STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
PUBLIC UTILITIES COMMISSION

REVIEW OF ELECTRIC DISTRIBUTION DESIGN PURSUANT TO R.I. GEN. LAWS § 39-26.6-24	)))))	Docket No. 4568

PRE-FILED DIRECT TESTIMONY ON ACCESS FEE OF ABIGAIL ANTHONY, PH.D., ON BEHALF OF ACADIA CENTER

I. INTRODUCTION

National Grid has filed, in Docket No. 4568, a "Review of Electric Distribution Rate Design." The opening of the Docket and the filing of the rate design were required in the Renewable Energy Growth Program legislation enacted in 2014. On October 23rd, 2015, Acadia Center submitted testimony from Abigail Anthony, Ph.D., regarding the qualifications of the witness, the tiered fixed customer charge proposals in this docket and background on the changing energy system. This additional testimony submitted on November 23rd, 2015 addresses the proposal for an access fee for stand-alone distributed generation, along with additional necessary background. Based on concerns that the access fee proposal has not been based on good ratemaking principles and relevant economic analysis, the access fee proposal is not "reasonable and just" under R.I. Gen. Laws § 39-2-1. The access fee proposal also fails to address many of the balancing factors under R.I. Gen. Laws § 39-26.6-24(b). Acadia Center recommends that the access fee proposal not be approved.

II. FURTHER BACKGROUND ON THE CHANGING ENERGY SYSTEM AND NECESSARY REFORMS

Q. How is stand-alone distributed generation important to a local clean energy future?

A. It is important for several reasons. First, not all consumers and businesses are able to take advantage of local clean generation options, such as solar photovoltaics (PV) or distributed wind, where they live or operate. That could be because they do not have a suitable rooftop, are renters, or are low-income and do not have good access to credit. Second, municipalities and other organizations that have multiple meters cannot necessarily use all of their properties for clean energy projects. Third, stand-alone distributed generation often can offer economies of scale compared to smaller distributed generation options, like rooftop solar. Mechanisms like virtual net metering allow all consumers, businesses, non-profits, and municipalities to participate in the clean energy future and control their electric bills.

Q. What is net metering?

A. Net metering is an accounting tool that allows a customer with distributed generation to only pay for net consumption over the course of a billing period. If net consumption is greater than zero, the customer pays for the net kWh consumed at the relevant retail rate. If net consumption is less than zero (i.e. generation over the course of the billing period is higher than consumption), then that customer is allowed to roll over “net metering credits” to the next billing period, which can be used to offset bills during that period.

Q. What is the difference between “volumetric” and “monetary” net metering?

A. It is a difference in the units for net metering credits. Under volumetric net metering, a customer with net consumption less than zero receives net metering credits in the form of kWhs, each of which offset one kWh during the next billing period (regardless of price differences between those two periods). Under monetary net metering, a customer with net consumption less than zero receives net metering credits in the form of dollars, which offsets that amount of dollars during the next billing period.

Q. What is virtual net metering?

A. Virtual net metering is an accounting tool that allows a customer to count generation that does not take place behind her meter towards her own electricity bills. It allows a customer/generator to allocate net metering credit to another customer's utility account. It also allows customers that may have multiple meters – for example a farm or municipality – to allocate credits across its operations or bills. As with net metering, virtual net metering can either be done volumetrically, offsetting a certain number of kWh on a bill, or monetarily, offsetting a certain number of dollars on a bill. Virtual net metering offers a number of unique benefits, notably expanding customer and community access to solar and other distributed generation, customer convenience, tax benefits, and avoiding restrictions on cash transfers to low-income residents and low-income housing.

Q. Do the same principles of rate reform apply to stand-alone distributed generation as those for more traditional utility customers?

A. Yes, they do. Bonbright's principles and more modern adaptations are relevant to stand-alone distributed generation. However, just like customers who use new distributed energy resources such as active load management and on-site distributed generation, stand-alone distributed generation is not simply a cost to the electric grid because it also offers a range of value propositions.

Q. Does Acadia Center have a specific proposal for reforming compensation models for distributed solar PV?

A. Yes, Acadia Center recently released the Next Generation Solar Framework. It is appended to this testimony as Exhibit No. AC-4. Compensation for distributed solar PV should be based on sound, comprehensive, and publicly scrutinized analysis of the long-run costs and benefits of distributed solar generation. These costs and benefits can be sorted into two categories: (1) value to the grid and ratepayers and (2) value to society. These two categories of value can be used in different ways. Once solar PV is expected to reach a significant level of penetration, the value to the grid and ratepayers can be used to adjust net metering credit value administratively. Any additional incentives necessary to build projects can be benchmarked to the value to society, but these incentives should be structured to minimize the additional public cost necessary to build different types of projects.

Q. Has Acadia Center studied the value of solar in Rhode Island?

A. Yes, in July 2015, Acadia Center issued a study estimating the marginal value of distributed solar PV in Rhode Island to the electric grid and society at large. It is appended to this testimony as Exhibit No. AC-5. For the categories of benefits included, the study estimated that south-facing solar PV in Rhode Island is worth approximately 19 cents per kWh to ratepayers and the electric system, with an additional societal value of approximately 7 cents per kWh. The study also looked at the value of other solar panel orientations. For west-facing solar projects, the value to the electric system was estimated to be 25 cents per kWh because of better alignment with system peaks and lower overall generation. On balance, the absolute value of west-facing solar systems was only estimated to be modestly higher than south-facing solar in Rhode Island. Solar projects with two-axis tracking were estimated to have the highest overall benefits, but come with additional costs. To be appropriate to use for ratemaking, a conceptually similar regulatory-grade analysis must be performed by a public agency with appropriate public scrutiny of the methodology, assumptions, and ultimate results.

Q. What are the details of the recommendations on revising net metering credit structures once that is appropriate?

A. First, net metering credits should be calculated on a monetary basis, not a volumetric basis. Second, the value of net metering credits can be aligned with ratepayer value. Existing projects can be grandfathered under current frameworks and it may be appropriate to only apply this new framework to certain categories of projects, such as larger projects where any economic imbalances are more significant. Third, the alignment with ratepayer value can be accomplished in an incremental way. The portions of net metering credit value based on retail energy supply and transmission can largely remain the same, since they represent a reasonable starting points for avoided costs. Two new attributes that apply to all projects under the new framework should be defined in order to reflect the other attributes of distributed solar: a “distribution system benefit credit or charge” that represents the net value to the distribution system and an “energy system benefit credit” that represents additional value to the ratepayers not captured in the other portions of the credit. In addition, new credits can be created for certain categories of projects that provide additional ratepayer value, like west-facing solar and projects located in constrained areas of the grid. These reforms should also facilitate the expansion of virtual net metering, by removing arguments about cross-subsidies.

Q. What are the recommendations regarding additional incentives programs?

A. To begin, these incentives represent the additional societal values of local clean energy in terms of public health, the environment, and the local economy. They should also be integrated with the relevant compensation structures beyond net metering, such as the Renewable Portfolio Standard, and structured to minimize the additional public cost necessary to build different types of projects. Additional desirable features are performance-based payments based on actual generation, open application processes that do not start and stop, long-term stable structures that enable financing and lower costs, and public policy carve-outs for low-income residents and housing, community shared solar, landfill and brownfield projects, and municipal projects.

Q. Can this framework be applied to other technologies?

A. Yes, with proper economic analysis, this framework can be applied to other distributed generation technologies, particularly non-dispatchable ones such as wind.

III. REVIEW OF ACCESS FEE FOR STAND-ALONE DISTRIBUTED GENERATION PROPOSED IN THIS DOCKET

Q. Please describe National Grid's access fee proposal for stand-alone distributed generation.

A. National Grid has proposed a monthly access fee for all "stand-alone distributed generation," defined as generation connected to the distribution system that does not have on-site load besides station power and parasitic load. This access fee is initially defined as $5 per kW-month for projects connected to the distribution system at primary voltage and $7.25 per kW-month for projects connected at the secondary voltage level. These fees are then adjusted by a technology-specific "capacity availability factor" of 40% for solar, 30% for wind, 10% for hydro, and 40% for anaerobic digestion. (Supplemental Response to PUC 1-18).

Q. How were the values of $5 and $7.25 calculated?

A. The company's response to CLF 1-12 provides a general indication without showing the exact calculations. It refers to line 24 of Schedule NG-11, which represents the demand-related costs in the most recent cost of service study. The response states that the value for Rate G-02 was used to determine the secondary voltage access fee and adjusted by 75%. However, the $8.55 value for small C&I in line 24 multiplied by 75% is $6.41, not $7.25. The response also states that the values for Rates G-32/G-62 were used to determine the primary voltage access fee and then adjusted by 85% to reflect the relationship between class non-coincident demand and class maximum demand. However, $8.66 in line 24 for General C&I multiplied by 85% is $7.36, not $5. The calculations described in CLF 1-12 do not appear to correspond to the proposed access fee levels. The proposed levels can be approximated by multiplying the $8.55 for small C&I by 85% ($7.27) and the value in line 24 for the 200 kW demand classification of $6.38 by 75% ($4.79). But the values of $7.25 and $5 could have been generated in a different way.

Q. Regardless of the specifics, what appears to be the theory behind the access fee?

A. It appears to be based on the assumption that (1) costs for use of the distribution system by stand-alone distributed generation should be allocated based upon the generation produced at the relevant peak times and (2) payments for those costs should be in the same proportion as unit costs for commercial and industrial demand. In other words, the distribution cost of facilitating exported generation is equivalent to the distribution cost of providing customer demand for arguably analogous customer classes.

Q. Is this economic theory accurate?

A. I do not believe so and, at best, it is unproven. Distributed generation, either "behind the meter" or "stand-alone," should provide a range of distribution-related benefits, but does also come with some integration costs. These distribution-specific costs and benefits likely vary based on the type of distributed generation, as well as other characteristics, such as the size of the system and location on the grid. It is not necessarily economically relevant whether the distributed generation is formally "behind the meter" or "stand-alone".

Q. Assuming, for the sake of argument, that distributed generation with no associated load behind the meter is a relevant economic distinction, did National Grid perform reasonable economic analysis to establish the value of the access fee?

A. No. Much more evidence and analysis is needed before any reasonable conclusions can be drawn about the necessity for or proper size of an access fee of this type.

Q. Does the apparent theory or economic analysis behind the access fee consider the benefits of distributed energy resources?

A. No, the theory and evidence presented by National Grid so far does not consider the benefits of stand-alone distributed generation to the distribution grid, or broader electric system.

Q. Does the theory or economic analysis behind the access fee properly apply equitable ratemaking principles or cost causation principles?

A. No. Equitable ratemaking and cost causation principles require more than an asserted analogy to commercial and industrial rate classes. As our energy system is changing, full analysis of both costs and benefits is now necessary for equitable ratemaking and determination of cost causation.

Q. Does the "cost shift" argument warrant immediate attention?

A. No, I do not believe immediate attention is required for a number of reasons. Based on the information provided in response to data request PUC 1-18, the access fee would collect $818,181 annually from existing and expected projects. However, at this time we do not know the costs – in addition to interconnection/integration costs which are collected up front – associated with managing this generation, which is critical for a proper evaluation of the access fee. Furthermore, as mentioned previously, National Grid has not quantified the benefits – such as avoided energy, capacity, and transmission costs – that these resources would provide to the grid and electric ratepayers in Rhode Island. Taken together, the parties cannot assess whether access fees are warranted and/or set at an appropriate level.

Given that the cost of the program is small in the near term and National Grid has the ability to recover this lost revenue through the decoupling mechanism, I believe it is prudent to take a step back and contemplate a rate design and utility business model that empowers all parties to work toward a modern, clean energy system and not settle for quick fixes.

Q. What are the practical impacts of National Grid's access fee?

A. The access fee proposal discourages stand-alone distributed generation arbitrarily without a good cost causation basis. It imposes additional hurdles on municipalities and farms which stand to benefit from virtual net metering by gaining more control over their energy costs and lowering their electricity bills and, if not appropriately integrated into the Renewable Energy Growth program, it imposes an additional hurdle for those projects as well. This would either reduce the attractiveness of the Rhode Island market for clean energy or encourage shifting from "stand-alone" projects to behind-the-meter projects without a clear cost basis.

IV. CONCLUSION

Q. Do you believe that the proposed access fee by National Grid in this docket is just and reasonable?

A. No, I do not. It is contrary to general rate design principles, Acadia Center's UtilityVision principles, and the public policy goals of Rhode Island.

Q. Do you believe that the proposals of National Grid in this docket should be approved under the balancing factors laid out in R.I. Gen. Laws § 39-26.6-24(b)?

A. No, I do not. This proposal fails to take into account the benefits of distributed energy resources, equitable ratemaking principles, and cost causation principles.

Q. Does this conclude your testimony?

A. Yes, it does.

Next Generation Solar Framework

Policy for Distributed Solar PV

November 2015

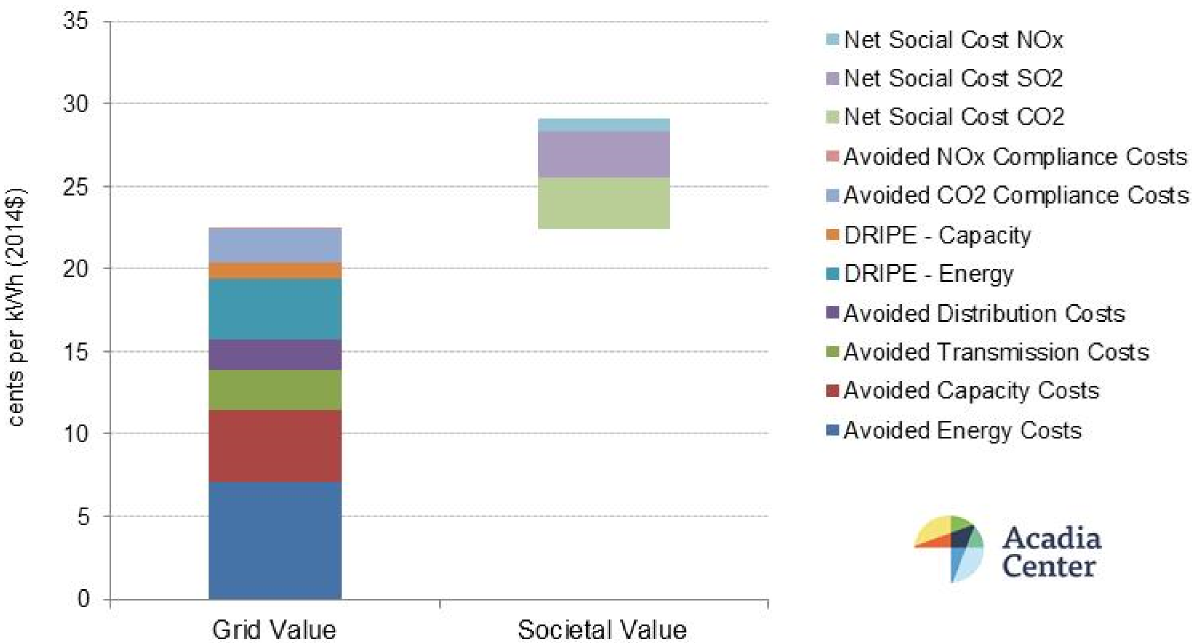
Acadia Center
Advancing the Clean Energy Future

Introduction

Across the United States, a debate is underway about proper rate design and compensation models for distributed energy resources generally and distributed solar photovoltaics (PV) specifically. An important first step in setting policy for distributed solar is to understand the value, or benefits, that distributed solar provides. Over the past year, Acadia Center has released Value of Solar studies that estimate the value of distributed solar generation in five states.

These studies estimate the long-term benefits that distributed solar provides, including avoided energy supply costs, savings related to peak demand reductions, reductions in market prices, and emissions benefits. For example, Acadia Center's Value of Solar analysis for Massachusetts examined a range of avoided costs to ratepayers totaling 22.4 cents per kWh as well as several additional societal benefits totaling 6.7 cents per kWh.

Figure 1: Grid and Societal Value of Solar PV in Massachusetts – 25-year Levelized Cost (2014$)



Policy Framework for Distributed Solar PV

Calculating the value of solar can serve as the basis for a "value of solar tariff", a two-way rate design that requires additional metering, but also can be the basis for other reforms. Any changes to solar compensation should be properly integrated with existing structures that support solar, such as net metering and renewable portfolio standards, and should reflect more general rate design principles like simplicity and understandability. In Massachusetts, Acadia Center worked with allies to develop the "Next Generation Solar Policy Framework for Massachusetts" that includes very specific recommendations for reforms, and these concepts can be applied in other jurisdictions.

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Compensation through Rates (e.g. Net Metering)

Acadia Center's studies, and many others, indicate that the ratepayer value of distributed solar is greater or equal to the retail rate of electricity. In other words, retail rate net metering is generally a fair policy that provides net benefits to ratepayers and society. However, once solar PV reaches significant penetration, balanced reforms can be undertaken to make rate structures more economically accurate and to ensure equitable payment for the distribution grid. In the long run, customers who provide a range of products and services to the electric system should be charged and credited at rates that reflect the granular costs and benefits. Acadia Center's UtilityVision lays out a full agenda for long-term rate reform.

In the shorter term, particularly in jurisdictions without widespread advanced metering infrastructure that enables more granular rate designs, balanced reforms to net metering credit value can be undertaken. These reforms must be based on a credible and publicly scrutinized analysis of the costs and benefits of solar PV, and should represent the full long-term value to ratepayers. A proper value-based policy will address any argument that net metering represents a cross-subsidy. The alignment of net metering credit to ratepayer value should also facilitate expansion of virtual net metering and community shared solar policies by addressing arguments about cross-subsidies. These changes can also be applied to certain categories of projects, such as larger projects where any imbalances are more significant, and existing projects can be grandfathered under current frameworks.

These reforms can occur in a way that changes current net metering credits modestly rather than radically. Currently, in many circumstances, overall net metering credit value is the sum of three components: (1) retail energy supply, (2) transmission, and (3) distribution. In the reform process, the **retail energy supply credit** and **transmission credit** can remain the same, since they are reasonable starting points for avoided costs. However, two new credits that apply to all solar PV should be defined in order to reflect the other attributes of solar: a "**distribution system benefit credit or charge**" and an "**energy system benefit credit**" as elaborated below. In addition, new credits can be created for specific categories of projects, such as **west-facing solar PV** and **solar PV that is located in particularly constrained areas of the distribution grid**. These credits should be paid for by the appropriate set of customers to which the value accrues, for example only the distribution utility should pay for distribution-related credits. It is also worth noting that this same structure can be applied to other generation technologies in addition to solar PV.

Other Compensation Mechanisms (e.g. Renewable Portfolio Standards)

Distributed solar projects also receive financial support from other mechanisms aside from retail rate reductions and net metering. Under this framework, these mechanisms represent broader environmental, economic, and social values, as well as any incremental support needed to build projects and launch an infant solar industry.

These incentives for solar can be benchmarked to the environmental and economic benefits of distributed solar generation, but should be structured to minimize the additional cost necessary to build different types of projects. Such a program can take a variety of forms, but key design features include:

- **Performance-based payments** based on actual generation;
- **Open application processes** that do not start and stop, or leave projects in limbo due to utility interconnection waiting times;
- **Long-term, stable structure** to lower overall costs and enable financing; and
- **Public policy carve-outs** for projects benefiting low-income residents and housing, community shared solar projects, landfill and brownfield projects, and municipal projects.

Over time, these should be integrated into broader frameworks for promoting renewable energy – e.g. Class I renewable portfolio standard policies.

Details on Reformed Net Metering Credit Structure

The following provides additional details on the net metering credit structure introduced on page 2.

Existing credits for all projects

Retail Energy Supply Credit

- Stays the same.

Transmission Credit

- Credit value for solar generators in rate classes with primarily per-kWh transmission rates should stay the same. Projects that are connected to the distribution grid do not use the transmission grid and should receive full offset for transmission.
- Credit value for solar generators in rate classes with demand charges should be switched to a value-based per-kWh credit for transmission.

New credits for all projects

Distribution System Benefit Credit or Charge

- New per-kWh distribution credit or charge should reflect the net value to the distribution system, including avoided distribution infrastructure investments, improved local reliability and reduced vulnerability to failures or disruption, and improved power quality, as well as any solar integration costs.
- This value can be determined separately for different categories of projects.

Energy System Benefit Credit

- New per-kWh credit incorporates energy system benefits above and beyond retail generation credit.
- These benefits include the additional value for energy and capacity from the generation profile of solar, reduction in line losses, wholesale energy and capacity market price suppression, fuel price risk mitigation, and reasonably foreseeable avoided public health and environmental compliance costs.

Credits that apply to select projects

Distribution Locational Credit

- Applicable to distributed generation that provides additional ratepayer value in areas of the grid that are particularly constrained.

West-facing Solar Credit

- Applicable to west-facing solar, which provides proportionally more on-peak generation and generates greater benefits related to peak demand than south facing solar, which maximizes energy production.

Conclusion

Balanced solar policy depends on valuing the unique benefits that distributed generation provides to customers, the grid, and society. The Next Generation Solar Framework lays out a balanced approach to account for system-wide benefits and costs, while optimizing payment structures and advancing complementary public policy objectives.

For more information:

Mark LeBel, Staff Attorney, mlebel@acadiacenter.org, 617.742.0054 ext. 104

Value of Distributed Generation

Solar PV in Rhode Island

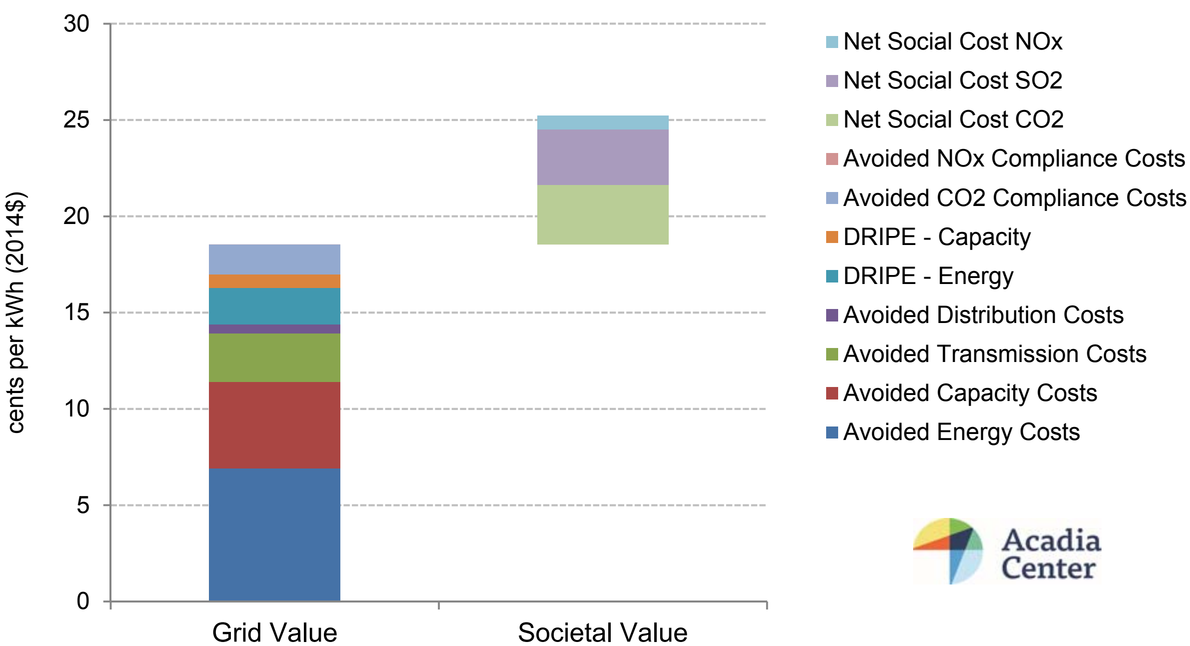
July 2015

Overview

Distributed energy resources (DERs) like solar photovoltaic (solar PV) systems provide unique value to the electric grid by reducing energy demand, providing power during peak periods, and avoiding generation and related emissions from conventional power plants. The overall value of solar is the sum total of these different benefits, which vary based on the time and location of output from solar panels.

Acadia Center assessed the grid and societal value of six marginal solar PV systems to better understand the overall value that solar PV provides to the grid. By evaluating an array of configurations, this analysis determines that the value of solar to the grid – and ratepayers connected to the grid – ranges from 19-25 cents/kWh, with additional societal values of approximately 7 cents/kWh. Figure 1 shows the grid value of a south-facing system (azimuth of 180 degrees) with a 35 degree tilt from horizontal and the corresponding, additional societal value.

Figure 1: Grid and Societal Value of Solar PV in Rhode Island – 25-year Levelized Cost (2014$)



The results of this analysis demonstrate that solar is a valuable local energy resource that provides benefits to all ratepayers and society. Deployment of clean distributed resources should be encouraged not capped. Solar PV, especially west-facing systems, can help reduce the cost of the electricity system, and while utilities should be appropriately compensated for the services they provide, DERs must also be fairly credited for the electricity and benefits they provide to the grid.

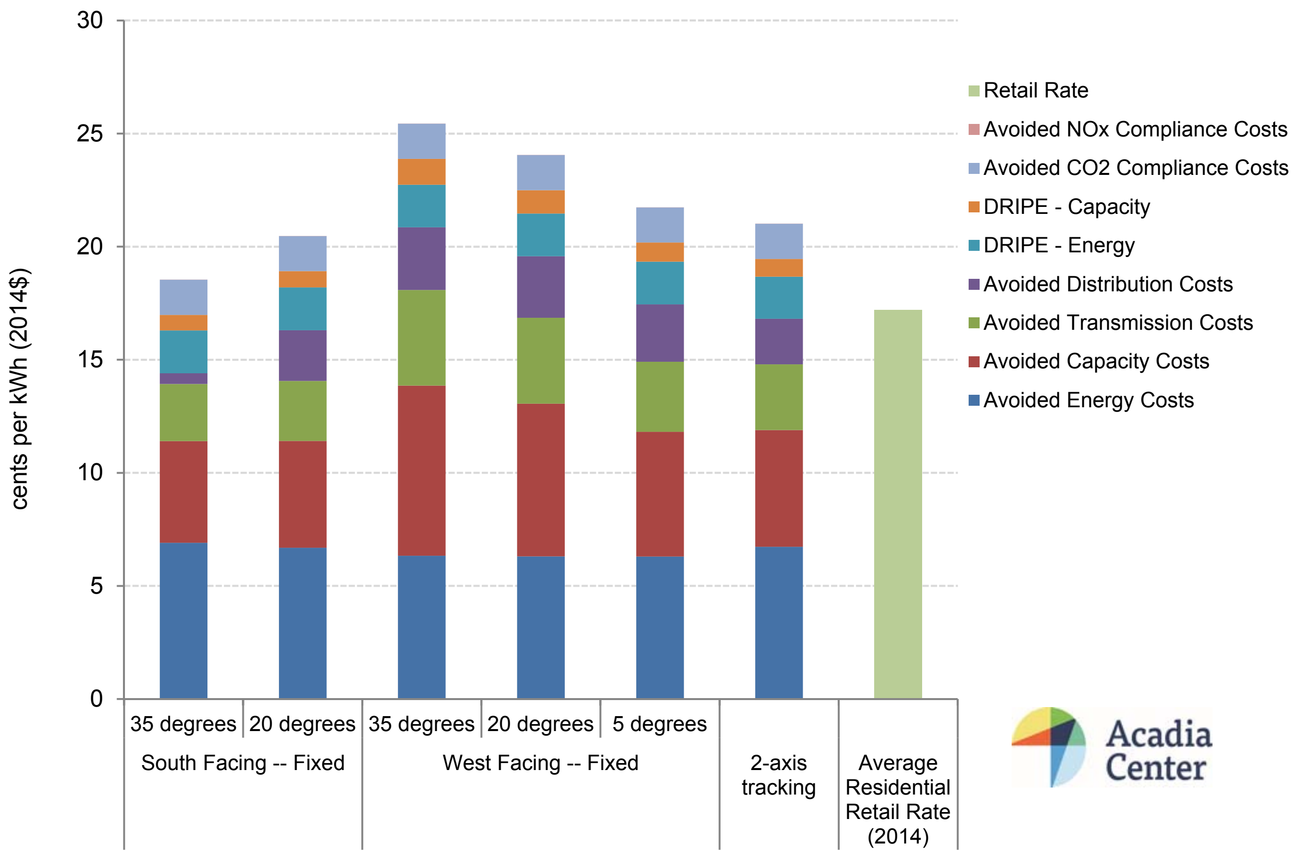
Grid Value of Solar PV

To understand how the value of solar generation is different during different times, it is worth noting that the price of electricity varies throughout the day. For example, at 6 a.m. on July 19, 2013, the average wholesale market price of electricity in Rhode Island was $49.28 per MWh; by 4 p.m. the price had jumped to $216.86 per MWh. A solar PV system feeding electricity into the grid at 4 p.m. on July 19, 2013 would have offset the need to purchase energy from another generator at the high market rate.

In addition to avoided energy costs, behind-the-meter solar PV helps offset other costs associated with the electric grid and, ultimately, all ratepayers' electricity bills. These include: avoided capacity costs; avoided transmission and distribution costs; energy and capacity market price suppression effects (also called demand reduction induced price effects or "DRIPE"); and, avoided environmental compliance costs. While not included in this phase of analysis, there is additional locational value associated with solar PV and other DERs if they are strategically located on the grid to help avoid the need for expensive infrastructure upgrades. This can increase the avoided distribution cost component and help direct more DER to be installed where it generates the most value.

Below are the results of Acadia Center's assessment of the value of an additional solar PV system installed near Cranston, RI (population-weighted center of RI). The methodology behind each component is available at: http://acadiacenter.org/?p=1764, and the precise values are provided on page 3 and in Appendix A. The average residential retail electric rate in Rhode Island is included as a point of comparison as residential rates are typically the level at which net metered customers are compensated. It would be more accurate to show the average residential retail rate in 2015, but because that data will not be available until the year has ended, 2014 rates are included here. The values for Rhode Island are slightly lower than the results from Acadia Center's Massachusetts and Connecticut value of solar studies, which is primarily due to lower DRIPE energy and capacity values, lower avoided distribution costs, and, to a lesser extent, lower avoided environmental costs.

Figure 2: Grid Value of Solar PV in Rhode Island – 25-year Levelized Cost (2014$)



Note: Where appropriate, avoided reserve capacity costs, transmission and distribution losses, and a wholesale risk premium or price hedge are included in the calculations.

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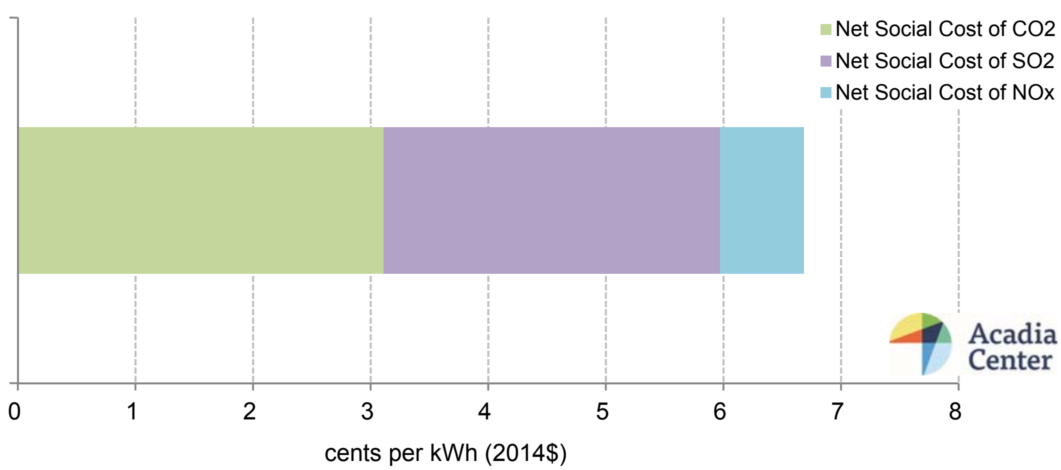
This assessment considers six different solar PV system orientations: 1) south-facing (azimuth of 180 degrees) with a 35 degree tilt from horizontal; 2) south-facing with a 20 degree tilt; 3) west-facing (azimuth of 270 degrees) with a 35 degree tilt; 4) west-facing with a 20 degree tilt; 5) west-facing with a 5 degree tilt; and, 6) a 2-axis tracking system. As shown in the figure above, the orientation of a system will deliver different values per kWh. For example, capacity-related values are larger in west-facing systems because these systems are more available during ISO reliability hours (i.e., west-facing systems that produce more energy in the afternoon). As noted below, the south and west-facing systems generate approximately the same level of absolute benefits ($) over the year; however, because these benefits are spread over fewer kilowatt-hours (due to less overall output), the result is higher per-kilowatt values for the west-facing systems, as shown in Figure 2.

Societal Value of Solar PV

Solar generates significant additional societal benefits. Economic benefits and the avoided social costs of greenhouse gas emissions and other pollutants such as sulfur dioxide enhance the value proposition of solar PV, and should be used by policymakers and other stakeholders to evaluate the net societal benefit of solar PV.

Below are the results of Acadia Center's assessment of the net social cost of carbon dioxide (CO2), sulfur dioxide (SO2), and nitrogen oxides (NOx). The societal benefits in Figure 3, below, are separate from and additional to the compliance costs for CO2 and NOx included above in Figure 2 (i.e. the values below are the social benefits only). The net environmental benefit of 6.7 cents per kWh shown in Figure 3 is the value of avoiding the average marginal kilowatt-hour of electricity. This average value can be used in the aggregate for determining the overall societal benefits.

Figure 3: Additional Societal Benefits of Solar PV in Rhode Island – 25-year Levelized Cost (2014$)



As with the components in Figure 2, the value of avoided emissions will change with increased levels of solar penetration and resulting impact on generation dispatch. Assessments that incorporate a fleet of savings may return a higher per unit value for avoided emissions if the fleet of solar pushes a more polluting generator out of the resource mix. As discussed below, it is important to get the numbers right and regularly update them to reflect changing system conditions over time.

Maximizing Benefits to the Grid

One of the key findings of this analysis is that a "flat" system of compensation – such as net metering – can distort the market for solar PV by inadequately valuing the benefits that west-facing systems provide in mitigating costs driven by afternoon peak demand. This is illustrated in the table below comparing the unit Value of Solar and Total Annual Value for each of the configurations described above, and a 2-axis tracking system which orients panels toward the sun throughout the day. Under a Value of Solar approach, the total annual value of a 5 kW south-facing system @35°

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($1,300/yr) would be similar to the total value of a 5 kW west-facing system @35° ($1,397/yr), because the higher energy production benefits of the south-facing system are roughly matched by the higher peak mitigation-related benefits of the west-facing system. In contrast, under net metering the west-facing system would receive almost 20% less compensation than a south-facing system (see Table 1).

Table 1: Grid Value of Solar, Annual Output and Total Annual Value by System Type

	South-facing @ 35˚	South-facing @ 20˚	West-facing @ 35˚	West-facing @ 20˚	West-facing @ 5˚	2-axis tracking
Unit Value of Solar (cents/kWh)	18.9	20.5	25.4	24.1	21.7	21.0
Total Annual Output (kWh)	6,879	6,664	5,501	5,671	5,805	8,878
Total Annual Value ($/yr)	$1,300	$1,366	$1,397	$1,367	$1,260	$1,864
% +/- credited under net metering compared to south-facing @ 35˚	100%	- 8%	- 26%	- 22%	- 13%	- 10%

The differences in value for production from south-facing and west-facing systems also have implications for the appropriate design of policies to incent solar generation. Incentives should be designed to maximize the value that the solar PV resource provides to both system owners and all ratepayers rather than simply kWh throughput. This helps ensure that incentives are fair and optimize grid support.

Implications & Policy Recommendations

1. Solar generation is a valuable local energy resource that provides significant benefits to all ratepayers, with a per-kWh value in excess of retail rates. In the aggregate, net metering is a fair policy.
2. Once sufficiently high levels of solar PV are installed, discrepancies between the individual pieces of the value of solar and the individual pieces of retail rates should be corrected. One mechanism to do this is a "value of solar" tariff, where generation is credited at an administratively determined rate. Under this framework, individual value components can be accounted for properly. For example, only the distribution system portion of solar benefits would be paid for directly by the distribution company and the cost of the energy portion could be included in basic service rates. Such a tariff avoids any need for minimum bills or increased fixed charges, policies that reduce customers' control over their energy costs without any economic justification. See Acadia Center's UtilityVision for additional rate design recommendations and information on fixed charges.
3. Current policies may discourage the installation of west-facing systems. For customers who cannot install south-facing solar, new policies recognizing the value of west-facing solar could be beneficial for both ratepayers and society.
4. Societal benefits should be used when assessing the costs and benefits of solar PV and determining additional incentives.
5. Locational values have not been considered in this study, but are important to maximize the savings in distribution costs that solar can bring to ratepayers. Appropriate incentives can ensure that solar PV, energy efficiency, and other customer-side resources are targeted to defer or avoid the need for new infrastructure spending.

For more information:

Leslie Malone, Senior Analyst, Energy and Climate, lmalone@acadiacenter.org, 401-276-0600

Appendix A

Components of the Grid Value* of Solar PV in Rhode Island – 25-year Levelized Cost (2014$)

	25 Year Levelized Value (cents/kWh) of the DG Resource in 2014$					
	South Facing -- Fixed		**West Facing -- Fixed**			**2-axis tracking**
Component	35 degrees	20 degrees	35 degrees	20 degrees	5 degrees	
Avoided Energy Costs	6.91	6.69	6.34	6.31	6.30	6.73
Avoided Capacity Costs	4.49	4.72	7.52	6.75	5.51	5.16
Avoided Transmission Costs	2.53	2.65	4.23	3.79	3.10	2.90
Avoided Distribution Costs	0.47	2.24	2.77	2.72	2.54	2.02
DRIPE - Energy	1.90	1.89	1.88	1.89	1.89	1.86
DRIPE - Capacity	0.69	0.72	1.15	1.03	0.84	0.79
Avoided CO2 Compliance Costs	1.55	1.55	1.55	1.55	1.55	1.55
Avoided NOx Compliance Costs	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006

* Value of avoiding a marginal kilowatt-hour of electricity.

Components of the Societal Value* of Solar PV in Rhode Island – 25-year Levelized Cost (2014$)

	25 Year Levelized Value (cents/kWh) in 2014$
Net Social Cost of CO2	3.11
Net Social Cost of SO_2	2.86
Net Social Cost of NOx	0.71
Total Social Value	**6.68**

* Value of avoiding the average marginal kilowatt-hour of electricity.

acadiacenter.org • admin@acadiacenter.org • 617.742.0054 ext. 001
Boston, MA • Hartford, CT • New York, NY • Providence, RI • Rockport, ME • Ottawa, ON, Canada