in the next month. Customers are paid by check at the end of the year for any remaining unused banked kWh bill credits at a ($/kWh) rate that reflects avoided non-firm power production variable costs (i.e., fuel, variable O&M, and purchased power costs).

[7] Under the rules adopted by the ACC, each utility must file an annual report listing the net metered facilities and their installed capacity in the previous calendar year.

[8] APS is responsible for the incremental costs of bidirectional metering. A bidirectional meter is not required if the customer-side renewable generating capacity is less than 10% of that customer's lowest billing demand over the previous 12 months, and if the customer does not intend to net any excess generation on that customer's monthly bill.

- Time-of-Use Rate. In the case of customers taking service under a time-of-use rate, any excess off-peak generation is credited against off-peak consumption, and any excess on-peak generation is credited against on-peak consumption. The customer's monthly bill is based on the resulting net on-peak kWh and net off-peak kWh amounts. Any remaining monthly customer NEG is banked and carried over to the customer's next bill as an off-peak or on-peak kWh bill credit.
- Inclining Block Rate. In the case of customers that are on inclining block rates, any excess generation is credited against the customer's consumption in the rate block in which that customer would have otherwise been charged for that additional load. The customer's monthly bill is based on the resulting net kWh in each rate block. Any remaining monthly customer NEG is banked and carried over to the customer's next bill as a kWh bill credit.

In both cases, at the end of each calendar year customers participating in net metering are paid by APS for any NEG bill credits that remain on the customer's last monthly bill. That true up payment at the end of the year is based on the EPR-6 net metering ($/kWh) non-firm power purchase price the ACC approved as a proxy for the short-run variable (fuel, variable operations and maintenance, and purchased power) costs[9] avoided by excess generation, rather than on the customer's retail rate. [10]

Customers participating in net metering that generate more electricity than they consume in a given billing period are in effect treated as if they had sold that excess generation back to the grid at the prices they would have paid for that electricity under their respective retail rates. At the end of each year, any remaining excess generation is sold back to the grid at ($/kWh) prices equal to the most recent ACC-approved purchase rates. [11]

[9] That cost includes an adjustment for avoided T&D line losses.

[10] Customers on TOU rates who have banked excess bill credits at the end of the year are paid the EPR-6 Net Metering on- and off-peak non-firm power purchase prices based on a 9 AM to 9 PM peak period, regardless of whether that TOU rate uses the noon to 7 PM or 9 AM to 9 PM residential rate peak period, or the 11 AM to 9 PM commercial rate peak period. Customers on standard rates such as E-12 or E-32 are paid at the average EPR-6 Net Metering non-firm power purchase price.

[11] For example, customers would be paid $0.033 to $0.035/kWh (the non-firm power purchase price reported in Table 12, page 38) for any banked excess generation remaining at the end of the calendar year, instead of the full retail rate (approximately $0.156/kWh, on average)

Subsidies

This section describes the cross-subsidies that APS DE customers are receiving due to the way in which self-generation and net metering policies have been implemented.

Cross-subsidies occur, all else being equal[12], if:

- Charges to DE customers for electricity are below the cost of serving those customers, and
- Charges to non-DE customers for electricity are above the cost of serving those customers.

We assume the rates APS customers are charged under ACC-approved rates are designed to recover the costs of serving those customers. Therefore, if the bill reductions that DE customers achieve with self-generation are higher than the costs that APS is avoiding as a result of those systems, DE customers are being cross-subsidized by charging non-DE customers higher rates.

Based on APS's rate structure and the examples presented in this report, the bill reductions that DE customers with solar systems are achieving are higher than the costs that APS is avoiding as result of those systems. Therefore, the amounts DE customers are paying for electricity, after the bill reductions due to self-supply and net metering are below the cost of serving those customers.

Subsidies

DE customers that self-generate (i.e., self-supply) avoid paying for the electricity that they would have otherwise purchased from APS. The DE customer's self-generation offsets the additional variable power production costs and some of the fixed costs associated with generation capacity that APS would have otherwise incurred. Although self-generation enables APS to avoid some fixed costs associated with generation capacity, those amounts are relatively small due largely to the limited ability of distributed generation capacity to replace firm dispatchable conventional generation capacity.[13] In particular, APS must maintain enough back-up (i.e., standby) generating capacity to provide the electricity that those customers consume when their systems are not producing electricity (e.g., when clouds obscure the sun, at night or when systems are down). The fact that these customers are producing energy at one point in time, and then using bill credits to offset the kWh for which they would have otherwise been charged later on, is often described as allowing those customers to use APS's grid as a virtual battery. APS also still needs a transmission and distribution (T&D) infrastructure to provide back-up generation to DE customers. Self-generation by DE customers also does not enable APS to avoid the cost of providing ancillary services needed to maintain the stability of the grid.

---

[12] Without changing the total revenues APS collects nor the total costs APS incurs.

[13] In its 2012 Integrated Resource Plan (IRP), APS documented that in the short run solar DE systems within its service territory have a limited capacity value that is significantly lower than the installed kW capacity of those systems. Both the variable costs discussed above and the limited capacity costs are avoided by APS, and therefore do not have to be recovered by charging more to non-DE customers.

As a result, DE customers in APS's service territory currently avoid paying for the full cost of the additional generation capacity, transmission, distribution and ancillary services that those customers still need.

Because of the way bill reductions due to self-generated are calculated, DE customers are currently able to avoid:

- The bulk of the fixed costs associated with procuring and maintaining generation capacity
- The fixed costs associated with investing in and maintaining T&D systems
- The fixed and variable costs associated with the ancillary services needed to maintain the stability of the grid; and,
- Various other costs (e.g., environmental remediation, storage of spent nuclear fuel, and decommissioning programs).

Cross-Subsidies

As discussed above, cross-subsidies occur if the annual amount DE customers pay for electricity provided by APS is below the cost of serving those customers and, conversely, the annual amount non-DE customers pay for electricity provided by APS are above the cost of serving those customers, all else being equal.

The bills paid by DE customers are no longer recovering the full fixed costs for service these customers incur. Therefore, those fixed costs are recovered by charging non-DE customers higher rates. That is why non-DE customers are effectively cross-subsidizing DE customers.

The problem is due in part to the fact that the bill reductions customers obtained by consuming self-generated electricity are based on retail rates. The bill reductions that DE customers obtain by consuming electricity they generated for themselves significantly exceed the costs APS is avoiding as a result of that self-generation.

The cross subsidies are also due to the way in which DE customers participating in net metering reduce their electricity bills by banking excess generation credits. The resulting reductions in the electricity bills of net metered DE customers exceed the costs APS is avoiding due to that excess generation.[14] DE customers that receive excess generation credits at the full retail rate under net metering receive a cross-subsidy that is greater than the credits due to self-generation bill reductions. The higher rates that non-DE customers are charged to fund that cross-subsidy will grow as self-generation growth reduces APS' retail (kWh) sales.

[14] Except for banked bill credits due to excess generation that remain at the end of the calendar year, , because the resulting customer bill reductions are based on ACC-approved estimates of APS's avoided costs ($/kWh).

Case Studies

This section uses three hypothetical customers as examples to compare the annual bill reductions to the annual costs avoided by distributed solar PV systems of:

- A residential customer on APS's ET-2 rate;
- A residential customer on APS's E-12 rate; and,
- A medium-size commercial customer on APS's E-32M rate.

Each of these case studies is based on data provided by APS. An underlying assumption in this analysis is that the rates APS charges non-DE customers are set at a level to recover the fixed and variable costs associated with serving all customers by rate class.

Example days were selected to highlight some of the unique issues APS faces.

Residential Hourly Gross Load vs. Self-Generation

Two residential customers were used as examples because approximately 50% of the APS residential customers in 2011 were on APS's standard inclining block rate (E-12). The other 50% were on a time-of-use (TOU) rate, which in most cases was the ET-2 rate, using 12 PM to 7 PM as peak period hours.

The hourly load profile of the hypothetical ET-2 residential customer is based on the shape of the aggregate hourly load profile of all customers on the ET-2 rate in 2011, the most recent year for which annual data are available. That hourly load profile also was used for the hypothetical E-12 residential customer, because E-12 customers with solar DE systems are often closer to a typical ET-2 customer load profile than the average profile across all E-12 customers.

The PV generation profile that was assumed for both of these hypothetical residential customers is a system that is installed at an actual APS customer's Sun City West, Arizona address. The system was selected because annual performance of that system in 2011 almost perfectly matched APS' assumption that, on average, a residential PV system has a 1,650 kWh/kW-year performance factor. APS also uses that assumption for external reporting purposes. In order to estimate the potential retail offset and net metering subsidy that would be observed with that PV system's production, APS assumed that the capacity of each customer's system was equal to 125% of that customer's maximum hourly demand, as allowed under Arizona's net metering rules. Based on these assumptions, both the residential customer on APS' ET-2 rate would have the same gross load profile and PV generation profile as the residential customer on APS' E-12 rate.

Figure 4 and Figure 5 (which is representative of either residential example) demonstrate that on a weekday in spring this residential customer would be likely to produce more power than it consumed and bank excess generation credits during most daylight hours. However, on a mid-summer weekday, this residential customer would be likely to produce less excess generation in the middle of the day.

The two days used in these examples – April 15, 2011 and August 2, 2011 – were selected to illustrate the issues APS faces among residential DE customers. On a typical spring weekday, residential DE customers tend to have lower base loads than in other seasons. Their loads also peak in morning and evening hours when PV generation tends to be somewhat lower. Because PV generation tends to be much higher in the intervening hours, those customers tend to produce significant amounts of excess generation between their morning and evening peak demand hours.

On mid-summer weekdays, those customers tend to have higher base loads, and their peak load tends to stretch into evening hours when no PV generation is occurring.

Therefore, excess generation by residential DE customers tends to be lower on mid-summer than on spring weekdays, and occurs in fewer hours during the middle of the day.

Figure 4. Hourly Gross Load vs. Hourly Self-Generation by Residential PV Customer on Spring Weekday

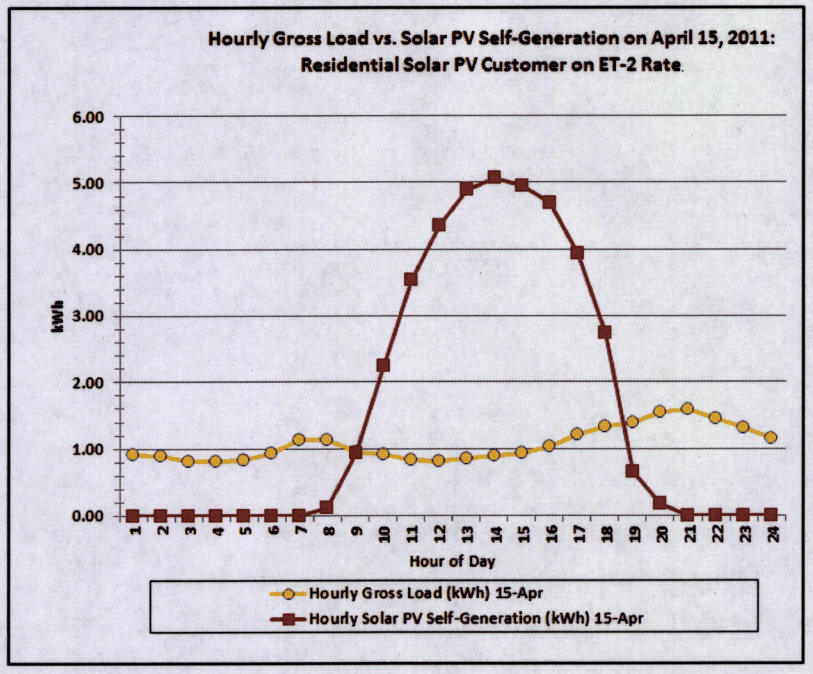
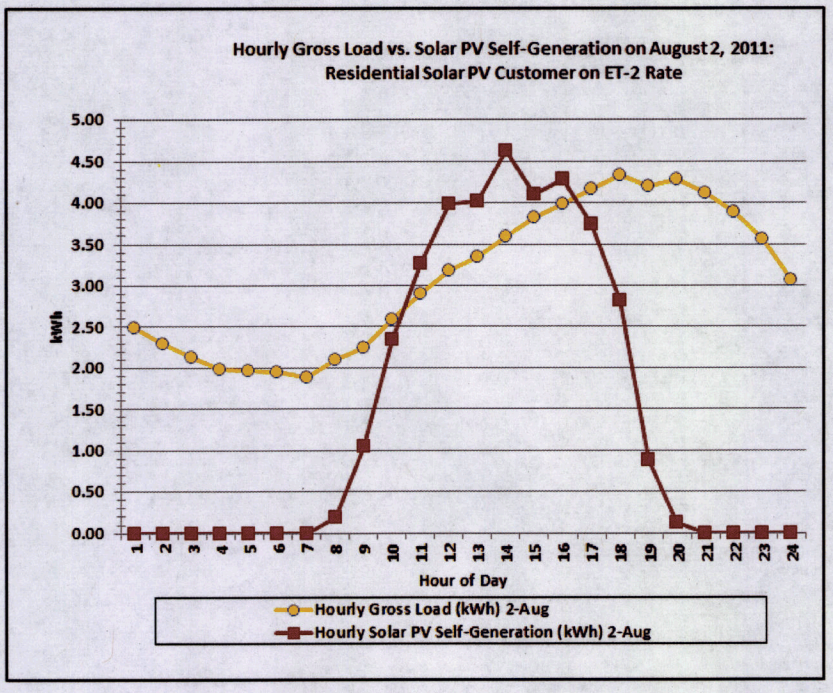


Figure 5. Hourly Gross Load vs. Hourly Self-Generation by Residential PV Customer on Mid-Summer Weekday



Commercial Hourly Gross Load vs. Self-Generation

The commercial customer example illustrates the impact of self-generation and net metering on the annual electricity bills of somewhat larger distributed PV customers within APS's service territory. A medium- rather than a large-size commercial customer was used as an example because APS has more E-32M medium-size customers than E-32L large-size customers. A typical example of an E-32M customer would be a grocery store.

The hourly load profile of that hypothetical medium-size commercial customer is based on the shape of the aggregate hourly load profile in 2011 of the entire set of customers on APS's E-32M rate. The PV system used for that hypothetical commercial customer is a system installed at an actual APS customer's Prescott, Arizona address. To estimate the generation produced by that commercial customer's PV system, APS assumed the capacity of that system was equal to 100% of that customer's maximum hourly demand, as few commercial customers currently size systems up to the maximum 125% of customer peak load allowed under Arizona's net metering rules.

The actual performance factor of that system in 2011 - 1,530 kWh/kW-year - was nearly identical to the 1,500 kWh/kW-year assumption APS uses for external reporting. That performance factor is slightly lower than the 1,641 kWh/kW-year performance factor assumed for the residential PV system primarily because many PV commercial systems are installed on flat rooftops instead of slightly pitched and south-facing rooftops.

Figure 6 and Figure 7 demonstrate that on a weekday in spring 2011 the medium-size commercial customer would have consumed more power than it generated, except during peak hour production periods in the middle of the day. On a mid-summer weekday, however, that customer would have consumed more power than it generated, even in the middle of the day.[15]

[15] The August 2nd example illustrates a below normal production day likely impacted by cloud cover or a monsoon season storm. On a typical peak summer performance day, the solar system's output would be higher and look similar to the load curve of the residential customer depicted in Figure 5. Because the commercial customer has a higher load in peak hours on a summer day, PV production in those hours is likely to produce a smaller amount of excess generation.

Figure 6. Hourly Gross Load vs. Hourly Self-Generation by Medium-Size Commercial PV Customer on Spring Weekday

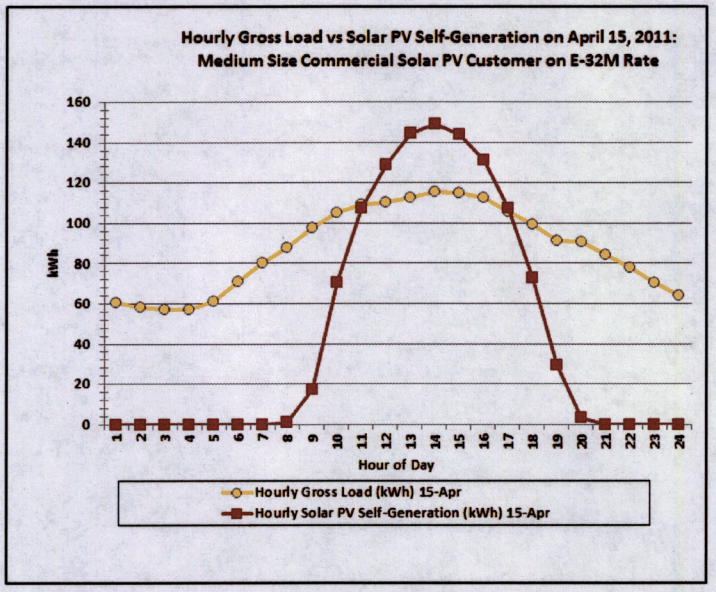
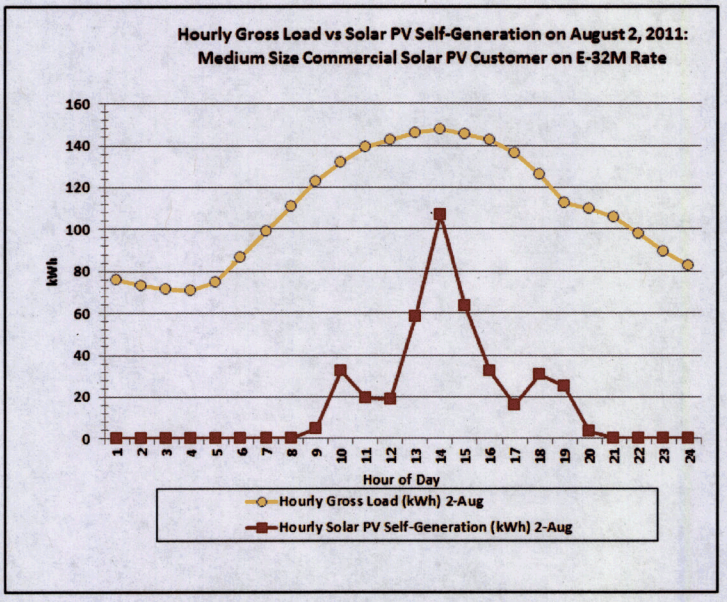


Figure 7. Hourly Gross Load vs. Hourly Self-Generation by Commercial PV Customer on Mid-Summer Weekday[16]



[16] This August 2nd example illustrates a below normal production day that was probably impacted by cloud cover or a monsoon season storm. On a typical peak summer performance day, the solar system's hourly output profile would be higher and look more similar to the hourly generation profile of the hypothetical residential customer.

DE Customer Bill Reductions vs. Avoided Costs

Figure 8 and Figure 9 compare the types of costs APS avoids because of the distributed PV systems of residential and commercial customers, to the types of costs recovered by each component of a customer's electricity bill. Each figure also indicates which bill components are reduced when a customer consumes and/or banks excess PV generation credit.

As the figures indicate, most of the reduced bill components recover APS costs that are not avoided by customer PV systems. Therefore, the portions of those unpaid costs that customers with PV systems avoid paying are instead recovered by charging APS customers higher rates. In other words, DE customers that consume and/or bank excess PV generation are being cross-subsidized by other APS non-DE customers. Except for a ($/day) basic service charge, most residential customers are charged only volumetric energy ($/kWh) rates. Therefore, the statement that fixed costs are not being recovered from customers with behind the meter renewable generating systems is particularly applicable to residential customers.

Figure 8. Residential Customer Bill Reductions vs. Avoided Costs

Bill Reductions Achieved by Solar PV Residential Customers vs. APS Costs Avoided by Residential Customer Solar PV Generation and Capacity

Billing Elements	Charge Type	Solar PV Customer Bill Reductions	APS Costs Avoided by Customer Solar PV Generation	APS Costs Recovered by Each Billing Element
Base Rates:				
Metering and Billing	Monthly			Metering and Billing
Delivery	kWh	X		Distribution "wires" service, substations, transformers
Transmission	kWh	X		Extra High Voltage lines, ancillary services
System Benefits	kWh	X		Solar programs, energy efficiency, low income discounts, nuclear decommissioning
Generation - Capacity	kWh	X	Limited[1]	Power plants
Generation - Fuel and variable O&M	kWh	X	X	Fuel and variable O&M for generation
Adjustments:				
Renewable Energy Standard	kWh, Capped			All renewable energy programs
Power Supply Adjustor	kWh	X	X	Fuel (changes from base rate)
DSM Cost Adjustment	kWh	X		Energy Efficiency programs
Environmental Improvement Surcharge	kWh	X		Pollution abatement equipment at power plants
Federal Transmission Cost Adjustment	kWh	X		Transmission (changes from base rate)
Lost Fixed Cost Recovery	%	X		Additional costs related to energy efficiency and renewable programs
Taxes and Government Fees:				
Regulatory Assessment Fee	%	X		Costs required to support Arizona Corporation Commission and RUCO
Franchise Fee	%	X		City Franchise Costs
Sales Taxes	%	X		State, County and City Sales Taxes

NOTES
[1] The capacity value of a solar PV (distributed energy) system is significantly lower than the system's installed kW capacity.

Source: APS data, November 2012

Figure 9. Commercial Customer Bill Reductions vs. Avoided Costs

Bill Reductions Achieved by Solar PV Business Customers [1] vs. APS Costs Avoided by Business Customer Solar PV Generation and Capacity				
Billing Element	Charge Type	Solar PV Customer Bill Reductions	APS Costs Avoided by Customer Solar PV Generation	APS Costs Recovered by Each Billing Element
Base Rates:				
Metering and Billing	Monthly			Metering and Billing
Delivery	kW	Partial		Distribution "wires" service, substations, transformers
Transmission	kW	Partial		Extra High Voltage lines, ancillary services
System Benefits	kWh	X		Solar programs, energy efficiency, low income discounts, nuclear decommissioning
Generation - Capacity	kW	Partial	Limited[3]	Power plant investments
Generation - Fuel and variable O&M	kWh	X	X	Fuel and variable O&M costs for generation
Adjustments:				
Renewable Energy Standard	kWh, Capped			All renewable energy programs
Power Supply Adjustor	kWh	X	X	Fuel (changes from base rate)
DSM Cost Adjustment	kW	Partial		Energy Efficiency programs
Environmental Improvement Surcharge	kWh	X		Pollution abatement equipment at power plants
Federal Transmission Cost Adjustment	kW	Partial		Transmission (changes from base rate)
Lost Fixed Cost Recovery [2]	%	X		Additional costs related to energy efficiency and renewable programs
Taxes and Government Fees:				
Regulatory Assessment Fee	%	X		Costs required to support Arizona Corporation Commission and RUCO
Franchise Fee	%	X		City Franchise Costs
Sales Taxes	%	X		State, County and City Sales Taxes
NOTES				
[1] Represents small, medium, large, and extra-large business customers				
[2] Large and Extra-large business custmers are exempt from the LFCR				
[3] The capacity value of a solar PV (distributed energy) system is significantly lower than the system's installed kW capacity.				

Source: APS data, November 2012

Net metered customers that consume and/or in effect "sell" PV generation back to the grid, avoid paying not only the variable costs APS would have incurred if it had supplied those kWh, but also the APS fixed costs whose recovery accounts for the bulk of a typical customer's bill. Most of those unrecovered fixed costs consist of generation capacity costs, T&D wires costs, and the system benefits charge, in addition to other costs. The only base bill component these customers would not avoid paying is the daily basic service charge for metering and billing.

Beginning in 2013, APS customer bills will include a Lost Fixed Cost Recovery (LFCR) adjustor. That adjustor is intended to recover some, but not all, of the fixed costs – excluding fixed generation costs – not recovered from PV customers, as well as some of the fixed costs that are not recovered because energy efficiency programs reduce the amount of electricity customers consume. Because that adjustor is a percentage of a customer's total bill, rather than a cents per kWh charge, customers that consume and/or export PV generation will avoid paying a portion of that adjustor. In addition, the local government taxes APS pays that are recovered through charges on a customer's bill are also based upon a percentage of that customer's total bill. Therefore, reductions in the remainder of the bills paid by PV customers will also enable those customers to avoid paying a portion of those taxes.

As noted above, the bulk of the costs avoided by distributed PV are variable power production costs (i.e., fuel, fixed O&M, and power purchase costs, as well as the associated T&D line losses). Although PV systems avoid some fixed costs associated with generation capacity, the amount of capacity (MW) avoided by a customer's PV system is less than its nameplate capacity.

APS provided an estimate for the costs the Company would avoid due to peak and off-peak distributed PV generation, assuming that more current firm and non-firm avoided costs from APS's IRP that will be reflected in an updated EPR-6 annual purchase rate. The weighted average of those costs reflects the inclusion of a limited value for PV generation capacity. Those annual average peak and off-peak hour prices, based on a 9AM to 9PM on peak period, are reported in the last three rows of Table 2.

Table 2. Proposed 2013 EPR-6 Net Metering Purchase Prices Used to Estimate Costs Avoided by PV Installed by Hypothetical APS Customers

Proposed 2013 EPR-6 Net Metering Purchase Prices for Year End Banked Excess Generation Bill Credits (based on 9AM to 9PM On-Peak Period)		
Non-Firm Power ($/kWh)		
On-Pk	$	0.03536
Off-Pk	$	0.03367
Avg	$	0.03427
Firm Power ($/kWh)		
On-Pk	$	0.04058
Off-Pk	$	0.03464
Avg	$	0.03676

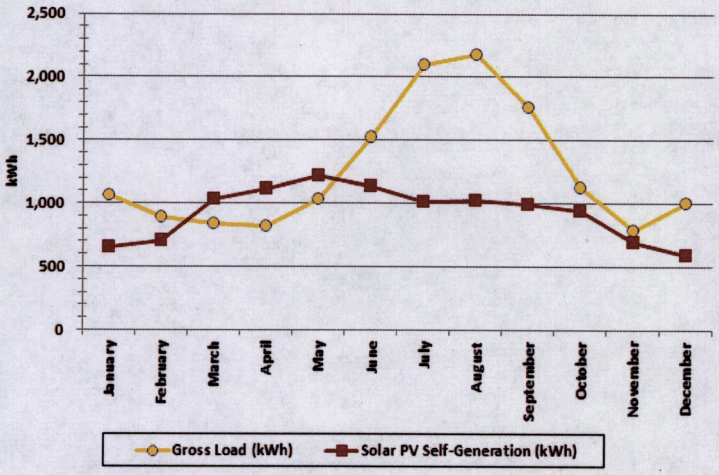
Average of Proposed EPR-6 Net Metering Purchase Prices ($/kWh) for Firm and Non-Firm Power		
On-Pk	$	0.03797
Off-Pk	$	0.03416
Avg	$	0.03552

Source: APS data, November 2012

Residential Solar PV Customer on ET-2 TOU Rate

Figure 10 compares the monthly electricity consumption (gross load) of the hypothetical residential customer on APS's ET-2 rate, to the amount of electricity that customer's PV system would have generated in each month in 2011.

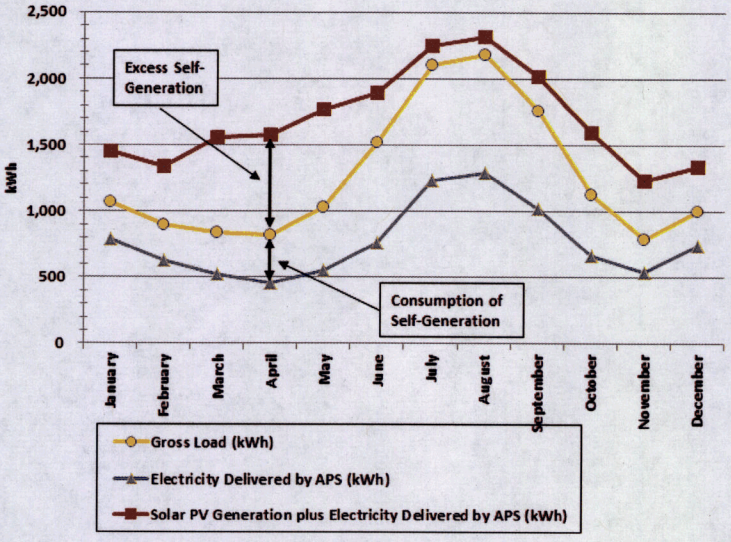
Figure 10. Monthly Gross Loads vs. PV Self-Generation: Residential PV Customer on ET-2 Rate



Source: Appendix B, Table 6

Figure 11 shows how much of that monthly PV generation would have been consumed by that customer, and how much would have been sold back to APS through net metering.

Figure 11. Monthly Gross Load vs. Self-Generation and Excess Generation: Residential ET-2 Customer



Source: Appendix B, Table 6

As indicated in Table 3 and Figure 12, a PV system would have reduced the annual electricity bill of the hypothetical residential customer on APS' ET-2 rate from $1,833 to $573. That $1,260 bill reduction[17] is 207.3% higher than the $410 in costs APS avoided due to that customer's PV system.

If that bill reduction was instead equal to the costs APS avoided due to that system, that customer's bill would be $1,424.[18]

Because that customer's bill would actually have been $573, however, APS would have had to charge other customers $851 more than it would have charged them if the reduction in that customer's bill equaled the cost APS avoided.[19]

Table 3. Bill Reduction vs. Avoided Costs: Excess Subsidy Provided to Hypothetical Residential Solar PV Customer on ET-2 Rate

		Residential Customer on ET-2 Rate
[1]	Annual Bill w/o Behind the Meter Solar Generation	$ 1,833
[2]	Annual Bill w/ Behind the Meter Solar Generation & Net Metering	$ 573
[3] (=[1]-[2])	Reduction in Annual Bill	$ 1,260
[4]	Annual Avoided Costs	$ 410
[5] (=([1] -[4])	Annual Bill if Bill Reduction Equaled Avoided Costs	$ 1,424
[6] (= [3]- [4])	Annual Cross-Subsidy	$ 851
[7] (=[3]/[4])	Reduction in Annual Bill as % of Avoided Costs	307.8%

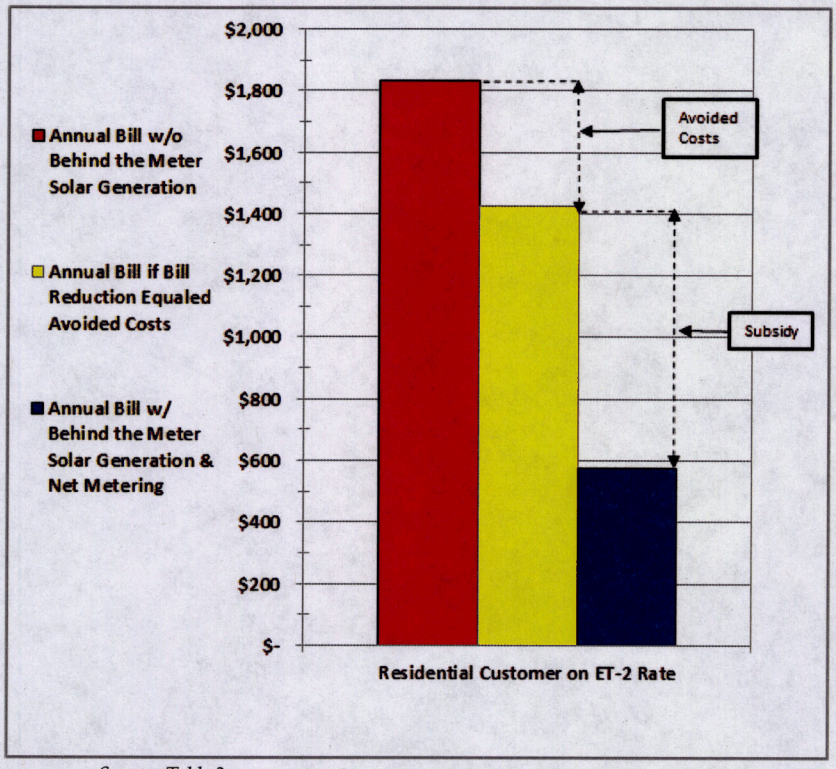
Source: Appendix B, Table 7 and Appendix B, Table 12

[17] $1,260 = $1,833 - $573.

[18] $1,423 = $1,833 – $410, after rounding. The actual difference is $1,424.

[19] $851 = $1,424 - $573, after rounding.

Figure 12. Bill Reduction vs. Avoided Costs: Subsidy Provided to Hypothetical Residential Solar PV Customer on ET-2 Rate



Source: Table 3

Residential PV Customer on E-12 Rate

The monthly load and self-generation profile of the hypothetical residential customer on APS's ET-2 are the same as those of the residential customer on APS's E-12 rate. Therefore, the monthly load and self-generation profile of the customer on the E-12 rate would be the same as those depicted in Figure 10. For the same reason, Figure 11 also shows how much of that monthly PV generation would have been consumed by that E-12 rate residential customer.

As indicated in Table 4 and Figure 13, a PV system would have reduced the annual electricity bill of the residential customer on APS's E-12 rate from $2,119 to $600. That $1,519 bill reduction[20] is 270.5% higher than the $410 in costs APS would have avoided due to that system.[21]

If that reduction was instead equal to the costs APS would have avoided, that customer's bill would be $1,709.[22]

Because the customer's actual bill would have been only $600, however, APS would have had to charge other customers $1,109 more than it would have charged them if the reduction in that customer's bill equaled the cost APS avoided.[23]

Table 4. Bill Reduction vs. Avoided Costs: Subsidy Provided to Hypothetical Residential Solar PV Customer on E-12 Rate

		Residential Customer on E-12 Rate
[1]	Annual Bill w/o Behind the Meter Solar Generation	$ 2,119
[2]	Annual Bill w/ Behind the Meter Solar Generation & Net Metering	$ 600
[3] (=[1]-[2])	Reduction in Annual Bill	$ 1,519
[4]	Annual Avoided Costs	$ 410
[5] (=([1] -[4])	Annual Bill if Bill Reduction Equaled Avoided Costs	$ 1,709
[6] (= [3]- [4])	Annual Cross-Subsidy	$ 1,109
[7] (=[3]/[4])	Reduction in Annual Bill as % of Avoided Costs	370.9%

Source: Appendix B, Table 9

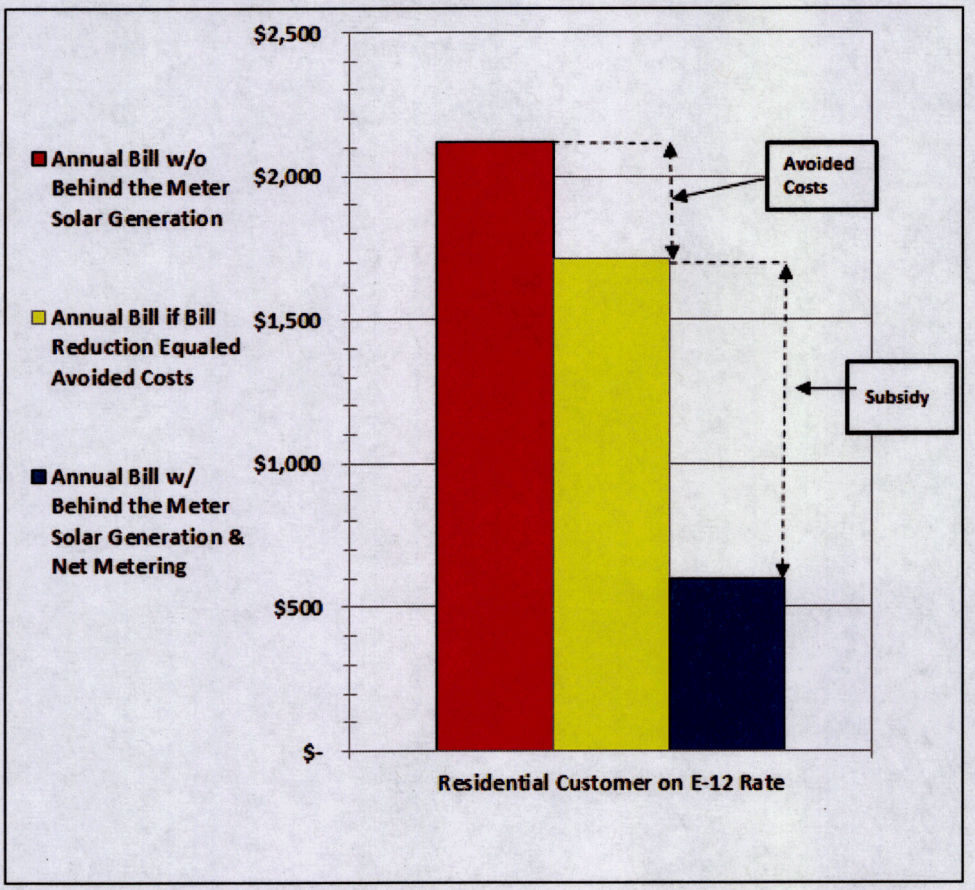
[20] $1,519 = $2,119 - $600.

[21] Because this analysis assumes both residential customers would have had the same hourly gross loads and the same hourly solar PV generation, in both cases the customer's PV system would have enabled APS to avoid $410 in power production and generation capacity costs.

[22] $1,709 = $2,119 – $410.

[23] $1,109 = $1,709 - $600.

Figure 13. Bill Reduction vs. Avoided Costs: Subsidy Provided to Hypothetical Residential Solar PV Customer on E-12 Rate

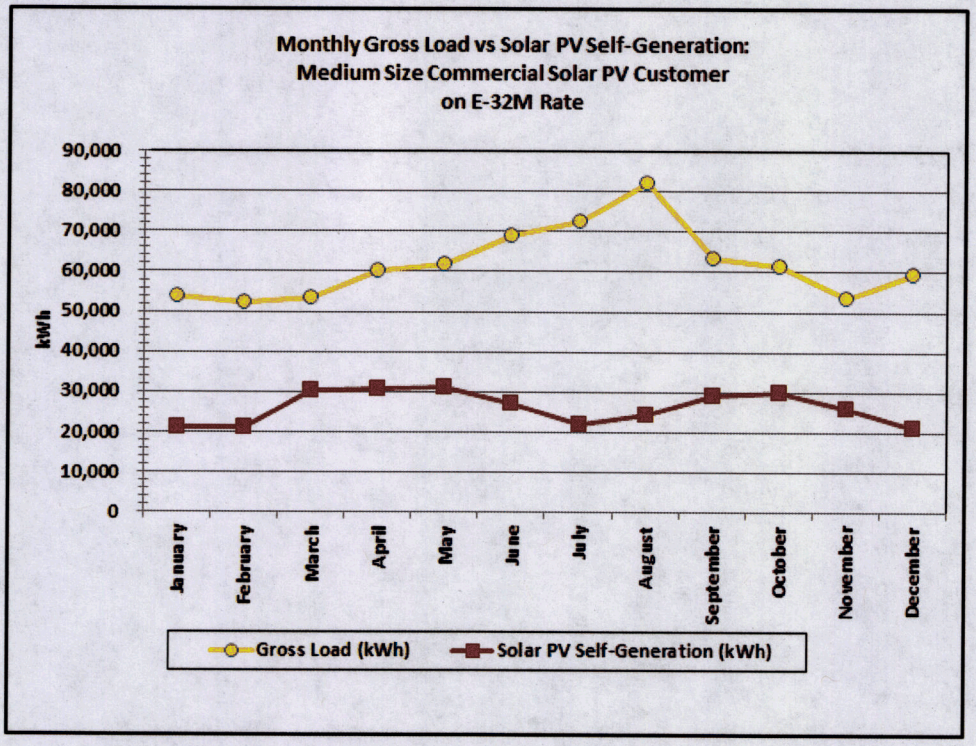


Source: Table 4

Medium-Size Non-Residential Customer on E-32M Rate

Figure 14 compares the monthly electricity consumption (gross load) of the hypothetical medium-size commercial customer on APS's E-32 M rate, to the amount of electricity that customer's PV system would have generated in each month of 2011.

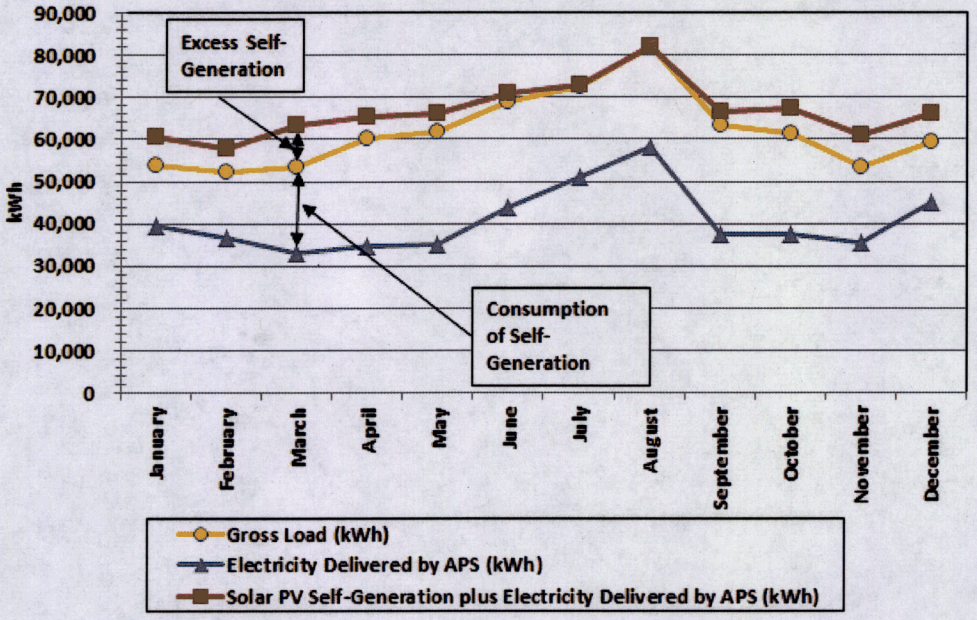
Figure 14. Monthly Gross Loads vs. PV Self-Generation: Medium-Size Commercial Customer on 32M Rate



Source: Appendix B, Table 10

Figure 15 shows how much of that monthly PV generation would have been consumed by that customer, and how much would have been sold back to APS through net metering.

Figure 15. Monthly Load vs. Self-Generation and Excess Generation: Medium-Size PV Commercial Customer on E-32M Rate



Source: Appendix B, Table 10

As Table 5 and Figure 16 indicate, a PV system would have reduced the annual electricity bill of that hypothetical commercial customer from $71,222 to $51,049. That $20,173 bill reduction[24] is 74.8% higher than the $11,539 in costs APS would have avoided because of that PV system.

If the reduction in that customer's bill was instead equal to the costs APS would have avoided, that customer's bill would have been $59,683.[25]

Because that customer's actual bill would have been only $51,049, however, APS would have had to charge other customers $8,634 more than it would have charged them if the reduction in that customer's bill equaled the cost APS avoided. [26]

[24] $20,173 = $71,222 - $51,049.

[25] $59,683 = $71,222 – $11,539.

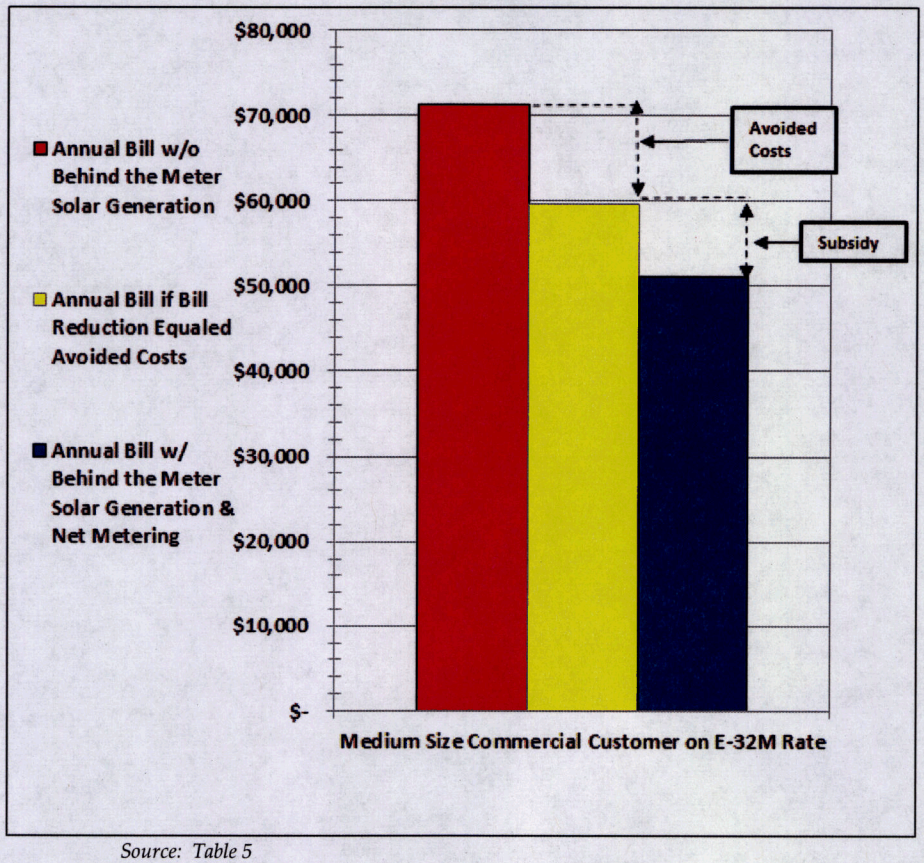
[26] $8,634 = $59,683 - $51,049, after rounding.

Table 5. Bill Reduction vs. Avoided Costs: Subsidy Provided to Hypothetical PV Commercial Customer on E-32 M Rate

		Medium Size Commercial Customer on E-32M Rate
[1]	Annual Bill w/o Behind the Meter Solar Generation	$ 71,222
[2]	Annual Bill w/ Behind the Meter Solar Generation & Net Metering	$ 51,049
[3] (=[1]-[2])	Reduction in Annual Bill	$ 20,173
[4]	Annual Avoided Costs	$ 11,539
[5] (=([1] -[4])	Annual Bill if Bill Reduction Equaled Avoided Costs	$ 59,683
[6] (= [3]- [4])	Annual Cross-Subsidy	$ 8,634
[7] (=[3]/[4])	Reduction in Annual Bill as % of Avoided Costs	174.8%

Source: Appendix B, Table 11 and Appendix B, Table 12

Figure 16. Bill Reduction vs. Avoided Costs: Subsidy Provided to Hypothetical Medium-Size Solar PV Commercial Customer on E-32M Rate



Source: Table 5

Conclusions

The rapid growth of the DE customer market segment is a tremendous success story of market transformation. In this white paper, Navigant examined several case studies of hypothetical DE customers to illustrate the magnitude of the financial benefits and cross subsidies resulting from the way in which self-supply and net metering have been implemented. Navigant also examined the extent to which the cross-subsidies require APS to charge non-DE customers higher rates.

Based on the case studies examined by Navigant, the key findings include the following:

1. DE customers appear to be cross-subsidized by non-DE customers because:
    - The amounts DE customers pay for electricity after bill reductions due to self-generation are below the cost of serving those customers,
    - APS must charge all customers higher rates to recover the fixed costs that DE customers would have paid in the absence of self-generation bill reductions, and
    - The amounts non-DE customers pay for electricity as a result are thus likely to be above the cost of serving those customers.

2. DE customers not only offset the additional variable energy costs and some generation capacity costs that APS would otherwise need, but also avoid paying for the actual costs incurred due to their use of APS's services, including fixed costs resulting from:
    - Distribution wires,
    - Transformers,
    - Substations and other delivery service costs,
    - Transmission lines and related equipment,
    - A portion of the generation capacity costs and standby generation costs,
    - Public policy program funding such as low income discounts and energy efficiency programs,
    - Funding for the Residential Utility Consumer's Office and the Arizona Corporation Commission,
    - Various other costs (e.g., environmental remediation, storage of spent nuclear fuel, and decommissioning programs).

3. The degree of cross-subsidization differs depending on customer type and rate schedule:
    - The cross-subsidy is especially pronounced for residential customers, whose volumetric ($/kWh) charges typically account for over 90% of their annual electricity bills,
    - The cross-subsidy is lower for medium and large business customers where many other costs are recovered through demand ($/kW) charges versus volumetric energy ($/kWh) charges,
    - All other things being equal, the difference between bill reductions and avoided costs is likely to be greater among customers on an inclining block rate structure, because the kWh bill credits those customers receive offset electricity consumption for which they would have been charged the highest tier rate.

4. The cross-subsidy is exacerbated by net metering because:
    - Excess generation in any hour that flows back to the grid is credited at the entire retail ($/kWh) rate and offset against future consumption, in effect using APS' grid as a "virtual battery",
    - DE customers are not required to pay charges for the standby generation capacity needed to back up the PV system when it is not producing electricity because of issues such as cloud cover, system downtime or loss of sunlight.

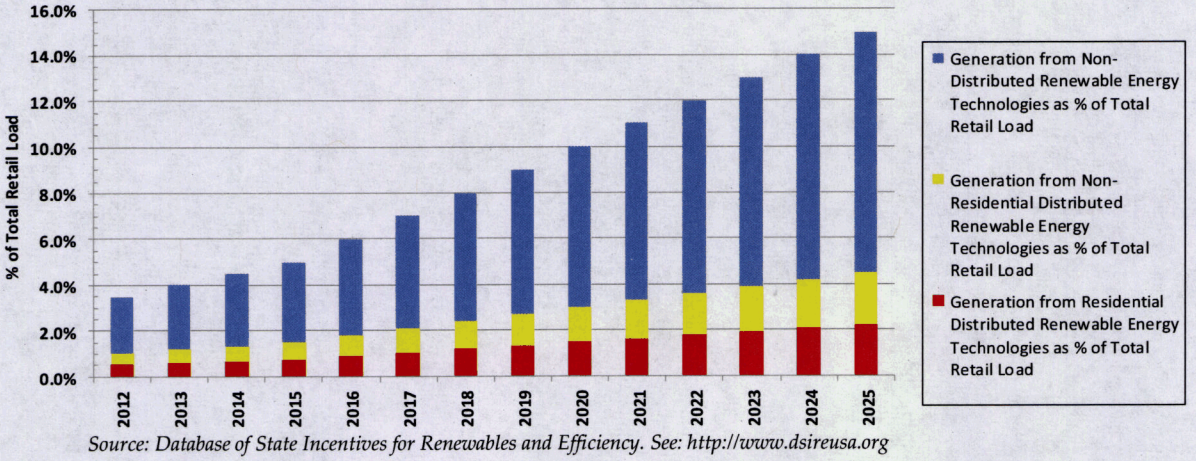
5. Currently there is no limit on the total solar capacity participating in net metering. Therefore, there is also no upper limit on the total amount of cross-subsidization of solar DE customers by other customers as the market penetration of distributed solar PV continues to increase.

Appendix A

The goals of the policies covered in this paper are driven by Arizona's Renewable Energy Standard (RES).[27] Utilities subject to RES must obtain enough renewable energy credits (RECs) to demonstrate that eligible renewable resources are meeting an increasing share of their retail electric load. By 2025 and thereafter, the energy each utility obtains from eligible renewable resources must account for at least 15% of the electricity delivered to that utility's retail customers. In addition, 30% of that renewable energy must come from distributed renewable (DR) generation technologies (i.e., 4.5% of their total retail load) by 2025. Half of that distributed generation must come from residential applications. The other half must come from non-residential, non-utility applications.

Figure 17 summarizes those annual RES targets.

Figure 17. Residential and Non-Residential DE Shares of Arizona's Annual RES Targets



Source: Database of State Incentives for Renewables and Efficiency. See: http://www.dsireusa.org

[27] In November 2006, the Arizona Corporation Commission (ACC) adopted final rules to expand the state's Renewable Energy Standard (RES) to 15 percent by 2025.(ACC R14-2-2301 et seq., which is available at: http://www.azsos.gov/public_services/Title_14/14-02.htm#ARTICLE_23). Those rules, which took effect in August 2007, apply to investor-owned utilities and electric power cooperatives serving retail customers in Arizona. The rules do not apply to distribution companies with more than half of their customers outside Arizona.

Appendix B

Table 6. Monthly Gross Loads, Behind the Meter Generation, Excess Generation, APS-Delivered Electricity, and Billed kWh: PV Residential Customer on ET-2 TOU Rate

On-Site Solar PV System Size and Performance Factor		
[1]	Maximum Hourly Generation (kW-AC)	6
[2]	Maximum Hourly Generation (kW-DC)	7
[3]	Max Gross Hourly Load (kWh)	5
[4]	% of Maximum (= (1)/(3))	1
[5]	Performance Factor (Annual kWh/kW-DC)	1,641

		Monthly Gross Load of Typical ET-2 Customer (kWh)			Solar Behind Meter Generation kWh			APS-Delivered kWh			Excess Solar Generation (kWh)			EPR-6 Banked kWh Bill Credits		Billed kWh	
				[3]+[4]			[6]+[7]			[9]+[10]	[6]+[9]-[3]	[7]+[10]-[4]	[12]+[13]	Max([12]-[9],0)	Max([13]-[10],0)	IF([15]>0,[9]-[12],0)	IF([16]>0,[10]-[13],0)
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
Month	# of Days	ON-PK	OFF-PK	Total	ON-PK	OFF-PK	Total	ON-PK	OFF-PK	Total	ON-PK	OFF-PK	Total	ON-PK	OFF-PK	ON-PK	OFF-PK
1	31	154	911	1,065	361	297	658	38	752	790	245	138	383	207	0	0	614
2	28	137	755	892	418	291	709	16	613	629	297	149	446	488	0	0	464
3	31	160	676	836	558	477	1,036	14	508	522	412	310	721	886	0	0	198
4	30	168	654	821	557	562	1,119	14	441	456	403	350	753	1,275	0	0	92
5	31	224	810	1,034	571	651	1,221	25	524	549	371	365	736	1,621	0	0	160
6	30	385	1,137	1,522	574	559	1,132	30	730	760	219	151	370	1,810	0	0	579
7	31	479	1,621	2,100	476	540	1,016	94	1,138	1,232	91	57	148	1,807	0	0	1,082
8	31	582	1,595	2,176	545	479	1,024	124	1,168	1,292	87	53	139	1,770	0	0	1,115
9	30	442	1,322	1,763	501	490	991	84	940	1,025	143	109	252	1,829	0	0	832
10	31	247	876	1,123	451	485	936	47	615	661	251	224	475	2,033	0	0	391
11	30	140	646	787	377	312	690	32	508	540	269	174	443	2,270	0	0	334
12	31	154	843	997	277	314	591	48	694	742	171	165	336	2,394	0	0	529
Total	365	3,272	11,846	15,118	5,666	5,457	11,123	565	8,632	9,197	2,959	2,244	5,202			0	6,388
Summer	184	2,359	7,361	9,720	3,117	3,203	6,320	403	5,115	5,519	1,162	958	2,119			0	4,158
Winter	181	914	4,485	5,398	2,549	2,254	4,803	162	3,517	3,679	1,797	1,286	3,083			0	2,231

Source: APS data, November 2012

Table 7. Reduction in Annual Bill of Hypothetical PV Residential Customer on ET-2 TOU Rate

Annual Bill of Typical Customer on ET-2 Time-of-Use Rate (On-Pk: noon-7pm)							
Annual Bill w/o Behind the Meter Solar Generation				Annual Bill w/ Behind the Meter Solar Generation & Net Metering			
	BD [1]	Charge ($/BD)	Base Bill (1) x (2)		BD [1]	Charge ($/BD)	Base Bill (4) x (5)
	(1)	(2)	(3)		(4)	(5)	(6)
BSC	365	$ 0.556	$ 202.94	BSC	365	$ 0.556	$ 202.94
Generation				Generation			
Summer				Summer			
On-Pk	2,359	$ 0.20960	$ 494.38	On-Pk	-	$ 0.20960	$ -
Off-Pk	7,361	$ 0.02601	$ 191.46	Off-Pk	4,158	$ 0.02601	$ 108.14
Winter				Winter			
On-Pk	914	$ 0.16330	$ 149.20	On-Pk	-	$ 0.16330	$ -
Off-Pk	4,485	$ 0.02599	$ 116.56	Off-Pk	2,231	$ 0.02599	$ 57.98
Total Generation			$ 951.60	**Total Generation**			$ 166.12
Transmission	15,118	$ 0.00520	$ 78.61	**Transmission**	6,388	$ 0.00520	$ 33.22
Delivery	15,118	$ 0.02700	$ 408.19	**Delivery**	6,388	$ 0.02700	$ 172.49
System Benefits Charge	15,118	$ 0.00297	$ 44.90	**System Benefits Charge**	6,388	$ 0.00297	$ 18.97
Annual Bill before Adjustors			$ 1,686.25	**Annual Bill before Adjustors**			$ 593.74
Adjustors [4]				**Adjustors [4]**			
	BD [1]	Charge ($/BD)	Adjustor Charges		BD [1]	Charge ($/BD)	Adjustor Charges
PSA-1	15,118	$0.00141	$ 21.35	PSA-1	6,388	$0.00141	$ 9.02
TCA-1	15,118	$0.00540	$ 81.68	TCA-1	6,388	$0.00540	$ 34.52
DSMAC-1	15,118	$0.00272	$ 41.08	DSMAC-1	6,388	$0.00272	$ 17.36
REAC-1			$ 2.78	REAC-1			$ 2.78
Total Adjustors			$ 146.89	**Total Adjustors**			$ 63.67
EPR-6 Non-Firm Avoided Cost Payment for Year End Banked kWh Bill Credits			$ 84.64 [5]				
Total Annual Bill			$ 1,833.13 [6]	**Total Annual Bill**			$ 572.78 [6]

SOURCE: APS, November 2012

NOTES:

[1] BD = billing determinant

[2] BSC = basic service charge (based on # of days of service)

[3] Non-Firm Avoided Costs = non-firm avoided power purchase costs, fuel costs, and variable O&M costs (includes line losses)

[4] Adjustment Schedules:

PSA-1 - Power Supply Adjustment PSA including update from 2012 Settlement Agreement that takes effect in 2013

TCA-1 - Transmission Cost Adjustment

DSMAC-1 - Demand Side Management Adjustment Charge

REAC-1 - Renewable Energy Adjustment Charge

[5] SOURCE: Table 12, row (15).

[6] Total Annual Bill = Annual Bill before Adjustors + Total Adjustors – EPR-6 Non-Firm Avoided Cost Payment for Year End Banked kWh Bill Credits

Source: APS data, November 2012

Table 8. Monthly Gross Loads, Behind the Meter Generation, Excess Generation, APS-Delivered Electricity, and Billed kWh: Hypothetical PV Residential Customer on E-12 Rate

On-Site Solar PV System Size and Performance Factor		
[1]	Maximum Hourly Generation (kW-AC)	6
[2]	Maximum Hourly Generation (kW-DC)	7
[3]	Max Gross Hourly Load (kWh)	5
[4]	% of Maximum (= (1)/(3))	1
[5]	Performance Factor (Annual kWh/kW-DC)	1,641

								kWh Load of Typical E-12 Customer w/o Solar Within Each Rate Block				kWh Load of Typical E-12 Customer w Net Metering Within Each Rate Block			
Month	# of Days	Monthly Gross Load of Typical E-12 Customer (kWh)	Solar Behind Meter Generation (kWh)	APS-Delivered (kWh)	Excess Generation (kWh)	EPR-6 Banked kWh Bill Credits	Billed kWh	1st 400 kWh	2nd 400 kWh	Next 2200 kWh	All Add'l kWh	1st 400 kWh	2nd 400 kWh	Next 2200 kWh	All Add'l kWh
					[4]+[5]-[1]	Max([6]-[5],0)	F[(7)>0,[5]-[6],0]								
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10[	[11]	[12]	[13]	[14]	[15]	[16]
1	31	1,065	658	790	383	0	406	400	400	265	0	400	6	0	0
2	28	892	709	629	446	0	183	400	400	92	0	183	0	0	0
3	31	836	1,036	522	721	199	0	400	400	36	0	0	0	0	0
4	30	821	1,119	456	753	497	0	400	400	21	0	0	0	0	0
5	31	1,034	1,221	549	736	684	0	400	400	234	0	0	0	0	0
6	30	1,522	1,132	760	370	294	0	400	400	722	0	0	0	0	0
7	31	2,100	1,016	1,232	148	0	791	400	400	1,300	0	400	391	0	0
8	31	2,176	1,024	1,292	139	0	1,152	400	400	1,376	0	400	400	352	0
9	30	1,763	991	1,025	252	0	772	400	400	963	0	400	372	0	0
10	31	1,123	936	661	475	0	187	400	400	323	0	187	0	0	0
11	30	787	690	540	443	0	97	400	387	0	0	97	0	0	0
12	31	997	591	742	336	0	406	400	400	197	0	400	6	0	0
Total	365	15,118	11,123	9,197	5,202		3,995	4,800	4,787	5,531	0	2,467	1,176	352	0
Summer	184	9,720	6,320	5,519	2,119		2,903	2,400	2,400	4,920	0	1,387	1,163	352	0
Winter	181	5,398	4,803	3,679	3,083		1,092	2,400	2,387	612	0	1,080	12	0	0

Source: APS data, November 2012

Table 9. Reduction in Annual Bill of Hypothetical Solar PV Residential Customer on E-12 Rate

Annual Bill of Typical Customer on E-12 Rate								
Annual Bill w/o Behind the Meter Solar Generation					Annual Bill w/ Behind the Meter Solar Generation and Net Metering			
	BD [1]	Charge ($/BD)	Base Bill (1) x (2)			BD [1]	Charge ($/BD)	Base Bill (4) x (5)
	(1)	(2)	(3)			(4)	(5)	(6)
BSC	365	0.285	$ 104.03		BSC	365	0.285	$ 104.03
Generation					Generation			
Summer					Summer			
1st 400	2,400	$ 0.06170	$ 148.08		1st 400	1,387	$ 0.06170	$ 85.57
2nd 400	2,400	$ 0.10300	$ 247.20		2nd 400	1,163	$ 0.10300	$ 119.82
next 2200	4,920	$ 0.12650	$ 622.34		next 2200	352	$ 0.12650	$ 44.57
All add'l	-	$ 0.13740	$ -		All add'l	-	$ 0.13740	$ -
Winter					Winter			
all kWh	5,398	$ 0.05900	$ 318.51		all kWh	1,092	$ 0.05900	$ 64.45
Total Generation			$ 1,336.14		Total Generation			$ 314.40
Transmission	15,118	$ 0.00520	$ 78.61		Transmission	3,995	$ 0.00520	$ 20.77
Delivery	15,118	$ 0.02700	$ 408.19		Delivery	3,995	$ 0.02700	$ 107.86
System Benefits Charge	15,118	$ 0.00297	$ 44.90		System Benefits Charge	3,995	$ 0.00297	$ 11.86
	Annual Bill before Adjustors		$ 1,971.87			Annual Bill before Adjustors		$ 558.93
Adjustors [4]					Adjustors [4]			
	BD [1]	Charge ($/BD)	Adjustor Charges (1) x (2)			BD [1]	Charge ($/BD)	Adjustor Charges (4) x (5)
	(1)	(2)	(3)			(4)	(5)	(6)
PSA-1	15,118	$0.00141	$ 21.35		PSA-1	3,995	$0.00141	$ 5.64
TCA-1	15,118	$0.00540	$ 81.68		TCA-1	3,995	$0.00540	$ 21.58
DSMAC-1	15,118	$0.00272	$ 41.08		DSMAC-1	3,995	$0.00272	$ 10.85
REAC-1			$ 2.78		REAC-1			$ 2.78
		Total Adjustors	$ 146.89				Total Adjustors	$ 40.86
					EPR-6 Non-Firm Avoided Cost Payment for Year End Banked kWh Bill Credits			$ - [5]
		Total Annual Bill	$ 2,118.76 [6]				Total Annual Bill	$ 599.79 [6]

SOURCE: APS (11/9/12)

NOTES:

[1] BD = billing determinant

[2] BSC = basic service charge (based on # of days of service)

[3] Non-Firm Avoided Costs = non-firm avoided power purchase costs, fuel costs, and variable O&M costs (includes line losses)

[4] Adjustment Schedules:

PSA-1 - Power Supply Adjustment PSA including update from 2012 Settlement Agreement that takes effect in 2013

TCA-1 - Transmission Cost Adjustment

DSMAC-1 - Demand Side Management Adjustment Charge

REAC-1 - Renewable Energy Adjustment Charge

[5] SOURCE: Table 12, row (15).

[6] Total Annual Bill = Annual Bill before Adjustors + Total Adjustors – EPR-6 Non-Firm Avoided Cost Payment for Year End Banked kWh Bill Credits

Source: APS data, November 2012

NAVIGANT

Table 10. Monthly Loads, Behind the Meter Generation, Excess Generation, APS-Delivered Electricity, and Billed kWh: Hypothetical Medium-Size PV Commercial Customer on E-32M Rate

On-Site Solar PV System Size and Performance Factor		
[1]	Maximum Hourly Generation (kW-AC)	178.0
[2]	Maximum Hourly Generation (kW-DC)	204.66
[3]	Max Gross Hourly Load (kWh)	178.0
[4]	% of Maximum (= (1)/(3))	100.0%
[5]	Performance Factor (Annual kWh/kW-DC)	1,530

		Monthly Gross Load of Typical E-32 M Customer w/o Solar PV		Solar Behind Meter Generation (kWh)	APS-Delivered kWh	Excess Solar Generation (kWh)	E-32 M Banked kWh	Monthly Load of Typical E-32 M Customer with Solar		Medium Commercial Customer on E-32 M Rate w/o Solar PV				Medium Commercial Customer on E-32 M Rate w Solar PV			
Month	Days	kW	kWh	kWh	kWh	kWh	kWh	kW	kWh	1st 100 kW	Add'l kW	1st 200 kWh/kW	All Add'l kWh	1st 100 kW	Add'l kW	1st 200 kWh/kW	All Add'l kWh
						[5] + [6] - [4]	Max([7] - [6], 0)		IF([8] > 0,[6] - [7])								
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
1	31	110	53,628	21,056	39,471	6,898	0	110	32,573	100	10	22,091	31,538	100	10	22,091	10,482
2	28	127	52,115	21,296	36,532	5,713	0	127	30,819	100	27	25,479	26,635	100	27	25,479	5,340
3	31	113	53,534	30,409	32,928	9,804	0	99	23,125	100	13	22,583	30,952	99	0	19,817	3,307
4	30	135	60,188	30,514	34,813	5,140	0	102	29,674	100	35	27,067	33,121	100	2	20,461	9,213
5	31	132	61,846	31,103	34,992	4,250	0	96	30,742	100	32	26,308	35,538	96	0	19,144	11,599
6	30	136	68,787	26,998	43,896	2,108	0	128	41,789	100	36	27,100	41,686	100	28	25,637	16,151
7	31	143	72,487	21,833	51,007	352	0	132	50,654	100	43	28,514	43,973	100	32	26,474	24,180
8	31	178	81,919	24,131	58,151	363	0	152	57,788	100	78	35,592	46,326	100	52	30,486	27,302
9	30	148	63,216	29,184	37,353	3,321	0	116	34,032	100	48	29,515	33,702	100	16	23,177	10,855
10	31	141	61,316	29,805	37,612	6,101	0	120	31,511	100	41	28,134	33,181	100	20	23,903	7,608
11	30	115	53,562	25,776	35,363	7,578	0	98	27,785	100	15	23,039	30,523	98	0	19,647	8,139
12	31	121	59,550	20,993	45,220	6,663	0	121	38,557	100	21	24,136	35,414	100	21	24,136	14,420
Total	365	1,598	742,146	313,099	487,338	58,291		1,402	429,047	1,200	398	319,558	422,588	1,193	209	280,452	148,595
Summer	184	876	409,570	163,054	263,012	16,496		744	246,516	600	276	175,164	234,406	596	148	148,822	97,694
Winter	181	722	332,576	150,044	224,327	41,795		658	182,532	600	122	144,394	188,182	597	61	131,630	50,901

Source: APS data, November 2012

NAVIGANT

Table 11. Reduction in Annual Bill of Hypothetical Medium-Size PV Commercial Customer on E-32 M Rate

Annual Bill of Medium Size Commercial Customer on E-32 M Rate									
Annual Bill w/o Behind the Meter Solar Generation					Annual Bill w/ Behind the Meter Solar Generation and Net Metering				
	BD [1]	Charge ($/BD)		Base Bill (1) x (2)		BD [1]	Charge ($/BD)		Base Bill (4) x (5)
	(1)	(2)		(3)		(4)	(5)		(6)
BSC	365	$ 1.324	$	483.26	BSC	365	$ 1.324	$	483.26
Generation					Generation				
Summer					Summer				
1 st 200 kWh/kW	175,164	$ 0.08938	$	15,656.18	1 st 200 kWh/kW	148,822	$ 0.08938	$	13,301.68
Add'l kWh	234,406	$ 0.05145	$	12,060.19	Add'l kWh	97,694	$ 0.05145	$	5,026.36
Winter									
1 st 200 kWh/kW	144,394	$ 0.07432	$	10,731.36	1 st 200 kWh/kW	131,630	$ 0.07432	$	9,782.78
Add'l kWh	188,182	$ 0.03640	$	6,849.83	Add'l kWh	50,901	$ 0.03640	$	1,852.80
Total Generation			$	45,297.55	Total Generation			$	29,963.62
Transmission kW	1,598	$ 1.585	$	2,532.50	Transmission	1,402	$ 1.585	$	2,222.58
Delivery 1st 100 kW (Secondary)	1,200	$ 8.650	$	10,380.00	Delivery 1st 100 kW (Secondary)	1,193	$ 8.650	$	10,319.78
Delivery All Addl kW (Secondary)	398	$ 3.800	$	1,511.61	Delivery All Addl kW (Secondary)	209	$ 3.800	$	795.05
Delivery - All kWh	742,146	$ 0.00649	$	4,816.53	Delivery - All kWh	429,047	$ 0.00649	$	2,784.52
Total Delivery			$	16,708.13	Total Delivery			$	13,899.34
System Benefits Charge	742,146	$ 0.00297	$	2,204.17	System Benefits Charge	429,047	$ 0.00297	$	1,274.27
	Annual Bill before Adjustors		$	67,225.62		Annual Bill before Adjustors		$	47,843.08
Adjustors [4]					Adjustors [4]				
	BD [1]	Charge ($/BD)		Adjustor Charges (1) x (2)		BD [1]	Charge ($/BD)		Adjustor Charges (4) x (5)
	(1)	(2)		(3)		(4)	(5)		(6)
PSA-1	742,146	$0.00141	$	1,047.91	PSA-1	429,047	$0.00141	$	605.81
TCA-1	1,598	$0.812	$	1,297.41	TCA-1	1,402	$0.812	$	1,138.64
DSMAC-1	1,598	$0.9685	$	1,547.46	DSMAC-1	1,402	$0.9685	$	1,358.09
REAC-1			$	103.44	REAC-1			$	103.44
	Total Adjustors		$	3,996.22		Total Adjustors		$	3,205.98
					EPR-6 Non-Firm Avoided Cost Payment for Year End Banked kWh Bill Credits			$	- [5]
	Total Annual Bill		$	71,221.84 [6]		Total Annual Bill		$	51,049.06 [6]

SOURCE: APS , November 2012

NOTES:

[1] BD = billing determinant

[2] BSC = basic service charge (based on # of days of service)

[3] Non-Firm Avoided Costs = non-firm avoided power purchase costs, fuel costs, and variable O&M costs (includes line losses)

[4] Adjustment Schedules:

PSA-1 - Power Supply Adjustment PSA including update from 2012 Settlement Agreement that takes effect in 2013

TCA-1 - Transmission Cost Adjustment

DSMAC-1 - Demand Side Management Adjustment Charge

REAC-1 - Renewable Energy Adjustment Charge

[5] SOURCE: Table 12, row (15).

[6] Total Annual Bill = Annual Bill before Adjustors + Total Adjustors – EPR-6 Non-Firm Avoided Cost Payment for Year End Banked kWh Bill Credits

Source: APS data, November 2012

Table 12. Determination of Avoided Costs and Payments for Banked Excess Generation at Year End

			Proposed 2013 EPR-6 Net Metering Purchase Prices for Year End Banked Excess Generation Bill Credits (based on 9AM to 9PM On-Peak Period)		
			Non-Firm Power ($/kWh)		
[1]			On-Pk	$	0.03536
[2]			Off-Pk	$	0.03367
[3]		Peak vs.Off Peak Hours Weighted Average	Avg	$	0.03427
			Firm Power ($/kWh)		
[4]			On-Pk	$	0.04058
[5]			Off-Pk	$	0.03464
[6]		Peak vs.Off Peak Hours Weighted Average	Avg	$	0.03676
			Average of Proposed EPR-6 Net Metering Purchase Prices ($/kWh) for Firm and Non-Firm Power		
[7]		= 0.5 x ([1]+[4]]	On-Pk	$	0.03797
[8]		= 0.5 x ([2]+[5])	Off-Pk	$	0.03416
[9]		= 0.5 x ([7]+[8])	Avg	$	0.03552

		Year End Banked kWh Bill Credits of Residential Customer on ET-2 Rate			Year End Banked kWh Bill Credits of Residential Customer on E-12 Rate			Year End Banked kWh Bill Credits of Medium Commercial Customer on E-32M Rate		
[10]		On-Pk		2,394	On-Pk		N/A	On-Pk		N/A
[11]		Off-Pk		-	Off-Pk		N/A	Off-Pk		N/A
[12]	= [10]+[11]	Total		2,394	Total		-	Total		-
		EPR-6 Non-Firm Avoided Cost Payment to Residential Solar PV Customer on ET-2 Rate for Year End Banked kWh Bill Credits (1)			EPR-6 Non-Firm Avoided Cost Payment to Residential Solar PV Customer on E-12 Rate for Year End Banked kWh Bill Credits (1)			EPR-6 Non-Firm Avoided Cost Payment to Medium Commercial Solar PV Customer on E-32M Rate for Year End Banked kWh Bill Credits (1)		
[13]	= [10] x [1]	On-Pk	$	84.64	On-Pk		N/A	On-Pk		N/A
[14]	= [11] x [2]	Off-Pk	$	-	Off-Pk		N/A	Off-Pk		N/A
[15]	= [13]+[14]	Total	$	84.64	Total	$	-	Total	$	-
		Solar PV Generation by Residential Solar PV Customer on ET-2 Rate (based on 9AM to 9 PM on peak period)			Solar PV Generation by Residential Solar PV Customer on E-12 Rate (based on 9AM to 9 PM on peak period)			Solar PV Generation by Residential Solar PV Customer on E-12 Rate (based on 9AM to 9 PM on peak period)		
[16]		On-Pk		7,763	On-Pk		7,763	On-Pk		221,415
[17]		Off-Pk		3,361	Off-Pk		3,361	Off-Pk		91,684
[18]	= [16)]+ [17]	Total		11,123	Total		11,123	Total		313,099
		Costs Avoided By Solar PV Generation of Residential ET-2 Customer, Based on Average of 2013 Non-Firm and Firm Purchase Prices APS Proposed in EPR-6 for Peak and Off-Peak Hours ($)			Costs Avoided By Solar PV Generation of Residential E-12 Customer, Based on Average of 2013 Non-Firm and Firm Purchase Prices APS Proposed in EPR-6 for Peak and Off-Peak Hours ($)			Costs Avoided By Solar PV Generation of Commercial E-32M Customer, Based on Average of 2013 Non-Firm and Firm Purchase Prices APS Proposed in EPR-6 for Peak and Off-Peak Hours ($)		
[19]	= [16] x [7]	On-Peak	$	294.76	On Peak	$	294.76	On Peak	$	8,407.12
[20]	= [17] x [8]	Off-Peak	$	114.78	Off Peak	$	114.78	Off Peak	$	3,131.47
[21]	= [16] + [17]	Total	$	409.53	Total	$	409.53	Total	$	11,538.59

NOTES

(1) TOU rate customers who have banked excess bill credits at the end of the year are paid the EPR-6 Net Metering on- and off-peak non-form power purchase prices based on this time period regardless of whether that rate uses the noon to 7 PM or 9AM to 9pm residential rate peak period, or the 11 AM to 9 PM commercial rate peak period. The amounts customers on the standard rates such as E-12 or E-32 are paid for any banked bill credits remaining at the end of the calendar year are based the average EPR-6 Net Metering purchase price.

Sources: APS (November 2012); Appendix B, Table 6; Appendix B, Table 8; and Appendix B, Table 10