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BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS

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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 **ARIZONA PUBLIC SERVICE COMPANY'S NOTICE OF FILING REBUTTAL TESTIMONY**

Arizona Public Service Company provides notice of filing Rebuttal Testimony of Bradley J. Albert, Ashley C. Brown and Leland R. Snook in the above-referenced matter.

RESPECTFULLY SUBMITTED this 7th day of April 2016.

By: ____________________
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REBUTTAL TESTIMONY OF BRADLEY J. ALBERT

On Behalf of Arizona Public Service Company

Docket No. E-00000J-14-0023

April 7, 2016

Table of Contents

REBUTTAL TESTIMONY OF BRADLEY J. ALBERT ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY (Docket No. E-00000J-14-0023)

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND POSITION.

A. My name is Brad Albert. I currently serve as the General Manager – Resource Management for APS. In this position, I have responsibility for overseeing the Company's energy commodity trading activities, long-term resource acquisition, fuel supplies, and fuel transportation.

Q. DID YOU FILE DIRECT TESTIMONY IN THIS DOCKET?

A. Yes.

II. SUMMARY OF TESTIMONY

Q. PLEASE PROVIDE AN OVERVIEW OF YOUR REBUTTAL TESTIMONY.

A. I first address two fundamental flaws in the analysis put forth by TASC witness Mr. R. Thomas Beach. Specifically, Mr. Beach:

1. Fails to consider that grid-scale solar can capture virtually all of the claimed solar value attributes at a fraction of the cost; and

2. Treats all energy produced by rooftop solar – both self-consumed energy and energy exported to the grid – as the same for purposes of establishing value.

I demonstrate that these flaws are so substantial that they invalidate his approach to valuing rooftop solar.

Q. PLEASE SUMMARIZE THE MAJOR FLAWS IN MR. BEACH'S PROPOSED VALUE OF SOLAR (VOS) METHODOLOGY.

A. There are two primary flaws:

- The first is that Mr. Beach fails to consider that grid-scale solar can provide virtually all of the claimed rooftop solar value attributes at a fraction of the cost. The failure to consider alternative means to obtain the same value violates one of the most basic principles of electric utility resource planning: identifying the least cost manner of meeting an identified resource need.

  Mr. Beach assumes that the lowest cost alternative means for a utility to obtain the attributes provided by exported rooftop solar energy is through construction of natural gas-fired generation and that the cost of this alternative must be adjusted to account for the fact that natural gas generation does not provide the same attributes as exported rooftop solar energy on a number of dimensions. But this approach ignores the fact that there is an alternative other than natural gas generation that can provide these same attributes at a significantly lower cost than what Mr. Beach calculates in his analysis – namely, grid-scale solar PV.

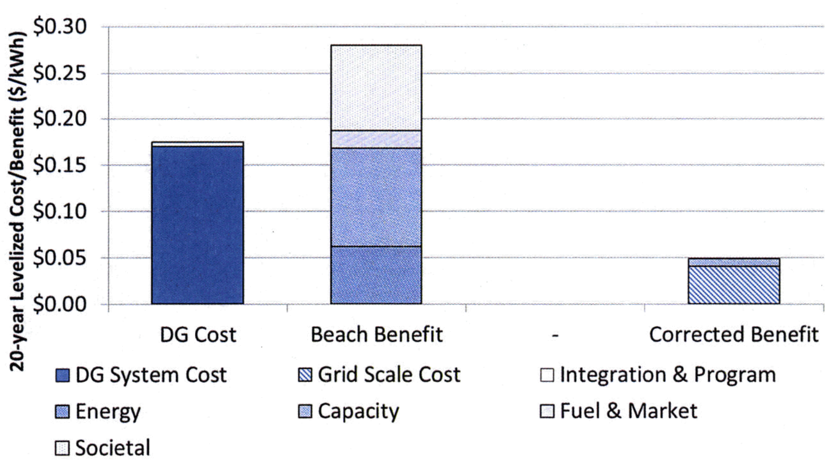
  One must ask: How can Mr. Beach's analysis represent the value of exported rooftop solar energy when his analysis is not based upon the least cost alternative? More importantly: Why should customers be compelled to buy exported rooftop solar energy at a high cost based on Mr. Beach's flawed analysis when there are far less costly ways of obtaining the solar power?

- The second is that Mr. Beach treats all energy produced by rooftop solar—both self-consumed energy and energy exported to the grid—as the same for purposes of establishing value. Mr. Beach calculates a value for the entire rooftop solar system output, and then applies that value on a per kWh basis to exported energy. Exported and self-consumed energy are not, however, the same because they occur in different proportions during different hours of the day. In particular, a small percent of exports occur during hours of peak customer demand on the APS system. A high percent of self-consumed energy occurs during those hours. This is an extremely important difference. The capacity value of any generating resource depends upon how much it generates during periods of peak customer demand. That value will be different for exported energy and self-consumed energy from rooftop solar systems. Any value of rooftop solar analysis that overlooks the differences in the time pattern of exports and self-consumption is critically flawed.

Q. PLEASE SUMMARIZE THE COMBINED EFFECT OF MR. BEACH'S TWO ERRORS.

A. The combined effect of these two errors causes a dramatic overestimation of the value of exported rooftop solar energy. Figure 1 illustrates the magnitude of Mr. Beach's analysis flaws and the impact these flaws have on his cost/benefit test results (from Figure 1 of his direct testimony). Correcting just these two obvious errors completely reverses his conclusions. Contrary to supporting the current cost paid for exported rooftop solar energy, Mr. Beach's analysis, performed correctly, should have concluded that an appropriate rate for exported rooftop solar is no more than 4.9 cents/kWh.

Figure 1 - Corrections Made to Beach Figure 1



III. GRID-SCALE SOLAR AS THE MOST COST-EFFECTIVE WAY FOR CUSTOMERS TO OBTAIN THE VALUE OF SOLAR

Q. PLEASE EXPLAIN THE IMPORTANCE OF IDENTIFYING THE LEAST COST MEANS TO OBTAIN A RESOURCE NEED.

A. Utility service inevitably involves incurring costs. But it should never be forgotten that costs incurred by utilities are ultimately paid by customers. The responsibility to carefully weigh and plan investments to avoid undue cost burdens on customers is one that APS takes very seriously.

In my role as General Manager for Resource Management, I work to ensure our procurement decisions start with a clearly identified resource need and include a robust study of the least cost method for fulfilling that resource need. It would be relatively easy to develop and implement a plan to meet a certain need without regard to cost or without assuring that the plan was the lowest reasonable cost way of meeting that need. But doing so would not be consistent with our responsibility to customers, nor with widely-recognized best practices.

The same is true for a VOS analysis. Simply establishing a value for rooftop solar attributes, without considering a full range of alternative means for obtaining those same attributes, is a woefully deficient planning and procurement process. The first step in any VOS methodology should be to identify the resource need to be fulfilled by solar. The second step should be to analyze available options for satisfying that resource need—for example, grid-scale solar, rooftop solar and conventional generation options. The value of a generating resource such as rooftop solar would be established by identifying the least cost alternative means of meeting that same resource need.

Q. DID MR. BEACH INCLUDE GRID-SCALE SOLAR IN HIS ANALYSIS?

A. No, Mr. Beach did not compare the cost of obtaining the attributes of solar with grid-scale instead of rooftop solar. He only compared the cost of obtaining these attributes with construction of natural gas-fired generation instead of rooftop solar. This is a foundational error in methodology that invalidates his conclusions.

Q. CAN YOU ESTIMATE THE MAGNITUDE OF MR. BEACH'S FAILURE TO ANALYZE GRID-SCALE SOLAR?

A. Yes, assuming Mr. Beach's other conclusions are correct, Mr. Beach would have customers pay 17.9 cents/kWh to obtain 22.4 to 26.3 cents/kWh of value, when they could pay 4.6 cents/kWh or less to obtain the same, or perhaps greater, value.

In Table 11 of Exhibit 2 of Mr. Beach's direct testimony, he summarizes the various value attributes that he ascribes to rooftop solar production (note that for ease of explanation, and without agreeing with its accuracy, I will base my example on the residential rooftop solar values from his table). Mr. Beach's combination of direct and societal benefits range in value from 24.8 to 31.1 cents/kWh. If I were to simply concede that a remotely-located grid-scale solar PV may not provide for his identified transmission and distribution capacity savings and recognize that it would clearly provide for all of the other value attributes that Mr. Beach identifies, the remaining portion of his total benefits range from 22.4 to 26.3 cents/kWh.

Additionally, for purposes of this comparison, I have chosen to exclude energy losses. Any losses actually avoided are small in magnitude. And I believe that a more detailed analysis would find that the incremental generation capacity and energy value benefits of grid-scale solar (versus rooftop solar) will more than offset the energy losses benefit of rooftop solar. What is also becoming more apparent is that some level of rooftop solar energy losses will be experienced, as the exported energy must utilize portions of the APS distribution system to reach other points of consumption. As rooftop solar penetration grows, some of our distribution feeders are actually experiencing an overall net export during certain times of the year.

Through publicly available PPA pricing information, we have a clear picture of what it would cost to obtain these identified benefits from a grid-scale solar PV system. A neighboring utility, NV Energy, recently signed a 20-year PPA with SunPower for a grid-scale solar PV plant near Boulder, Nevada. This facility is expected to be in operation prior to year end 2016. Most importantly, the levelized price of this PPA is 4.6 cents/kWh.[1] There is further evidence that this price is expected to continue to fall in the future as the City of Palo Alto signed a PPA for a grid-scale solar PV plant to be in service by 2021 at a levelized price of 3.6 cents/kWh.[2]

These PPA prices make clear that Mr. Beach's claimed 22.4 to 26.3 cents/kWh of benefits are grossly overstated and that the value of solar can, in fact, be obtained for a fraction of the price that Mr. Beach identifies in his analysis. Although Ms. Kobor focuses on methodology instead of calculating numbers, her analysis is likely to suffer from the same error. Based on the general similarities between Ms. Kobor's and Mr. Beach's methodologies, I think it is reasonable to assume that the consequences of her failure to analyze grid-scale solar would be similar to Mr. Beach's failure.

Q. DOES MR. BEACH EXPLAIN WHY CUSTOMERS SHOULD PAY 17.9 CENTS PER KWH FOR THE VALUE OF SOLAR WHEN THEY COULD PAY 4.6 CENTS, OR LESS?

A. I am not able to discern a justification for this methodological flaw in Mr. Beach's testimony, or in the filed testimony of any other party. This failure to consider grid-scale solar as a resource alternative gives rise to two primary questions: "How can the value

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[1] *See* Application of Nevada Power Co. d/b/a NV Energy for Approval of the First Amendment to Its 2014 Emissions Reduction & Capacity Replacement Plan As It Relates to Two New Renewable Energy Purchased Power Agreements, Docket No. 15-07003 (Nev. Pub. Util. Comm'n Sept. 9, 2015).

[2] *See* Staff Report from City of Palo Alto Finance Committee on Wilsona Solar Renewable Power Purchase Agreement (Feb. 16, 2016), http://www.cityofpaloalto.org/civicax/filebank/documents/50920 (approved on Mar. 21, 2016, http://www.cityofpaloalto.org/civicax/filebank/documents/51640).

of the exported rooftop solar energy possibly be 22.4 to 26.3 cents/kWh when this same value can be obtained for 4.6 cents/kWh or less?" And, "Why should APS customers pay any more for this energy than what the best alternative would be for producing this energy?"

Other factors further underscore the magnitude of the difference between grid-scale and rooftop solar in obtaining the value of solar. This comparison between the two solar applications was kept at a high level to illustrate the point. A more detailed analysis would need to recognize the higher capacity, energy and curtailability values of grid-scale PV (all of which I described in my direct testimony). Furthermore, the cost of grid-scale solar PV (the 4.6 cents/kWh or lower identified above) should only be viewed as a "cap" on the value. It is possible that APS's current and future fleet of generating assets (both conventional and renewable) may be able to produce this energy at an even lower cost than the cited PPAs.

The importance of using grid-scale solar as a reference point becomes clear using Mr. Beach's own charts. In his Exhibit 2, Mr. Beach performs four different cost/benefit tests. The results of Mr. Beach's four cost/benefit tests for residential rooftop solar applications are summarized in his Figure 1 and Table 1. When one corrects the flaw in Mr. Beach's methodology by including grid-scale solar prices, the conclusions from these cost/benefit tests reverse. Instead of being cost-effective, residential rooftop solar no longer passes these cost/benefit tests (with the exception of the participant test which only looks at cost/benefit from the perspective of the participating rooftop solar customer). Mr. Beach's failure to consider grid-scale solar as an alternative means to acquire the value of solar is a profound methodological flaw that raises serious questions about whether his study is reliable or his conclusions are valid.

Q. DOES MR. BEACH GIVE ANY RATIONALE AS TO WHY GRID-SCALE IS NOT AN APPROPRIATE ALTERNATIVE ON WHICH TO BASE THE VALUE OF ROOFTOP SOLAR?

A. Yes. On page 29 of his testimony, Mr. Beach contends that grid-scale and rooftop solar are not comparable because grid-scale solar is a wholesale product, while rooftop solar is a retail product. Mr. Beach also contends that energy exported from rooftop solar should be considered a retail product because it displaces retail power provided by the utility.

Q. DO YOU AGREE WITH MR. BEACH'S ASSERTION THAT EXPORTED ENERGY SHOULD BE CONSIDERED A RETAIL PRODUCT?

A. No, I do not. Exported energy is the quintessential wholesale product. It is sold to the utility, which in turn sells it to customers. Exported energy only displaces retail power in the same way that any power purchased from a third party supplier does—instead of delivering one electron to complete the retail transaction, the utility uses a different electron.

Displacing one source of electrons with purchases from another source does not change the nature of the underlying transaction. The electrons exported from rooftop solar look exactly the same to the non-solar customer as the electrons from the grid-scale solar or any other wholesale power source. Both are first sold to the utility at wholesale before the utility sells them in a subsequent retail transaction. Additionally, it is exactly those wholesale power sources (either grid-scale solar, conventional generating units or purchases from wholesale power suppliers) that would be used to replace the energy exported from the rooftop solar systems.

Q. DOES MR. BEACH GIVE ANY TECHNICAL REASONS WHY GRID-SCALE AND ROOFTOP SOLAR ARE NOT COMPARABLE?

A. No, aside from policy issues addressed below, Mr. Beach appears to concede that grid-scale solar can be adjusted so that it is comparable to rooftop solar from a technical and operational perspective. On page iv of his direct testimony, Mr. Beach states, "Thus, for a fair comparison between the two resources, at a minimum one must add to the cost of utility-scale solar the marginal costs associated with delivering this power to the customers that can be served by solar DG located on their own roofs. Furthermore, these resources differ in their value for Renewable Energy Standard compliance, and rooftop solar provides additional societal benefits to the local environment and economy."

Later in his testimony, however, Mr. Beach notes that rooftop solar would not bring RES compliance value to APS.[3] Setting aside for now the policy question of whether local environmental or economic benefits should be factored into rates, Mr. Beach statement suggests that grid-scale solar, adjusted for operational differences associated with energy losses and transmission and distribution infrastructure, would be equivalent to rooftop solar in terms of direct benefits. He does not, however, quantify such a comparison.

Q. WHAT POLICY REASONS DOES MR. BEACH GIVE TO PREFER ROOFTOP SOLAR OVER GRID-SCALE SOLAR?

A. On pages 30 and 31 of his direct testimony, Mr. Beach offers policy reasons why rooftop solar is preferable to grid-scale solar. These include claims that rooftop solar has a greater economic benefit than grid-scale solar, the resiliency of local power

[3] *See* R. THOMAS BEACH, THE BENEFITS AND COSTS OF SOLAR DISTRIBUTED GENERATION FOR ARIZONA PUBLIC SERVICE 2016 UPDATE, page 8 (2016). Moreover, because APS does not purchase RECs from new rooftop solar customers, new rooftop solar installations do not contribute to APS's RES compliance requirements.

production, and alleged habitat impacts of grid-scale solar installations. APS witness Ashley Brown rebuts each of these policy claims in his direct and rebuttal testimony. In any event, Mr. Beach offers no explanation why these policy assertions justify customers paying 17.9 cents/kWh for the value of solar when they could pay 4.6 cents/kWh, or less.

Mr. Beach also argues that important policy considerations support pro-rooftop solar regulatory environments, including attracting new capital, new competition, grid services, enhanced reliability and resiliency, high-tech synergies, customer engagement, and self-reliance. None of these change the fact that grid-scale solar can acquire all the same value provided by rooftop solar that forms the basis of Mr. Beach's quantitative analysis.

In addition, Mr. Brown makes clear that the very policies Mr. Beach references actually harm the future of solar, and stifle alternative forms of distributed technologies. Contrary to Mr. Beach's assertion, the long-term future of rooftop solar and the policy considerations he identifies are better served by modernized rate design that causes distributed technologies to compete on the basis of cost rather than on their ability to arbitrage rate subsidies as discussed by Mr. Brown.

IV. <u>SEPARATE TREATMENT OF ROOFTOP SOLAR SELF-CONSUMPTION AND EXPORTS</u>

Q. BEYOND IGNORING THE COST-EFFECTIVENESS OF GRID-SCALE SOLAR, WHAT OTHER MAJOR FLAW UNDERMINES MR. BEACH'S VOS METHODOLOGY?

A. Mr. Beach treats all rooftop solar production—both energy that is consumed immediately by the customer and energy that is exported to the grid—as the same in developing a value of exported solar energy. This is not, however, an appropriate way to develop a value for exported energy. To assess the value of exported energy itself, the only appropriate course is to focus exclusively on the value and benefits attributable to exported energy only, not those provided by the self-consumed energy.

Q. MANY OF THE WITNESSES IN THIS PROCEEDING ASSERT THAT ROOFTOP SOLAR CUSTOMER SELF-CONSUMPTION AND EXPORTS SHOULD BE CONSIDERED SEPARATELY. DO YOU AGREE?

A. Yes, I do. And in fact, almost all of the parties to this case contend that this proceeding is about valuing only the exported rooftop solar energy. Specifically, Staff witness Howard Solganick, Ms. Kobor, and Vote Solar's second witness, Mr. Volkmann, as well as Mr. Beach all concur that the VOS methodology should establish the right value for exported energy. This is a logical distinction. Power supplied by the utility to the consumer is a retail product and should be priced at retail rates that are determined through a Cost of Service Study (COSS).

By contrast, power supplied by the customer to the utility is a wholesale product and should be priced at wholesale rates determined in the VOS process. What is critical, however, is to appropriately account for the very real differences between the two categories of rooftop solar energy. To establish a value for exported energy, one must look at the benefits of exported energy only, not at the total rooftop solar output.

Q. DO THE SELF-USE AND EXPORT PORTIONS OF THE ROOFTOP SOLAR OUTPUT HAVE DIFFERENT VALUES?

A. Absolutely. The value of energy to the utility varies by hour and the capacity value of a generating resource depends upon its output during the hours of peak customer demand. It is logical that rooftop solar customers will self-consume more of their solar output at times when it is more valuable. On hot summer afternoons at 5 p.m., energy is more valuable precisely because consumption is high and demand is greater relative to supply. It is also clear that customers will export more energy at times when it is less valuable, i.e. the non-summer midday, when consumption, and therefore demand, is lower. To value export energy the same as one values self-consumption grossly overstates the value of the exported rooftop solar energy.

Further, exported energy adds another layer of intermittency. Solar is already an intermittent resource due to weather-related conditions such as cloud cover. Assessing the capacity benefits of exported energy requires accounting for another factor—customer usage. Since the self-use always comes first (i.e., the export only occurs after first satisfying the customer's total load requirements), passing cloud events and/or increases in customer usage impact the exported energy first. It is difficult, if not impossible, to establish any capacity value after considering this double layer of intermittency.

Q. CAN YOU QUANTIFY THE DIFFERENCE BETWEEN SELF-CONSUMED AND EXPORTED ENERGY?

A. Using actual meter data on the peak load day of 2015 (August 15), APS observed that at the time of peak customer consumption (5 p.m.), only 5% of rooftop solar energy was being exported (as a percent of nameplate rating). And if one looks at the amount of rooftop solar energy exported during the top 90 hours,[4] the percentage only rises to 7%. Yet Mr. Beach attributes a capacity value of 36.2% to 53.2% to this exported energy (*see* Mr. Beach's Table 5).

[4] APS uses a top 90 hours analysis as a proxy for a full-blown Effective Load Carrying Capability (ELCC) analysis to estimate capacity value.

Q. WHAT IS THE EFFECT ON MR. BEACH'S ANALYSIS IF THE CAPACITY VALUE IS CORRECTED TO REFLECT THAT ONLY 5% TO 7% OF ROOFTOP SOLAR ENERGY IS EXPORTED AT THE PEAK PERIOD?

A. The effect is dramatic, and is critical to accurately perform any VOS analysis. If I were to accept the rest of Mr. Beach's methodology in Tables 4, 5 and 6, and only account for the fact that 5% rooftop solar energy was being exported at the time of peak customer consumption in 2015, Mr. Beach's claimed savings for generation, transmission, and distribution capacity from exported energy would drop from 10.6 cents/kWh to 1.2 cents/kWh. Looking at the top 90 hours, these capacity values drop from 10.6 cents/kWh to 1.7 cents/kWh.

Q. HAS APS COLLECTED AND ANALYZED DETAILED CUSTOMER DATA IN ORDER TO UNDERSTAND THE TRUE NATURE OF SELF-USE AND SOLAR EXPORTS?

A. Yes, we have analyzed the available data for 28,826 residential customers who had rooftop solar systems that were operating for all of 2015. We excluded customers for whom we did not have complete information and customers that installed rooftop solar after January 1. At the end of 2015, we had 39,171 rooftop solar residential customers on our system, so the analysis covers a large portion of our current rooftop solar customer base, and can be used to accurately understand and characterize solar self-consumption and exports in our service territory. It is significant that this represents real system conditions based on actual metered data; it is not modeled or projected or subject to assumptions.

Q. PLEASE SUMMARIZE YOUR ANALYSIS.

A. Figure 2 presents a high level summary of the analysis. The nameplate capacity of the studied systems was 200 MW_{DC}, or 170 MW_{AC}.[5] During 2015, our sample rooftop solar customers generated 339,356 MWhs from their rooftop solar units. Of that, 156,136 MWhs (or 46%) were self-consumed and 183,220 MWhs (or 54%) were exported to the grid for use by our non-solar customers. At APS's peak load hour, 5 p.m. on August 15, 2015, these rooftop solar units were producing 72.8 MWs and these customers were self-consuming 64.0 MWs, therefore exporting 8.8 MWs to the grid. And over APS's 90 highest net system load hours for the entire year (net of grid-scale renewable energy contribution), rooftop solar customers exported an average of 11.5 MWs to the grid. The maximum export during any one hour was 128.6 MWs which occurred on April 16 at 1 p.m.

One of the most interesting aspects of this data is that it indicates these rooftop solar customers actually export more energy over the course of the entire year than they use to offset their own consumption. This is in contrast to the statement that Mr. Beach makes on page 13 of his direct testimony that only 30 – 40% of the total rooftop solar output is exported. The actual data indicates that these rooftop solar systems look more like a wholesale generator than an "energy efficiency" device.

[5] Rooftop solar produces direct current, or DC power. Alternating current (or AC) power is what flows on the grid. Before rooftop solar energy is exported to the grid, it is converted to AC power. Unless otherwise noted, all capacity measurements in this testimony are stated in AC.

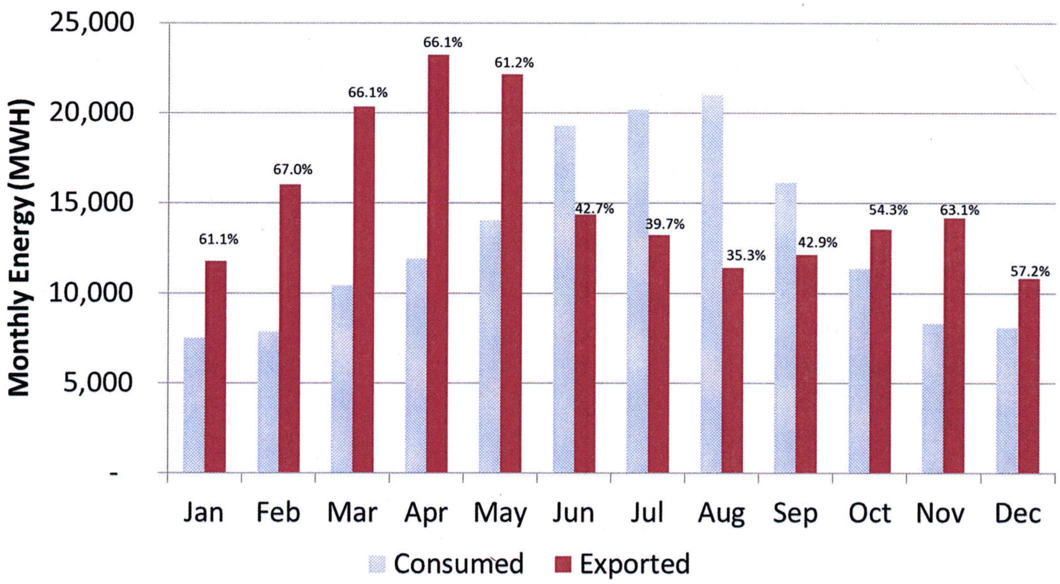
Figure 2 – Summary of Residential Solar DG Analysis

Residential Systems Included	28,826
Nameplate Rooftop Solar Capacity (MWs-AC)	170
Total Rooftop Solar Production at Peak Load Hour (MWs)	72.8
Self-Consumption at Peak Load Hour (MWs)	64.0
Total Exported at Peak Load Hour (MWs)	8.8
Maximum Export on April 16, 2015 at 1 p.m. (MWs)	128.6
Average Exported Over Top 90 Hours (MWs)	11.5

Q. PLEASE PROVIDE MORE INFORMATION ABOUT THE SEASONAL NATURE OF ROOFTOP SOLAR GENERATION.

A. Over the course of the year, exported rooftop solar energy was highest in April and May, with rooftop solar customers exporting about two-thirds of the total energy produced during these months. During the summer period of June through September, total solar generation was still high, but rooftop solar customers self-consumed about 60% and exported 40% to the grid. The primary difference between the summer and non-summer periods is the degree of customer usage. During the summer, customers consume more with air conditioning units running. In the non-summer period, they consume less and more rooftop solar energy is available to be exported to the grid. Figure 3 provides the amount of self-consumption and export energy on a monthly basis, as well as the percentage that is exported on a monthly basis.

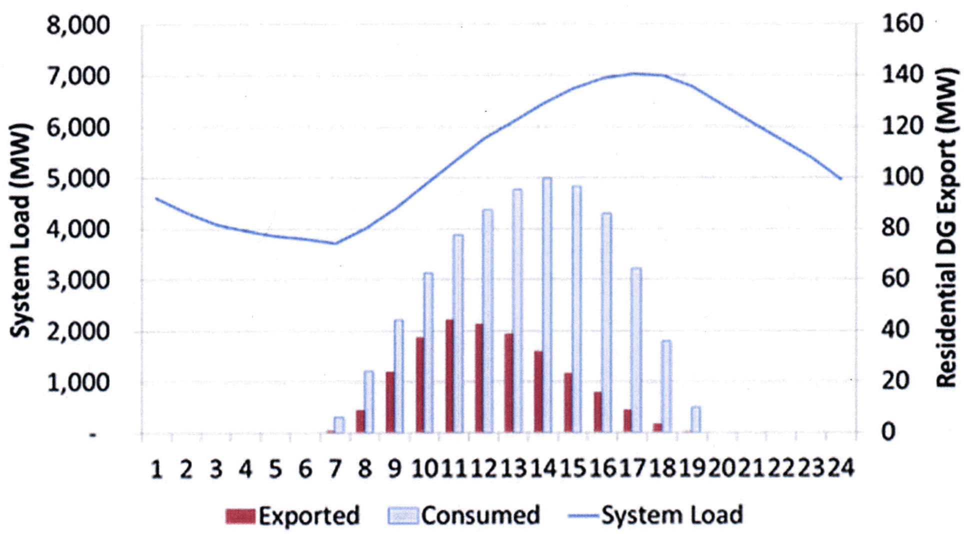
Figure 3 - Residential Rooftop Solar Self-Consumption and Export



Q. ON APS'S PEAK DAY IN 2015, HOW DID ROOFTOP SOLAR GENERATION, BOTH SELF-CONSUMED AND EXPORTED, COMPARE TO APS'S LOAD SHAPE OVER THE COURSE OF THE DAY?

A. Figure 4 sets forth the relevant data. During all hours of rooftop solar production, our rooftop solar customers self-consumed more energy than they exported to the grid. The maximum export occurred in the morning when APS system load was relatively low, and steadily declined after 11 a.m. for the rest of the day as customer consumption continued to build. During the late afternoon hours, when APS customer consumption was peaking, rooftop solar customers self-consumed the vast majority of their rooftop solar generation and exported very little. And, when APS hit its annual peak load at 5 p.m., rooftop solar was exporting only 8.8 MWs to the grid, or about 5% of the aggregate nameplate capacity of all residential rooftop solar systems. Over the course of the day, rooftop solar customers self-consumed 74% of their solar output, and only exported 26% to the grid.

Figure 4 – Residential Rooftop Solar on August 15, 2015



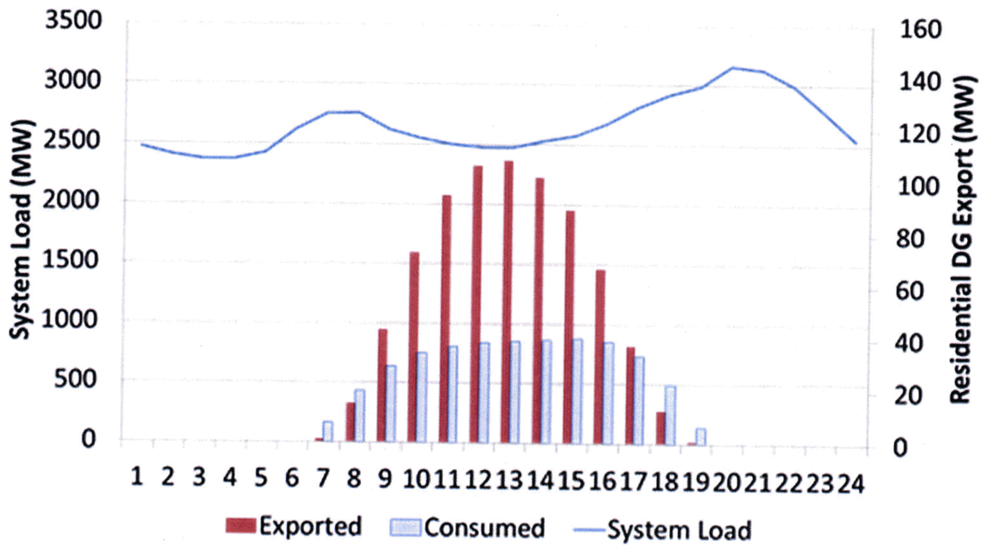
Q. WHAT CONCLUSION DO YOU DRAW FROM THE FACT THAT ROOFTOP SOLAR ONLY EXPORTED 8.8 MWS AT APS'S PEAK?

A. This data makes it clear that the vast majority of capacity-related benefits from rooftop solar are captured by rooftop solar customers themselves. There is very little generation, transmission, or distribution capacity related benefits left to be allocated to the export portion of the rooftop solar energy production.

Q. PLEASE EXPAND ON YOUR DISCUSSION OF HOW ROOFTOP SOLAR GENERATION WAS SELF-CONSUMED AND EXPORTED DURING A SHOULDER MONTH DAY.

A. During non-summer (or shoulder) periods, APS's system load is much lower than it is in the summer. During most solar hours of the day, rooftop solar customers export much more than they self-consume. The month of April provides a good example of what happens during a shoulder month. Figure 5 shows that on a typical day in April 2015, our rooftop solar customers' self-consumption pattern was fairly steady from about 9 a.m. to 5 p.m., and their exports were the highest at midday while system loads were dipping.

Figure 5 – Residential Rooftop Solar on a Typical April Day (2015)



Q. WHAT DO YOU CONCLUDE FROM THE RELATIVELY LARGE AMOUNT OF ROOFTOP SOLAR ENERGY EXPORTED DURING LOW LOAD PERIODS?

A. I conclude that there is a significant mismatch between when rooftop solar customers export to the grid and when the energy is most valuable. Due to low demand during shoulder periods, the relatively high supply of exported rooftop solar energy is simply not very valuable.

Q. IS IT APPROPRIATE TO USE THE SHAPE OF THE TOTAL SOLAR OUTPUT OF A RESIDENTIAL ROOFTOP SOLAR SYSTEM TO DEVELOP THE VALUE OF THE EXPORT?

A. No, it is entirely inappropriate to take a value derived from the total rooftop solar output and apply it to exported energy. The value of exported energy must be based on the specific timing of when it is delivered to the grid.

Q. IN FIGURE 1 OF MR. BEACH'S TESTIMONY, HE SHOWS THAT RESIDENTIAL ROOFTOP SOLAR PASSES ALL FOUR COST-BENEFIT TESTS AND CONCLUDES THAT IT IS A COST EFFECTIVE RESOURCE. DO YOU AGREE WITH HIS CONCLUSION?

A. Absolutely not. If Mr. Beach had correctly accounted for the limited value of exported energy, residential rooftop solar would have failed three of the four tests, and the conclusion would have been that it is not a cost effective resource for anyone other than the rooftop solar customer. The only cost test that would still show a favorable result is the participant test, which only looks at the cost/benefit from the perspective of the participating rooftop solar customer.

In Figure 6 below I show what Mr. Beach should have concluded if he had applied his methodology correctly. It captures all of the separate value components that Mr. Beach claims are provided by solar, and adjusts the total to reflect a capacity value that is based on exported rooftop solar energy only. Note that Figure 6 only accounts for two of the flaws that I have identified in Mr. Beach's methodology.

Figure 6 – Summary of Corrections Made to Mr. Beach's Table 11

(all numbers are in cents/kWh)

Value Category	Residential Values (avg. of south + west)	Comments	Adjusted Value
Energy	6.2	Provided by grid-scale solar (energy losses not included, see note below)	-
Fuel Price Hedging	0.9	Provided by grid-scale solar	-
Market Price Mitigation	1.0	Provided by grid-scale solar	-
Capacity	7.0	Provided by grid-scale solar	-
Transmission	1.3	Corrected for lower export capacity contribution during peak hours	0.2
Distribution	2.3	Corrected for lower export capacity contribution during peak hours	0.6
Carbon	3.3	Provided by grid-scale solar	-
Criteria Pollutants	1.1	Provided by grid-scale solar	-
Water	0.2	Provided by grid-scale solar	-
Local Economic Benefits	4.7	Provided by grid-scale solar	-
Total	**28.0**		
Grid-scale solar (unadjusted)		Not adjusted for higher capacity value, energy value or curtailability benefits. The value is the average of the two grid-scale PPA prices cited earlier in this rebuttal testimony.	4.1
Adjusted Total			**4.9**

- Note that energy losses were excluded from this analysis. I believe that the higher generation capacity, energy and curtailability values of grid-scale solar would more than offset the energy loss benefits of rooftop solar.

Q. IS 4.9 CENTS PER KWH THE VALUE OF SOLAR ACCORDING TO APS?

A. No. This calculation only shows a corrected version of Mr. Beach's analysis. It is clear that a grid-scale solar system provides a higher value product than exported rooftop solar energy in terms of both energy value and generation capacity value. The base grid-scale solar value is consistent with a published grid-scale solar PPA rate for the higher-value grid-scale product. To ensure an accurate comparison with the lower-value rooftop solar product, the PPA rate would need to be adjusted downward to reflect the lower energy and capacity values provided by rooftop solar. I discuss these adjustments in greater detail in my direct testimony. For this simple comparison, however, I have not performed the calculations necessary to show the impact on the overall value from these and other variables.

V. SPECIFIC CONCERNS REGARDING MR. BEACH'S REPORT

Q. ASIDE FROM CONFLATING SELF-CONSUMED AND EXPORTED ENERGY, AND THE FAILURE TO CONSIDER GRID-SCALE SOLAR, DO YOU HAVE OTHER CONCERNS WITH MR. BEACH'S ANALYSIS?

A. Yes, as a general matter, the analysis is based on numerous predictions about what might happen in the future, including both load growth and customer behavior. Mr. Beach relies on projections APS made regarding future capacity needs in connection with APS's 2014 Integrated Resource Plan. This was appropriate for purposes of assessing future resource needs at that time. As time passes, APS updates its resource plans with and makes procurement decisions based on the best available information. But only actual costs are used to set rates; rates are not set on the future projections of resource values.

Moreover, Mr. Beach includes societal values without acknowledging that societal values are not included in rates and cannot be accurately quantified. Finally, Mr. Beach relies on numerous flawed assumptions designed to produce an over-the-top estimate of the value of solar. Mr. Beach's value of solar methodology appears to exemplify many of the flaws associated with attempting to set rates based on a long-term resource valuation. I provide examples below.

Q. WHAT FLAWS EXIST WITHIN MR. BEACH'S ENERGY SAVINGS METHODOLOGY?

A. Mr. Beach's assessment of energy value contains several flaws:

- Mr. Beach readily acknowledges that his natural gas prices are out of date. Although Mr. Beach claims that correcting utility rate escalation can address this problem, this is not true. Natural gas only contributes a portion of the energy costs in APS's retail rates. The relationship between natural gas prices and retail rates is not one to one, and reducing Mr. Beach's retail rate escalation cannot correct for his use of inaccurate natural gas prices.

- Mr. Beach fails to account for the possibility of negative pricing. As discussed in my direct testimony, negative pricing involves APS receiving compensation for taking excess power from neighboring utilities. It is inaccurate to assume, as Mr. Beach does, that rooftop solar will permit ever-increasing energy savings over time when, in fact, rooftop solar energy might hinder APS's ability to take advantage of negative prices and, hence, the value of the rooftop solar export energy could be negative during some hours in the future.

- Mr. Beach's energy savings analysis includes non-existent carbon tax costs. Including potential future carbon costs is the appropriate, conservative approach when planning resources. But it is inappropriate to include non-existent costs when setting rates.

Q. WHAT ARE THE FLAWS IN MR. BEACH'S CLAIMS REGARDING TRANSMISSION CAPACITY SAVINGS?

A. Mr. Beach generically estimates transmission capacity savings based on generation capacity savings. This methodology suffers from the flaw relating to exported energy discussed above. In addition, it is a generic assessment. APS's recently filed Biennial

Transmission Assessment provided a detailed study of actual transmission projects that might be deferred or avoided by rooftop solar and found a single potential project that could be deferred and that most of that result was due to the impact of energy efficiency programs, not rooftop solar.[6] Compared to Mr. Beach's generic analysis, APS's specific study offers a more accurate conclusion regarding actual projected transmission capacity savings.

Q. IS MR. BEACH'S METHOD FOR CALCULATING DISTRIBUTION SAVINGS FLAWED?

A. Yes. Mr. Beach's method for calculating distribution savings assumes that on-peak capacity related savings occur, and that for every MW of peak load reduction, a MW of distribution can be deferred. Unless APS can actually reduce distribution expenditures due to rooftop solar, these savings will never occur.

Given that we have a large distribution system already in place, and that we are unlikely to reduce new construction on the chance that future customers might install solar, the opportunity for distribution savings is very limited. APS has undertaken a detailed evaluation of its distribution system and has found almost no opportunity for significant distribution savings, as was documented in the R.W. Beck and SAIC studies previously discussed in this docket.

If distribution savings are valued at all, they need to be based on detailed analysis of the distribution system that will produce verified savings, and not Mr. Beach's system average approach in which the purported savings will never materialize. This kind of

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[6] ARIZ. PUB. SERV. CO., TECHNICAL STUDY ON THE EFFECTS OF DISTRIBUTED GENERATION AND ENERGY EFFICIENCY ON FUTURE TRANSMISSION NEEDS, Docket No. E-00000D-15-0001 (Jan. 29, 2016).

analysis is particularly needed if the focus is on exported energy that has even less contribution at the time of system peak.

Q. MR. BEACH CONTENDS THAT ROOFTOP SOLAR SHOULD BE VALUED USING INCREMENTAL RATHER THAN SYSTEM AVERAGE LOSSES. DO YOU AGREE?

A. No. In my direct testimony I explain why we should not use incremental losses. And considering that self-consumption occurs during higher load times, and exports are delivered at lower load times when losses are lower, it makes even less sense to use incremental losses. If I were to use our average system energy loss rate of 7% versus the incremental loss rate of 12% used by Mr. Beach, this would reduce his calculated energy value by 0.3 cents/kWh.

Q. MR. BEACH APPLIES A 15% RESERVE MARGIN MULTIPLIER TO THE CAPACITY VALUE. IS THAT CORRECT?

A. No. That is already accounted for in the way APS develops ELCC capacity value, so applying it in the way that Mr. Beach does in his analysis amounts to double-counting this value. Eliminating this value from Mr. Beach's calculation reduces his generation capacity value by 1 cent/kWh.

Q. MR. BEACH ASCRIBED NEARLY ONE CENT PER KWH OF FUEL HEDGING VALUE TO ROOFTOP SOLAR GENERATION. IS THAT APPROPRIATE?

A. Absolutely not. It appears that Mr. Beach might have misunderstood or misinterpreted information acquired from APS to develop this value. The data request response that Mr. Beach relies upon, included as Attachment BJA-1RB to this testimony, shows an approximate annual average of $50 million as the difference between APS's hedged cost of natural gas and the price of natural gas on the spot market for the years 2003 through 2012. However, this is not the same as APS's costs to hedge natural gas.

Instead, it costs APS fractions of a cent per MMBtu to hedge natural gas prices. It is this cost to hedge natural gas that could be the only relevant value in a value of solar analysis. To the extent rooftop solar would assist APS in hedging natural gas prices (which Mr. Beach asserts, but does not prove), APS would only avoid its hedging costs, not the difference between the hedged cost of natural gas and the price of natural gas on the spot market. Hedge value should not be included in the value of rooftop solar calculation in the first place, but even if it was, it would truly be negligible.

Q. MR. BEACH ALSO ASCRIBED ONE CENT PER KWH VALUE OF MARKET PRICE MITIGATION VALUE TO ROOFTOP SOLAR. IS THAT APPROPRIATE?

A. Absolutely not. Mr. Beach claims regarding market price mitigation rely on highly theoretical numbers from a 2010 study that cannot be considered in this VOS docket. The 2010 study is based on outdated market information and prices. Significant changes to the wholesale power market, including fundamental shifts in natural gas supply caused by hydraulic fracturing technology, make any study in 2010 essentially useless for accurately assessing future market trends.

Perhaps more importantly, the study upon which Mr. Beach relies considers all solar, not just rooftop solar, much less exported energy. And the study highlights additional costs caused by solar penetration, including the need for gas turbine "peaking units" and the potential need for "expensive generation to be brought on line" to make up for forecast errors.[7] APS did not separately investigate details related to the additional costs referenced in the NREL study. What is notable, however, is that Mr. Beach appears to ignore the warning in this study upon which he relies regarding potential costs

[7] *See* NREL AND GE CONSULTING, IMPACT OF HIGH SOLAR PENETRATION IN THE WESTERN INTERCONNECTION, PAGE 7-8 (2010), http://www.nrel.gov/docs/fy11osti/49667.pdf.

associated with solar, and instead only references those aspects of the study that support his position. Finally, assuming market price mitigation actually does occur, even Mr. Beach acknowledges that the largest reductions have already occurred.

Q. TASC WITNESS BEACH AND VOTE SOLAR WITNESS KOBOR ASSERT THAT ENVIRONMENTAL BENEFITS OF ROOFTOP SOLAR EXPORTS SHOULD BE INCLUDED IN THE VOS ANALYSIS. MS. KOBOR GOES ON TO SAY THAT THE ACC REQUIRES UTILITIES TO USE THE SOCIETAL COST TEST IN EVALUATION OF DSM PROGRAMS AND THAT THE RULES SPECIFICALLY ADDRESS THE INCLUSION OF ENVIRONMENTAL IMPACTS. DOES THE COMMISSION REQUIRE YOU TO MONETIZE ENVIRONMENTAL IMPACTS?

A. No. Ms. Kobor is correct that APS is required to perform a DSM cost-effectiveness test using Staff's Societal Cost Test methodology.[8] That methodology quantifies environmental impacts (i.e., reduced tons of NOx, Sox, CO2, and particulates), but does not assign a monetary cost to them. Likewise, both TASC's and Vote Solar's methodology would have us give monetary credit for purported fuel or market price mitigation, hedging expenses, distribution savings, and other externalities savings, but those are not included in Staff's Societal Cost Test either.

Q. DO VOTE SOLAR AND TASC ADVOCATE ANY OTHER ITEMS FOR CALCUATING THE VALUE OF SOLAR THAT WOULD BE IN CONFLICT WITH THE WAY DSM TESTS ARE DONE IN THIS JURISDICTION?

A. Yes, there are at least two. Ms. Kobor advocates using a marginal loss rate and a societal discount rate (approximately equal to the inflation rate). Our Societal Cost Test in practice uses an average loss rate and after tax weighted cost of capital as the discount rate. Further, DSM tests in Arizona quantify societal costs, but do not monetize them.

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[8] *In re* Appl. of Ariz. Pub. Serv. Co. for Approval of the Company's 2012 Demand Side Mgmt. Implementation Plan, Decision No. 73089 (Ariz. Corp. Comm'n Apr. 5, 2012).

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.

REBUTTAL TESTIMONY OF ASHLEY C. BROWN

On Behalf of Arizona Public Service Company

Docket No. E-00000J-14-0023

April 7, 2016

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REBUTTAL TESTIMONY OF ASHLEY C. BROWN
ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY
(Docket No. E-00000J-14-0023)

I. <u>INTRODUCTION</u>

Q. PLEASE STATE YOUR NAME, OCCUPATION, AND ADDRESS.

A. My name is Ashley C. Brown. I am Executive Director of the Harvard Electricity Policy Group (HEPG) at the Harvard Kennedy School, at Harvard University. HEPG is a "think tank" on electricity policy, including pricing, market rules, regulation, environmental and social considerations. HEPG, as an institution, never takes a position on policy matters, so my testimony today represents solely my opinion, and not that of the HEPG or any other organization with which I may be affiliated.

Q. HAVE YOU PREVIOUSLY TESTIFIED IN THIS PROCEEDING?

A. Yes. I submitted direct testimony in this docket.

Q. ON WHOSE BEHALF DO YOU OFFER TESTIMONY?

A. On behalf of the Arizona Public Service Company.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. The purpose of my testimony is to rebut direct testimony provided by Briana Kobor, witness for Vote Solar, and Thomas Beach, witness for The Alliance for Solar Choice, in this matter.

Q. PLEASE PROVIDE AN OVERVIEW OF YOUR REBUTTAL TESTIMONY.

A. My testimony is composed of two parts. The first shows that a "value of solar" approach to pricing rooftop solar is not appropriate, and Mr. Beach and Ms. Kobor do not offer a rationale for taking such an approach to pricing rooftop solar. The second part, offered on the assumption that the Commission wants to examine how a "value" approach to rooftop solar might work, is an analysis of why the methods and considerations suggested by Mr. Beach and Ms. Kobor are inappropriate, incomplete, and, in many cases, simply inaccurate.

II. HOW THE TESTIMONY OF MS. KOBOR AND MR. BEACH DEMONSTRATES THE PROBLEMS WITH A VALUE OF SOLAR ANALYSIS.

Q. PLEASE DISCUSS THE ARBITRARINESS OF MR. BEACH AND MS. KOBOR'S PROPOSED VALUE OF SOLAR ANALYSIS.

A. A "value of solar" analysis is inherently too uncertain and arbitrary to be a useful guide to set public policy. Ms. Kobor's proposal for a value of solar methodology proves my point. It's revealing to gather together in one place a list of all of the assumptions, estimates, forecasts, and approximations Ms. Kobor suggests would need to be made during the course of her testimony on value of solar:

- Forecast of future utility rates going out twenty to thirty years, by customer class, assessed for reasonableness by "interested parties";[1]
- Impact analyses of any expected "significant changes in rate design," with a scenario analysis of potential rate design structures;[2]
- Hosting capacity analyses;[3]
- "Inputs…for a detailed marginal cost study valuing transmission and distribution capacity";[4]

[1] Direct Testimony of Brianna Kobor, p. 27.
[2] *Id.* at 27.
[3] *Id.* at 22:9.
[4] *Id.* at 22:9-10.

- A "chosen" discount rate;[5]
- An estimate of expected DG penetration levels;[6]
- A decision about what time period will be looked at for estimating DG penetration (Ms. Kobor suggests one to three years, which is in tension with her emphasis in other cases on twenty or thirty year projections);[7]
- A value for incremental DG capacity additions;[8]
- Utility data on current price paid to customers for DG exports by customer class;[9]
- Hosting capacity analyses specific to each utility system (as suggested by Mr. Volkmann and endorsed by Ms. Kobor);[10]
- An estimate of "the cost to produce the energy that would be offset by additional DG exports," reflecting differences depending on "the individual utility and the timing and seasonality of DG exports." Ms. Kobor recommends that "assumptions" can be developed about "the marginal generator that would serve various portions of the load expected to be served by additional DG exports," based on "data on the current export profile of [utility] NEM customers";[11]
- Avoided cost of energy from each of the marginal generators identified through the assumptions above. This includes estimates (over twenty or thirty years, presumably) of natural gas prices, heat rates, and "variable costs of operations and maintenance";[12]
- A projection of future prices of natural gas;[13]
- Extrapolated longer-term values for natural gas "based on publicly available forecasts";[14]
- Futures data on basis swaps prices;[15]
- Estimated costs to bring gas to generators;[16]

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[5] *Id.* at 23:8.
[6] *Id.* at 24.
[7] *Id.* at 24:16-19.
[8] *Id.* at 25.
[9] *Id.* at 27.
[10] *Id.* at 11; *see* Direct Testimony of Curt Volkmann 6:18-20.
[11] Direct Testimony of Brianna Kobor 28:7-14.
[12] *Id.* at 28:18-19.
[13] *Id.* at 28.
[14] *Id.* at 28:25.
[15] *Id.* at 28-29.
[16] *Id.* at 29.

- "sensitivity analysis based on higher- and lower-than projected natural gas prices";[17]
- An "assumption" about heat rate, "specific to the type of plant"[18] based on:
  - Expected average heat rate;[19]
  - Long-term heat rate degradation that "may occur";[20] and,
  - And "a reliable estimate of variable O&M...forecasted over the period of the analysis."[21] (20-30 years, that is);
- "marginal line losses expected during the periods of DG exports"[22] (average line loss figures will not do);
- "...assumptions must be made regarding the generation capacity additions that would be needed but for the additional DG export capacity";[23]
- New generator capital costs, to best estimated by "developing assumptions for":
  - capital costs;[24]
  - fixed O&M;[25] and
  - gen-tie transmission costs;[26]
- "level of DG export capacity that is expected to contribute to the system peak";[27]
- "an assessment of the effective load carrying capacity," which will require the analyst "to evaluate the expected technology of future DG additions";[28]
- The analysis Mr. Volkmann recommends about transmission capacity and distribution capacity savings;[29]
- A value for the social cost of carbon;[30]

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[17] *Id.* at 29:4.
[18] *Id.* at 29:7.
[19] *Id.* at 29.
[20] *Id.* at 29:9.
[21] *Id.* at 29:9-11.
[22] *Id.* at 29:17-18.
[23] *Id.* at 31:1-2.
[24] *Id.* at 31.
[25] *Id.*
[26] *Id.*
[27] *Id.* at 31:7.
[28] *Id.* at 31:8-9, 15.
[29] *Id.* at 32.
[30] *Id.* at 34.

- EPA estimate of social cost of major pollutants, "netted against the level of compliance costs embedded in avoided energy costs";[31]
- A value for avoided water consumption;[32] and
- An assessment of "the potential multiplier affect associated with DG-related jobs."[33]

All of this is to be provided for twenty or thirty years. What could possibly go wrong?

Ms. Kobor herself downplays the difficulty of the task she is setting for regulators and analysts, sometimes to (presumably unintentionally) humorous effect. After laying out a daunting list of approximations and assumptions necessary in order to value the capacity of rooftop solar ("assumptions must be made regarding the generation capacity additions that would be needed...[c]apacity costs...can be estimated by developing assumptions for capital costs, fixed O&M, and gen-tie transmission costs...the level of DG export capacity that is expected to contribute to system peak...an assessment of the effective load carrying capacity...it will be necessary to evaluate the expected technology of future DG additions."[34] Ms. Kobor goes on to write that "[w]ith these assumptions in place, calculating the generation capacity savings of DG is a relatively simple undertaking[!]"[35] Ms. Kobor's testimony in that regard calls to mind the story of the economist who, stranded on a desert island, plans his escape by assuming a boat. The analysis is only simple if you assume the hard part happens and is somehow reliable despite all the different judgments and assumptions that must be made, not to mention that it is almost inevitable that every analyst will have varying points of view on each and every one of these data points, leaving the Commission to wade through them to derive "the truth." All of this burden will be placed on the Commission despite the fact

[31] *Id.* at 34:15-16.
[32] *Id.* at 35.
[33] *Id.* at 35:18-19.
[34] *Id.* at 31:1-5.
[35] *Id.* at 31:17-18.

that cost data and market measures are readily available for use at considerably less cost and guaranteed to arrive at an outcome that is considerably more fair to consumers.

Q. DO MS. KOBOR OR MR. BEACH OFFER A JUSTIFICATION FOR FOLOWING A "VALUE OF SOLAR" APPROACH TO PRICING?

A. No. Neither witness offers any justification, or even rationale, for the idea that we should price rooftop solar based on highly subjective, often factually challenged, notions of value, while we price every other energy resource, including other renewables, based on the firm and transparently derived foundations of either cost or market. While they lay out their perspectives on how to weigh the costs and benefits of rooftop solar, they do not justify a "value" approach to pricing. Nor do they bother to try to assure the long run sustainability of rooftop solar energy, namely, finding ways to integrate solar costs and benefits as fully as possible into the generally applicable market and/or cost based pricing, thereby avoiding the controversial, highly subjective, very litigious, and historically disproven process of administratively determining "value." What they, in essence, seek is to provide a thinly veiled rationale for pricing rooftop solar at high prices that will assure rooftop solar developers high profits on a per project basis without subjecting them to the rigors of either the competitive market or cost based regulation.

In fact, the testimony provided by Mr. Beach and Ms. Kobor supports the perspective provided in my original testimony that a "value of solar" analysis is inherently arbitrary and unhelpful. It is, moreover, an approach certain to lead to unending litigation and costly administrative proceedings. When applied to a single resource in isolation, it is unclear what the purpose of the "value of solar" analysis is, other than to perpetuate monopoly, non-competitive pricing for rooftop solar that enriches developers at significant cost to all consumers, solar and non-solar alike.

Q. GIVEN THE MULTITUDE OF ASSUMPTIONS, THE CALL FOR EXTRAORDINARY PREDICTIONS OVER 30 YEARS, AND THE IMMENSE COMPLEXITY OF THE PROPOSED VALUE OF SOLAR ANALYSIS, SHOULD IT BE USED TO DETERMINE HOW MUCH CUSTOMERS PAY FOR SOLAR?

A. No. The sheer complexity of what Mr. Beach and Ms. Kobor have proposed makes it plain that the effort is simply not worthwhile. Their testimony, with all of its twists, turns, and complexities makes it plain that establishing a definitive methodology is an extraordinarily difficult task by itself, but even if we were able to derive such a product, every input that went into the analysis would be challenged and contested by any number of parties. Why would we undertake such complicated calculations, rife with so many arbitrary assumptions? Each and every element of these intricate value of solar methodologies is almost certain to be highly contested. And any conclusion would necessarily have to be revisited by the Commission and subjected to protracted and expensive administrative proceedings on a regular basis. Why do this when we have ready access to market and cost information that are certain to yield, on a transparent and relatively simple basis, all the information required to set prices? Moreover, the prices set through markets or cost based regulation will be on the same playing field that applies to all other energy resources, thus removing such risks as misallocation of capital, incoherent price signals, and costly, socially regressive cross-subsidies.

Q. ARE THE PROPOSALS OF MR. BEACH AND MS. KOBOR TO HAVE PRICES SET BY A VALUE OF SOLAR ANALYSIS HARMFUL TO CUSTOMERS?

A. Yes. By proposing an approach that insulates rooftop solar from the pressures of the market and cost based regulation, pressures that incentivize greater efficiency and productivity, Ms. Kobor and Mr. Beach would leave customers having to pay excessive prices for rooftop solar—effectively implementing (unregulated) monopoly pricing, with no long term assurance of the benefits claimed by the two witnesses. Indeed, by locking in high prices for the long term for a rather primitive product, it is inevitable that those prices will be less and less advantageous to consumers.

Q. WHY DO YOU SAY THAT ADVOCACY FOR VALUE OF SOLAR ANALYSIS IS EFFECTIVELY ADVOCACY FOR MONOPOLY PRICING FOR SOLAR?

A. Value analysis, unless carefully contextualized (an extraordinarily complicated thing to do), under the value maximization / cost minimization methodologies advanced by witnesses Ms. Kobor and Mr. Beach, inevitably pushes prices to monopoly levels. Indeed, the 2015 10K filing at the Securities and Exchange Commission by SolarCity, the nation's largest provider of rooftop solar, makes it clear that the monopoly retail price is the price they target in their business plan.[36] The "value" of a product or a service to the consumer is the full amount that consumer would be willing to pay for that product—the point at which the consumer is more or less indifferent between keeping the money and getting the product. A world in which customers were always expected to pay full "value" to them of a product would be a terrible world for consumers—one in which it would be essentially impossible for them to improve their well-being through purchases, since in every case, the would have to pay a price whose value to them is fully equal to the value of the product purchased.

Q. INSTEAD OF VALUE-BASED PRICING, HOW SHOULD ELECTRICITY BE PRICED?

A. Instead of prices reflecting the subjectively ascertained full value of products to consumers, prices should end up somewhere between the cost to produce a product and the value of that product to a customer, leaving the customer better off after buying the product than he or she would have been without the product. In order to sell the

[36] That is a peculiar benchmark, given that the retail price is a fully bundled package of goods and services, of which energy from rooftop solar or other sources is but one component.

product, the provider must bring his price down to the level where he can meet the customer's cost benefit expectation.[37] Ms. Kobor and Mr. Beach, unlike some other advocates of value of solar approaches to pricing,[38] do not give any indication that they would support preserving a margin between the "value" of solar and what customers are actually required to pay.

Q. DO MS. KOBOR AND MR. BEACH TIE COSTS TO HOW ROOFTOP SOLAR SHOULD BE PRICED?

A. No, they do not. Nor do they appear to contemplate that a reasonable price for solar power might bear some relationship to production costs or market prices. Ms. Kobor's treatment is particularly egregious here. She completely denies that declining solar panel costs are relevant to the analysis at all, arguing that the important question is only "whether the price paid for exports is commensurate with the value received," and whether "the price paid for DG exports appropriately reflects the value of the energy provided." This would harm both customers and the development of solar.

Q. HOW WOULD DELINKING COST DECLINES AND ROOFTOP SOLAR PRICES HURT CUSTOMERS AND THE DEVELOPMENT OF SOLAR?

A. Ms. Kobor's view that declining panel costs need not be reflected in prices charged consumers is not only an extraordinarily anti-consumer sentiment worthy of a Charles Dickens novel, but is profoundly anti-solar. If costs are declining, that is good for solar, as it puts the panels within reach of more customers and will increase sales. That is exactly what markets do.

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[37] This is what markets do. In incentivizing producers to lower their prices, they also provide a robust incentive to improve production processes and lower costs.

[38] *See*, Harvard Electricity Policy Group, Eighty-First Plenary Session, *Rapporteur's Summary*, Session 2 (2015), http://www.ksg.harvard.edu/hepg/Papers/2016/December%202015%20Rapporteur's%20Report%20Final.pdf.

Instead, she says it has no relevance in her construct of "value" pricing. It is also extraordinary, because it fails to recognize that the value proposition is enhanced by obtaining the same product at lower cost. Nor does she even acknowledge the fact that many of the values she assigns to rooftop solar may be obtained at lower cost by other means. She has inadvertently revealed a mindset that focuses solely on maximizing the price of solar regardless of consumer welfare and regardless of the future for the product she purports to advocate for. In essence, her view of declining costs not having to be passed on to customers removes the "value of solar" fig leaf and leaves exposed what value of solar pricing is all about to the rooftop solar industry: excessive short term profit taking by rooftop solar vendors/lessors regardless of costs to others and even to the product they sell.

Q. HOW WOULD THIS EXCESSIVE PROFIT-MAKING HARM CONSUMERS?

A. It would be extremely unfortunate for customers if the "value" of solar were taken as the methodology for appropriate pricing, even if this "value" were assessed accurately. The situation in regard to rooftop solar is even worse than this, however, because, as I argue below, if one follows the value of solar analysis approach suggested by Mr. Beach and Ms. Kobor, the "value" likely to be attributed to solar will be significantly overstated, and "value" of solar pricing would be imposed on customers without giving them the ability to choose not to pay what is asked, and without giving them the option to choose competing resources that offer better value for their money.

Q. WHAT ABOUT THE ARGUMENT THAT THESE EXCESSIVE PROFITS MUST CONTINUE OR UTILITY CUSTOMERS WILL DISCONNECT FROM THE GRID?

A. This argument is surprisingly anti-competitive. If it were true that rooftop solar in combination with storage could provide the same or better electric service at an equal or lower price, then it would not be in the public interest for utility commissions to structure rates that blindly discourage defection. If the technology ever develops to this point, and if customers can do without the utility and be equally well off or even better off, the underlying economics of the market should drive how rooftop solar is priced.

The truth, however, is that not only are we a very long way from facing that problem, given the ongoing advantages of economies of scale, but it is not even in the interest of solar customers to abandon the grid and thereby lose the opportunity of selling their excess generation (i.e. capturing the value of their own scale economies), as well as of having the grid as a full service backup. The danger I see is not that distributed energy resources will out-compete utility services under rational pricing; it is that if we follow the paths sought by Ms. Kobor and Mr. Beach, we would adopt a system so rife with cross-subsidies and uncompetitive pricing that some customers might be better off defecting than carrying the burden of cross-subsidies, leaving everyone—defectors and traditional customers alike—much worse off than they would have been under a well-priced utility system. Indeed, there is far more historical precedent for uneconomic bypass on electric utility systems than there is for going off-grid to realize real economic benefits.

This last scenario highlights what is at stake in this proceeding—any errors made in developing a value of solar methodology, if this aim is pursued, may well be multiplied by attempts to apply this methodology more broadly. It is thus vital to avoid crediting false values and adopting a form of value analysis that will not produce efficient or fair results for customers. In short, we know from the PURPA experience I laid out in my direct testimony "how this movie will end"--very unhappily, so why make the film at all, when we have rational, efficient, and fully compensatory pricing methods (cost and/or market) which will serve us much better?

Q. DOES THE TESTIMONY OF MS. KOBOR AND MR. BEACH COMPARE THE VALUE OF ROOFTOP SOLAR GENERATION TO ANY OTHER COMPETING RESOURCES?

A. The only competing resource Ms. Kobor and Mr. Beach benchmark their value analysis against is natural gas.[39] Their analyses are examples of the problem of not considering the potentially greater value offered by other resources, such as grid-scale solar, which I identified in my earlier testimony. Throughout their analyses, Ms. Kobor and Mr. Beach assume that the marginal resource displaced by rooftop solar is natural gas generation, and therefore that more rooftop solar necessarily means fewer emissions of carbon and other pollutants. While it may be a reasonable assumption that gas is the marginal resource being displaced short-term, that assumption provides us no actual data as to exactly what saving or benefits might be derived, or costs incurred, due to that fact. Taking that next step to actually quantify the costs and benefits of displacing natural gas fired generation requires a highly sophisticated, highly granular analysis which is both costly and ultimately highly contestable.[40]

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[39] That is, natural gas is the only resource they benchmark against in any quantitative sense. Mr. Beach does have a qualitative discussion of the value of rooftop solar vs. grid-scale solar, which I discuss briefly below.

[40] While displacing gas fired generation may have the immediate benefit of reducing carbon, the additional strains imposed by requiring gas plants to be ramped up and down will cause additional wear and tear on plants that can not only be costly, but is likely to cause the plants to be less efficient in their operations, increasing both costs and carbon emissions. Thus, identifying the exact amount of reduction of carbon emissions is a highly complex calculation, and that assumes that there is a net reduction over time, something we cannot be certain of. Whatever value, if any, is derived from the calculation will then have to be tested against the opportunity cost of being able to attain the same level of emissions reduction via less expensive means, such as trading RECs, energy efficiency, and/or grid-scale renewables. It is very revealing that neither Ms. Kobor nor Mr. Beach ever even raise the question of the

Q. HOW MIGHT ROOFTOP SOLAR ACTUALLY DISPLACE GRID-SCALE SOLAR INSTEAD OF NATURAL GAS?

A. It is not at all clear that in considering utility investment decisions, utilities with more rooftop solar will be less likely to invest in new natural gas plants when it comes to adding new generation. A more plausible scenario, it seems to me, is that a utility with an abundance of rooftop solar generation that it must integrate into its system will be most likely to cut back on investment into grid-scale solar power or other intermittent renewable power sources, reflecting its greater need for the flexibility, baseload, and ramping capability provided by natural gas plants. The ability to measure the "value" of avoided emissions from rooftop solar breaks down when we recognize that we don't know, over the medium to long term, what resource rooftop solar is displacing.

Q. HOW DO MS. KOBOR AND MR. BEACH RESPOND TO THE QUESTION OF WHAT THE VALUE OF SOLAR MEANS IN A WORLD OF MULTIPLE COMPETING RESOURCES?

A. Mr. Beach largely ignores this problem, except to the extent that he offers a few arguments for the superior value of rooftop solar over grid-scale solar. To the extent that Ms. Kobor acknowledges this problem, her response is to recommend that value analysis be applied to multiple resources (including "community and utility-scale solar, other renewables, and efficiency."[41] Writes Ms. Kobor, "[a]n important first step in any comparison would be to develop a robust methodology for fully valuing each resource.

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very real opportunity costs they would impose using their "value of solar" approach to pricing rooftop solar. (For more on the wear and tear costs of ramping, see, e.g., N. KUMAR ET AL., NREL, POWER PLANT CYCLING COSTS (2012), http://www.nrel.gov/docs/fy12osti/55433.pdf; Sonja Wogrin, *The Impact of Cycling Costs Due to Fatigue Damage on Optimal CCGT Operations*, Presentation to the Harvard Electricity Policy Group's 82nd Plenary Session (Mar. 11, 2016), http://www.ksg.harvard.edu/hepg/Papers/2016/March%202016/wogrin%20presentation.pdf; Debra Lew, *Coal/Gas Plant Cycling: Costs, Causes, Impacts*, Presentation to the Harvard Electricity Policy Group's 82nd Plenary Session (Mar. 11, 2016), http://www.ksg.harvard.edu/hepg/Papers/2016/March%202016/Lew%20Presentation.pdf.

[41] Kobor at 39:9-10.

Until such a methodology is used to analyze the value of specific resources, it is difficult to compare the value and cost of these different resources."[42] In effect, were we to follow her suggestion, we would abandon both market and cost based pricing for the highly speculative, imprecise, and arbitrary method of "value" pricing. To her credit, she does recognize that there are transaction costs, in the form of studies, associated with activities of that magnitude, especially if we applied it to all resources. What she ignores is the sheer magnitude of those costs, and the fact that no single study will be sufficiently definitive as to be uncontestable by all of the interests who participate in, or are affected by the outcome of, the proceedings of the ACC. Moreover, the consequences of value-based pricing to consumers would be too significant to ever consider moving forward with such an approach. Why should customers be forced to pay more for rooftop solar than they are currently paying for grid-scale solar as determined by the market?

Q. DOES MR. BEACH OFFER ANY COMPELLING REASON NOT TO COMPARE THE BENEFITS AND COSTS OF ROOFTOP SOLAR TO THOSE OF GRID-SCALE SOLAR?

A. No. Mr. Beach asserts a number of benefits of rooftop solar as opposed to grid-scale solar, none of which hold up to scrutiny (and which are certainly not quantifiable). "New capital," from the investments of rooftop solar customers, for example, is one he mentions—but there is no reason to prefer this source of capital to more traditional financing (this is not "free" capital – just as with more traditional forms of financing, a rate of return is expected). "Grid services," to the extent these exist, would come from the inverters, not the solar power itself, and are at this point potential, rather than reality. Other benefits include "new competition" and "high tech synergies," (fine things, potentially, except that the pricing generally proposed for rooftop solar has the effect of

[42] *Id.* at 39:10-13.

insulating rooftop solar from meaningful competition, even with other, more efficient, rooftop solar installations, eliminating incentives to adopt productivity-enhancing technologies like storage); and "enhanced reliability and resiliency"—a benefit which, if it exists at all, accrues only to the individual solar customer, since supply to the distribution network must be cut off, for safety reasons, in case of a distribution outage (I explain this in more detail in my original testimony, p. 39). Two final categories, "customer engagement" and "self-reliance" (with reference to Thomas Jefferson) are, in my opinion, far too subjective, and offer a benefit too specific to individual customers, to justify the payment of real money by customers without rooftop solar.[43] Why should we subsidize "self-reliance," rather than "cooperation," arguably an equally important element of American traditions?

III. SOME ITEMS TO CONSIDER, SHOULD THE COMMISSION WISH TO PURSUE VALUE OF SOLAR ANALYSIS, DESPITE ITS PROBLEMS

Q. DO YOU STILL MAINTAIN THAT A VALUE OF SOLAR ANALYSIS SHOULD NOT BE THE BASIS FOR HOW MUCH CUSTOMERS PAY FOR ROOFTOP SOLAR, AS OPPOSED TO MARKET AND/OR COST BASED PRICING?

A. Yes, I do. The whole notion of the "value of solar" neglects the crucial consideration of the opportunity costs of investing in solar rather than other resources. And the proposed analysis itself is so full of arbitrary estimates and judgments it is impossible to see how a "robust" value could emerge—still less, if we are supposed to do value analysis for multiple resources and compare the results.

[43] *See* Direct Testimony of R. Thomas Beach 30-32.

Q. IF THE COMMISSION NEVERTHELESS WANTS TO PURSUE THE IDEA OF VALUE OF SOLAR ANALYSIS, DO YOU HAVE ANY COMMENTS ON THIS?

A. If a value of solar analysis is going to be done, and taking the testimony of Ms. Kobor and Mr. Beach as examples, there are some clear problems that should be avoided.

Q. CAN YOU GIVE SOME EXAMPLES OF PROBLEMATIC ANALYTICAL CHOICES MADE OR SUGGESTED BY MR. BEACH AND MS. KOBOR?

A. Whenever it is suggested that customers should pay real money today for hypothetical and less than certain benefits tomorrow, one must proceed with great caution. One must take great care to consider all aspects of such an arrangement, including looking at all of the options to serve a defined need. This is particularly the case where it is not individuals making decisions affecting only themselves, but, rather, regulators making decisions that affect many tens of thousands of consumers. It is important to avoid unnecessary and asymmetrical shifts in risk allocation, incurring unnecessary costs, commitments to technology that may soon become obsolescent, or setting prices with no incentive for improving productivity. Neither Ms. Kobor nor Mr. Beach, in urging value based pricing for rooftop solar, even recognize the role that regulators must play in protecting consumers. They simply claim that rooftop solar has the values they claim, and no further consideration, or than offsetting the value asserted by the minimal costs they identify, is in order. A few issues that seem particularly worth highlighting in the analysis presented by Ms. Kobor and Mr. Beach are highlighted below:

- The insistence on long term analysis multiplies the number of potentially arbitrary or controversial analytical choices that must be made, starting with the choice of discount rate. The potential for arbitrary skewing of the analysis is multiplied further when analysts pick and choose some elements to be considered over the long term and some elements to be analyzed over the short term.

- The idea that rooftop solar offers utilities a value as a hedge against possible increases in natural gas prices is simply wrong, and should be dropped entirely.
- If a "value" analysis based on benefits and costs is to be undertaken, costs should be considered with at least as much thoroughness as benefits. In the case of Ms. Kobor and Mr. Beach, the list of costs considered, not surprisingly, is not nearly as comprehensive as the list of benefits considered. Indeed, that asymmetry is foundational to the approach they advocate: that benefits be maximized (indeed, often simply assumed) and costs minimized (indeed, often simply ignored).

Q. CAN YOU EXPLAIN FURTHER WHY YOU SEE THE LONG TERM LEVELIZED ANALYSIS OF BENEFITS ENDORSED BY MS. KOBOR AND MR. BEACH AS MULTIPLYING THE ANALYTICAL PROBLEMS AND ARBITRARINESS OF VALUE OF SOLAR ANALYSIS?

A. Ms. Kobor and Mr. Beach insist that an appreciation of the full value of rooftop solar requires that analysts look out twenty or thirty years into the future—a requirement that greatly multiplies the difficulty in conducting a robust, impartial, and even remotely accurate analysis of the value provided by rooftop solar. At the most fundamental level, it introduces the question of selecting a discount rate, something Ms. Kobor terms a "crucial assumption in a levelized cost analysis." Ms. Kobor rejects the discount rate typically used by utilities (6%-9%) in favor of a rate "similar to inflation," (in today's economy, presumably a very low rate). Mr. Beach uses two different rates in the updated analysis of the benefits and costs of solar in Arizona, using the utility's 7.2% discount rate in much of his analysis, but switching to a lower 3% "social discount rate" in calculating "societal" benefits, such as carbon emissions reductions.[44] The lower rate makes future benefits and costs look bigger; the higher rate makes them look smaller.

[44] R. THOMAS BEACH AND PATRICK G. MCGUIRE, THE BENEFITS AND COSTS OF SOLAR DISTRIBUTED GENERATION FOR ARIZONA PUBLIC SERVICE 7, 17 (2016) (Attached to Mr. Beach's direct testimony in this docket).

My purpose here is not to judge what the appropriate discount rate is—it is simply to point out that this is a crucial analytical decision with significant implications for how big or small the "values" look that come out of value of solar analysis. And there is far from being a consensus as to what the correct rate is. A second crucial issue relates to mixing long term with short term analysis. Both Mr. Beach and Ms. Kobor insist that long-term analysis is crucial—except when it comes to analyzing the capacity value of rooftop solar. (Over the long term, the capacity value of rooftop solar is expected to decline significantly as rooftop solar penetration increases and as panels age). In this one case, Ms. Kobor argues for a "near term" look, because "[t]he valuation of DG exports will be most relevant if it examines current and/or near-term expected penetration levels on the utility's system." I don't know about "most relevant." Certainly, the valuation will be higher if it is focused on the near term. Similarly, Mr. Beach argues that future capacity value declines are too hard to predict—so in his Arizona analysis, he uses the capacity value of "solar installed today" for his entire "levelized" analysis.[45] I don't necessarily disagree with Ms. Kobor and Mr. Beach's caution in this case about trying to project costs decades into the future—I just wish they showed similar caution in all cases. The approach they choose (long term or near term) appears to have the self-serving characteristic of attributing the greatest value to rooftop solar.

Q. WHY DO YOU SUGGEST, ABOVE, THAT THE IDEA THAT ROOFTOP SOLAR OFFERS UTILITIES A VALUE AS A HEDGE AGAINST POSSIBLE INCREASES IN NATURAL GAS PRICES SHOULD BE DROPPED ENTIRELY?

A. Mr. Beach and Ms. Kobor both argue that there is a "hedging value" for rooftop solar that is realized by the utilities. The argument is based on the true observation that the marginal cost of solar electricity production is zero, whereas the marginal cost of the

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[45] *Id.* at 13.

production of electricity from a natural gas plant goes up and down with the price of natural gas.

So solar power potentially does have a value as a hedge against natural gas, but only for the owner of the solar panels. For a utility that will be buying power from solar panel owners, the hedge value under net metering is nil. The reason is that the price to be paid by the utility for power from rooftop solar will include all of the elements included in the monthly electric utility bill, including the full cost of energy. When gas is expensive, this price paid by non-solar customers will be higher; when it is cheaper, it will be lower. There is no mechanism envisioned by anyone on either side of this debate (as far as I am aware) under which gas prices would be high, but solar producers would be compensated at a rate lower than the cost of electricity produced from gas generators. So, if it is worth hedging against variations in the price of natural gas, the utility should buy the same hedge against variations in the price of rooftop solar power. From the utility's and the non-solar customer's point of view, the two costs will vary together. Thus, the hedge value is not only zero, any consideration paid for such a hedge would be more expensive than incurring the risk from which protection is sought.

With that said, solar can provide a hedge for the owner of the solar panels. Thus, in the case of larger-scale, utility-owned solar plants, there could be a hedge value. But for rooftop solar panels, whatever hedge value may exist stays with the owners of the solar panels—it does not transfer to the utility. It should therefore be dropped from the list of "values" provided to the utility by rooftop solar.

Q. ARE THE COSTS IDENTIFIED BY MR. BEACH AND MS. KOBOR COMPREHENSIVE?

A. No, they are not. Ms. Kobor lists the costs of payments to customers and "integration costs and benefits." Beach lists lost revenue, integration, and administrative/interconnection costs.

Neither Mr. Beach nor Ms. Kobor bring anywhere near the same comprehensive, creative thoroughness to the identification of costs as they do to their much more extensive list of benefits. To correct the balance, let me suggest that the following costs should also be considered:

- The wear and tear on natural gas and other thermal plants caused by additional cycling to accommodate solar power's production profile;
- The cost of additional regulation services needed to supply necessary reactive power not supplied by rooftop solar generation;
- The cost of providing additional power regulation, as some of the physical inertia provided to the system by large turbines is lost;
- Incremental changes to distribution system caused by the presence of and unplanned additions of rooftop solar to the system;
- Lost revenues caused by net metering enabled avoidance of paying fixed and demand charges;
- The economic and job losses caused by higher electricity rates, caused by paying above market prices to rooftop solar vendors/lessors and/or displacement of jobs in other sectors of the electricity market, such as thermal plants;
- The costs of additional reporting and analysis necessary to support extensive new 'valuation" efforts;

- The costs to society of a policy that, in the aggregate, transfers money from poorer households to richer households;
- The opportunity costs of investing money in a less efficient resource, as opposed to more cost-effective forms of clean energy;
- The costs of inefficiency in the production of rooftop solar power perpetuated by uncompetitive compensation of this power;
- The taxes and cross-subsidies that are used to subsidize rooftop solar;
- The cost associated with protecting rooftop solar vendors/lessors from market pressure to pass on declining panel costs;
- While not a cost, *per se*, the risk that rooftop solar may, as in the final EPA Rules under the Clean Power Plan, not be considered as a basic building block for a state plan of compliance, or may prove to be a highly inefficient method of carbon reduction;
- The costs associated with displacing lower cost energy with higher price rooftop solar;
- The costs associated with a pricing regime that fails to recognize that rooftop solar is largely off peak;
- The costs associated with having to incur sufficient capacity to back up intermittency in rooftop solar energy supply;
- The costs associated with the reallocation of capital from more efficient sources of generation (e.g., grid-scale renewables) to less efficient but higher priced rooftop solar; and

- Finally, the costs associated with all of the studies and litigation associated with value of solar pricing (recognized by Ms. Kobor but not by Mr. Beach). This is particularly burdensome for commissions and their staff.

Q. IS THERE ANY OVERALL PATTERN IN THE PROBLEMS WITH MS. KOBOR AND MR. BEACH'S VALUE OF SOLAR ANALYSIS?

A. Yes. Whenever there is uncertainty/risk, Ms. Kobor and Mr. Beach use their value analysis to put the risk on ratepayers. There is one telling moment in Mr. Beach's testimony that suggests he is well aware that there is something wrong with the value analysis he is offering. In arguing for the benefits of a minimum bill, Mr. Beach writes, "A minimum bill can address impacts on non-participants by providing DG vendors with a signal to reduce the sizing of DG system to keep customers above the minimum bill level, thus reducing the costs of net metering for other ratepayers."[46] Mr. Beach's cost benefit analysis in fact shows a (small) benefit to other ratepayers from net metering. If this benefit were real, presumably, the more of it ratepayers could get, the better. Instead, Mr. Beach's true opinion seems to be that less of this particular benefit is what is best for ratepayers—presumably because he recognizes the obvious, which is that exchanging real money today for hypothetical, uncertain "benefits" tomorrow is not a good bargain for anybody.

IV. <u>CONCLUSION</u>

Q. ANY CONCLUDING THOUGHTS?

A. First, there is a lot at stake here, especially if, as suggested by Ms. Kobor and Mr. Beach, this is to become a template for valuing all kinds of distributed energy services.

[46] R. Thomas Beach Direct Testimony 28.

Any errors or overestimates of benefits that get baked into a "value of solar" analysis may end up multiplying, not only as rooftop solar itself grows, but as other distributed energy resources begin to develop and clamor for the same benefits.

Second, it is pretty clear that when you do these value of solar studies, you can direct them to any conclusion you want to make. These studies are packed with "data" selected by the author of the study and can be used to prove whatever you want it to prove, as the range of findings on value of solar studies makes clear.

Third, it is worth remembering that there are alternatives to the uncertainties of value of solar analysis. We should use market-based or market-derived (e.g., benchmarks from the wholesale market, real time energy prices) pricing wherever possible. Another option, of course, is cost based pricing.

Finally, it is important not to view rooftop solar in the out of context fashion that both Mr. Beach and Ms. Kobor do. Rooftop solar is but one option among a number of others for meeting our energy needs. For it to prosper and be in the mainstream of Arizona's energy mix, it must be cost effective and competitive. Isolating it into an isolated, non-mainstream, corner of the energy market by using "value pricing," as opposed to market or cost based pricing is a big mistake that threatens the long-term viability of rooftop solar and deprives consumers of a cost effective resource.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.

REBUTTAL TESTIMONY OF LELAND R. SNOOK

On Behalf of Arizona Public Service Company

Docket No. E-00000J-14-0023

April 7, 2016

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REBUTTAL TESTIMONY OF LELAND R. SNOOK
ON BEHALF OF ARIZONA PUBLIC SERVICE COMPANY
(Docket No. E-00000J-14-0023)

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, ADDRESS, AND OCCUPATION.

A. My name is Leland R. Snook. My business address is 400 North 5th Street, Phoenix, Arizona, 85004. I am Director of Rates and Rate Strategy for Arizona Public Service Company (APS or Company). I have management responsibility for all aspects relating to rate strategy and specific rates and prices.

Q. HAVE YOU PREVIOUSLY FILED TESTIMONY IN THIS PROCEEDING?

A. Yes. I filed direct testimony on February 25, 2016.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY IN THIS PROCEEDING?

A. In my rebuttal testimony, I address the direct testimony of those witnesses who have incorrectly applied either the principles of ratemaking based on a Cost Of Service Study (COSS) or introduced a flawed analysis regarding rate design.

- First, I address the testimony of Vote Solar witness Ms. Briana Kobor, who incorrectly claims that:
  - A COSS is a short-term evaluation of costs;
  - Rooftop solar customers are no different than customers that participate in energy efficiency or electric vehicles;
  - It is difficult to assess the value of Distributed Generation in a COSS;

- A utility's ratepayers pay the large upfront capital costs when a utility builds a power plant; and
- An energy-only time-of-use (TOU) rate would encourage orientation of rooftop solar systems that provide more capacity benefit.

Additionally, I will address Ms. Kobor's apparent misunderstanding of the relationship and distinctions between setting rates and resource planning.

- Second, I will address the direct testimony of The Alliance for Solar Choice (TASC) witness Mr. R. Thomas Beach, who erroneously suggests that:
  - A traditional energy efficiency analysis should be used in a Value of Solar (VOS) analysis for setting rates;
  - A COSS is a short-term analysis;
  - Energy only TOU rates are all that is needed to address rooftop solar rate design issues, or alternatively, a minimum bill approach would be appropriate;
  - A rooftop solar customer is no different than a customer engaging in energy efficiency;
  - Resource planning and ratemaking can be combined into one process;
  - The current state of rate design and rooftop solar has created competitive choice; and
  - Demand charges would overcharge rooftop solar customers and be inappropriate as a rate design approach for customers.

Also, I correct the record where Mr. Beach has misstated the findings of the Energy+Environmental Economics (E3) study in Nevada, as well as the Public Utilities Commission of Nevada.

- Third, I address the testimony of the Residential Utility Consumer Office (RUCO) witness Mr. Lon Huber. I put into its proper context Mr. Huber's reference to Professor Bonbright's discussion of value-based rates. I also clarify Mr. Huber's reference to value in Decision No. 73130, which authorized APS to proceed with the acquisition of Southern California Edison's (SCE) share of Four Corners Units 4 and 5, but did not make any determination regarding the future rate treatment of such an acquisition.

II. RESPONSE TO THE TESTIMONY OF VOTE SOLAR WITNESS MS. BRIANA KOBOR

Q. MS. KOBOR SUGGESTS THAT A COSS IS A SHORT-TERM EVALUATION OF COSTS. DO YOU AGREE WITH MS. KOBOR ON THIS POINT?

A. No. Ms. Kobor apparently misunderstands the nature of a COSS by mischaracterizing it as a "short term" look at costs. A COSS is based on a full 12-month test-year period, and provides a comprehensive historical look at the entirety of a utility's actual costs for every item of utility plant and property that is dedicated to providing service to its customers, many with asset lives of 40 years or more, as well as the full extent of all expenses presently incurred in the provision of service.

In a cost of service regulated environment, the COSS is the foundational tool for determining the authorized level of revenue and for setting just and reasonable rates. To refer to a COSS as a short-term evaluation of costs grossly over-simplifies the comprehensive nature of the tool, the conclusions that can be drawn from the actual and quantifiable data in the study and the importance a COSS has in the rate setting process.

Ms. Kobor does not indicate what benefit, if any, would be served by a "long term" look at actual costs. The historical and factual analysis provided by a COSS has proven to be and is a reliable and verifiable basis for setting future rates, and is vastly superior to relying on subjective and speculative expectations of "value" projected decades into the future.

Moreover, the COSS demonstrates and incorporates the actual benefits provided by rooftop solar. The COSS can be considered a holistic analysis that fully looks at all quantifiable costs and benefits.

Q. MS. KOBOR ALSO INDICATES THAT A ROOFTOP SOLAR CUSTOMER IS NO DIFFERENT THAN CUSTOMERS WHO PARTICIPATE IN OTHER ACTIVITIES, SUCH AS ENERGY EFFICENCY, AND ELECTRIC VEHICLES. MS. KOBOR INDICATES THE ONLY DIFFERENCE IS THAT THE ROOFTOP SOLAR CUSTOMER SOMETIMES EXPORTS ENERGY TO THE GRID. DO YOU AGREE WITH THIS ASSESSMENT?

A. No. Ms. Kobor's statement is factually and empirically incorrect. The load shape data I provided at pages 26 and 27 of my direct testimony squarely controverts Ms. Kobor's assertion.

As clearly supported by the data, the load shapes of rooftop solar customers are dramatically different than the load shape of residential customers without rooftop solar, even if a residential customer lives in an apartment, has natural gas appliances in her home, engages in energy efficiency or only lives in Arizona during the milder winter time of year.

In contrast to this uncontroverted data, Ms. Kobor has only offered her unsubstantiated assertion that the load shapes are similar, without any factual evidence. Again, the uncontroverted data I have presented in my direct testimony disproves the notion that there is no difference in these types of customers. The reality is that rooftop solar customers have monthly energy consumption equivalent to a small apartment and they continue to have a maximum demand on the system that is much closer to what their demand was prior to installing rooftop solar.

Q. MS. KOBOR ASSERTS THAT IT IS DIFFICULT TO ASSESS THE VALUE OF ROOFTOP SOLAR IN A COSS AND THAT A COSS IS ILL-SUITED TO PERFORM THE EVALUATION. DO YOU AGREE?

A. Again, Ms. Kobor is incorrect on several levels.

First, a COSS is a ratemaking tool that has been used in ratemaking proceedings for many decades to produce what public utility commissions and courts throughout the country have confirmed are just and reasonable rates. Ms. Kobor's apparent goal in this proceeding is to persuade us that a VOS analysis, which plays a role in a resource planning context (not ratemaking), should immediately be force-fed into the ratesetting process.

As I indicated previously, a COSS is the foundational tool in determining the appropriate level of revenues based on the facilities a utility has dedicated to serving customers, and is a comprehensive look at actual costs <u>incurred</u> in the provision of utility service.

Further, the COSS is the factual basis for establishing just and reasonable rates. As I indicated in my direct testimony in this docket, there should be no confusion between a COSS that is used to establish rates based on historical costs and a resource planning exercise that is used to evaluate various resource options based on projections of future events. They are not the same, do not serve the same purpose, and never were intended to do so. As I indicated in my direct testimony in this proceeding, a VOS analysis is an appropriate tool for calibrating the price paid for energy exported to the grid from rooftop solar.

Q. WHY SHOULD RATES ONLY BE SET ON ACTUAL COSTS RATHER THAN THROUGH A RESOURCE PLANNING ANALYSIS?

A. The resource planning process compares resources on a level playing field of assumptions to determine which resources perform better under a variety of scenarios. It is a comparative tool that is updated formally every two years (and updated as needed during a procurement process or decision timeline) to keep pace with the ever-changing assumptions. Resources are procured using the best available information concerning future events. Once a resource decision is made, the utility procures the resource and incurs the cost. It is only then that the ratemaking process takes over.

Actual costs are used for the ratemaking process in a COSS, not the type of assumptions that are used during the resource planning process. To base rates on anything but actual costs would create significant risks based upon the accuracy of the assumptions used, which accuracy no one can guaranty. As opposed to just and reasonable rates, customers could be unfairly subject to rates that were too high and have no basis in fact. Alternatively, if the rates were too low, a utility would be at risk for not having sufficient resources to maintain the grid or pay back investors. Neither scenario could be said to involve just or reasonable rates.

Q. MS. KOBOR INDICATES THAT A UTILITY'S RATEPAYERS PAY THE LARGE UPFRONT CAPITAL COSTS WHEN A UTILITY BUILDS A POWER PLANT. IS THIS STATEMENT CORRECT?

A. No. I was quite surprised when I read Ms. Kobor's testimony on this point. It suggests a disconnect regarding how utility plant dedicated to providing service to customers is financed and eventually recovered in retail rates.

A utility finances all of its assets using a combination of debt and equity. Customers pay for these assets over their useful life in rates. Customers' payments can be likened to a mortgage payment. Mortgage payments include principal, which is similar to depreciation for utilities, and interest, which is the utility's cost of financing. Just as a bank might pay for a home upfront, with the homeowner paying the bank back over time through a mortgage, customers never pay the upfront cost for utility assets, the utility does.

Q. MS. KOBOR ALSO CLAIMS THAT AN ENERGY-ONLY TOU RATE WOULD ENCOURAGE ORIENTATION OF ROOFTOP SOLAR SYSTEMS THAT PROVIDE A GREATER CAPACITY BENEFIT. DO YOU AGREE?

A. No. I do not agree. Once again, Ms. Kobor makes a sweeping claim but offers no facts to support this assertion. And in reality, this claim is yet another that is directly contrary to the facts.

APS has the largest adoption of TOU rates in the United States. More than 53% of APS's residential customers are served under a TOU rate. APS's demand-based rates for residential customers are also TOU rates. Approximately 60% of APS's rooftop solar customers take service under an energy only TOU rate, and the evidence suggests this has had no effect on system orientation to provide a greater capacity benefit. Rather, the evidence shows that these customers still install their rooftop systems to maximize energy production under an energy-only TOU rate.

III. RESPONSE TO THE TESTIMONY OF TASC WITNESS MR. R. THOMAS BEACH

Q. MR. BEACH SUGGESTS THAT A VALUE OF SOLAR ANALYSIS SHOULD USE TRADITIONAL ENERGY EFFICIENCY ANALYSIS METHODS TO DETERMINE THE VALUE OF ROOFTOP SOLAR. DO YOU AGREE?

A. No, I do not. While there are some methods that have become somewhat standardized for energy efficiency analysis, they are used to compare different energy efficiency programs and to evaluate how various programs compare to each other. Like any resource planning tool, these methods are solely designed to facilitate selecting which programs should be offered. The analysis in energy efficiency programs is not used to determine any rate treatment or setting of rates.

Q. MR. BEACH CONTENDS THAT AN ENERGY-ONLY TOU RATE OR A MINIMUM BILL WOULD ADEQUATELY ADDRESS ROOFTOP SOLAR RATE DESIGN FLAWS. DO YOU AGREE?

A. No. Mr. Beach misunderstands the relationship between cost drivers and the rate features that would correlate to the cost drivers.

Approximately 70% of APS's costs are driven by either fixed costs that do not vary or costs that only vary with a customer's demand. Only 30% of APS's costs vary with a customer's consumption of energy. Using an energy price, even a TOU price, does not and cannot accurately reflect the cost of providing service because it relies on a bill element that does not match what actually drives the cost to be recovered.

APS's experience with energy TOU rates proves the point. APS perhaps has the most robust residential TOU rate in the country. Yet, APS is also experiencing some of the most extreme rooftop solar-related cost shifts.

Regarding minimum bills, I don't believe they can be designed in a way that is reasonable, fair, and effective. A one-size-fits-all approach to a minimum bill that is sized appropriately would function as a very high customer charge, and would be very regressive, among other flaws. The alternative is to set a one-size-fits-all minimum bill that is reasonable for a small residential customer. But this would be tantamount to maintaining the status quo, as the vast majority of all customers, including rooftop solar customers, already pay monthly bills in excess of that amount. Further, the minimum bill lacks the precision of a demand rate. A demand rate would bill each customer uniquely for their actual demand, creating a price signal that provides the customer with more control.

Q. DOES MR. BEACH CONFUSE RESOURCE PLANNING EXERCISES WITH THE RATEMAKING PROCESS?

A. Yes, he does. Similar to Ms. Kobor's misunderstanding, Mr. Beach suggests that the VOS analysis is directly applicable to the rate setting process in assessing the economics of rooftop solar. As I have pointed out previously, COSS is the foundational tool for establishing rates, while a VOS is a resource planning analysis. The two are not the same and should not be confused as serving the same purpose. Moreover, it is not clear how rates set by a resource planning tool could be found to be just or reasonable in Arizona.

Q. DO YOU BELIEVE, AS MR. BEACH SUGGESTS, THAT UNDER THE CURRENT STATE OF RATE DESIGN, ROOFTOP SOLAR PROVIDERS HAVE SOMEHOW CREATED COMPETITIVE CHOICE FOR CUSTOMERS?

A. No. Essentially, the current rate design allows rooftop solar customers to exploit a flaw in APS's tariffs; it doesn't provide an actual competitive alternative. Instead of cost-based competition, rooftop solar is heavily subsidized through today's flawed rate design and significant tax incentives. Moreover, without services provided by the grid, rooftop solar could not function. It is simply not an "all-in" alternative to traditional electric service, and customers who install rooftop solar still depend on the grid 24 hours a day.

Q. MR. BEACH CLAIMS THE STUDY SUBMITTED IN NEVADA, WHICH WAS CONDUCTED BY E3, FOUND THAT THE VALUE OF ROOFTOP SOLAR EXCEEDED ITS COSTS. IS MR. BEACH CORRECT?

A. No, Mr. Beach is not correct. One significant factor that Mr. Beach does not mention is that the renewable portfolio standard in Nevada had an initial extra-credit multiplier of 2.45 (2.45x) for rooftop solar through 2015. E3 used this 2.45x in assessing the value of rooftop solar, which artificially increased that value in relation to other renewable resources. If you erase this multiplier, in all E3 cases except the participant cost test, the economics in the original study flip.[1] Further, E3 found rooftop solar to be a net benefit if grid-scale solar's price was $100/MWh. But this net benefit (of $36 million) became a net cost of over $220 million if grid-scale solar was priced at $80/MWh. And, in September 2015 the Public Utilities Commission of Nevada found the price of grid-scale solar to be below $50/MWh. This is why the Public Utilities Commission of Nevada (PUCN) in their recent decision on net metering concluded that the E3 study had become irrelevant.[2]

Q. DO YOU AGREE WITH MR. BEACH THAT DEMAND CHARGES WOULD OVERCHARGE ROOFTOP SOLAR CUSTOMERS?

A. No. Rooftop solar does not permit utilities to avoid costs. Demand charges that are aligned with the cost to provide service would send the proper price information to all customers, including rooftop solar customers. Mr. Beach, by contrast, bases his assertion on hypothetical future values that cannot be netted against costs incurred in a historical test year that form the basis of rates.

IV. <u>RESPONSE TO THE TESTIMONY OF RUCO WITNESS MR. LON HUBER</u>

Q. RUCO WITNESS MR. HUBER REFERS TO PROFESSOR BONBRIGHT IN CONNECTION WITH VALUE-BASED RATES. DO YOU HAVE ANY THOUGHTS ON MR. HUBER'S PERSPECTIVE?

A. Yes, I do. Mr. Huber references some language in Professor Bonbright's book, "Principles of Public Utility Rates" that references value-based rates with cost of service ratemaking. However, Professor Bonbright did not conclude that value should be the basis for setting rates. Professor Bonbright only discussed value-based rates as one option in a potential spectrum of possible ways to set rates. Consistent with Professor

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[1] In fact, the E3 study acknowledges this: "When the RPS multiplier is removed…we find that NEM will again be a net cost to the state." ENERGY+ENVIRONMENTAL ECONOMICS, NEVADA NET ENERGY METERING IMPACTS EVALUATION page 11 (2014).

[2] *In re* Nev. Power Co. d/b/a NV Energy for Approval of a Cost-of-Service Study and Net Metering Tariffs, Modified Final Order in Docket Nos. 15-07041, 15-07042 page 48 n.19 (Nev. Pub. Utils. Comm'n Feb. 17, 2016).

Bonbright's conclusion, value based rates are not used. Rates for utilities, either at retail or wholesale, have only been set based on the cost of service or at a market price.

I do not believe that Professor Bonbright even tacitly endorsed using value to set retail utility rates. In fact, Bonbright concedes the hypothetical nature of his discussion by stating the following at the beginning of the chapter referred to by Mr. Huber, "Postponing for later discussion the formidable problem of defining value of service so as to qualify it as a definite standard for ratemaking…".[3] I do not believe that one can properly cite Professor Bonbright as a source in support of setting rates based on a value of solar analysis.

Q. MR. HUBER ALSO SUGGESTS THAT APS'S RECENT DECISION ON THE ACQUISITION OF SCE'S SHARE OF FOUR CORNERS UNITS 4 AND 5 HAD A RECOGNITION OF VALUE. PLEASE CLARIFY HOW THE FOUR CORNERS DECISION DISCUSSED THE CONCEPT OF VALUE.

A. Decision No. 73130 authorized APS to proceed with the acquisition of SCE's interest in Four Corners Units 4 and 5, but did not make any determination regarding the future rate treatment of such an acquisition. The discussion of value in that Decision addressed the self-build moratorium that was in effect for APS at the time and one of the conditions under which APS would be allowed a waiver under the moratorium. Most significantly, the proceeding was a resource planning decision to authorize an acquisition, not a rate setting decision. In fact, Decision No. 73130 demonstrates how value can be used in connection with resource planning decisions before and independent of the setting of rates based on the costs associated with that resource planning decision.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

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[3] JAMES C. BONBRIGHT ET AL., PRINCIPLES OF PUBLIC UTILITY RATES 125 (Pub. Utils. Reports, Inc., 2nd ed. 1998).