

Solar Energy in Michigan: The Economic Impact of Distributed Generation on Non-Solar Customers

Executive Summary

On April 20, 2017, Michigan’s new Clean and Renewable Energy and Energy Waste Reduction Act and revisions to Michigan’s general public utilities act (Public Acts 341 and 342 of 2016) took effect. Among other things, the new laws require the Michigan Public Service Commission (“MPSC” or “Commission”) to “conduct a study on an appropriate tariff reflecting the equitable cost of service for utility revenue requirements for customers who participate in a net metering program or distributed generation program” within one year. (1)

This new statutory provision reflects the rapid growth in the installation of solar distributed generation (herein referred to as “solar DG”¹) systems, and concerns regarding the impact of net energy metering (NEM) policies on ratepayers and utilities. Opponents of NEM argue that giving net metering customers full retail credit for the surplus energy they generate overvalues both the capacity and energy that solar DG systems provide. As a result of this pricing structure, opponents assert that net metering customers are able to avoid paying for the grid support services on which they rely and are, therefore, being subsidized by non-solar customers. Establishing a new tariff that reflects the equitable cost-of-service is a means to ensure fairness for both for those ratepayers who have installed solar DG systems and those who have not.

Rather than endorsing additional costs on non-solar ratepayers, however, a majority of studies conducted to date have concluded that the utilization of NEM for solar DG offers net benefits to the electric system as a whole, including non-solar customers. Rather than shifting costs to other ratepayers, the growth of solar DG systems in most cases helps to reduce overall costs and represents a net benefit to all utility customers.

This report by the Institute for Energy Innovation (IEI) is intended to (1) summarize the national data related to evaluating the “value of solar” (VOS) to the overall grid; and (2) to outline “best practices” for compensating net metering customers. Through this report, IEI seeks to inform

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¹ There are a variety of terms used to describe small-scale energy resources. Distributed energy resources (DER) or distributed generation (DG) is often used to refer to a broad set of technologies located on the distribution grid, often close to a customer’s premises. DER can include solar, small-scale wind, geothermal, combined heat and power, battery storage, demand response, electric vehicles, and energy efficiency, among other technologies. In this report, we specifically focus on solar distributed generation and use the more narrow term “solar DG” herein.

discussions regarding net energy metering (NEM) across Michigan, and ensure that the aforementioned study being conducted by the MPSC accurately reflects the true costs and benefits of solar DG in Michigan.

Part I of this report considers the growth of solar DG across the country, as well as the increasing controversy over NEM policies that is driven, in large part, by concerns that non-solar ratepayers are effectively subsidizing those who install solar DG systems.

Part II reviews the dozens of recent studies comparing the value of solar and NEM policies. While there is substantial variability between studies in terms of the assumptions and methodologies employed, a majority of these studies conclude that NEM represents a net benefit to ratepayers – even those that are not enrolled and who have not installed solar DG systems. It also outlines a standard comprehensive methodology developed by the Interstate Renewable Energy Council (IREC) to address the variability between studies in order to enable “apples-to-apples” comparisons between value of solar calculations.

Part III offers a series of recommendations for the MPSC to consider in crafting the study on an appropriate distributed generation tariff as required under MCL 460.6a.

IEI’s Key Findings:

- The majority of studies conducted to date find that customers participating in net metering programs represent a net benefit to the grid.
- While NEM customers receive credits that reduce or eliminate their monthly utility bills, solar DG provides measurable and monetizable benefits to the power system that should be considered when evaluating the true impact of solar DG and NEM on all ratepayers.
- Solar DG both reduces demand for power from the utility and provides power to the grid when the systems generate more power than is used at a residential or commercial site. This surplus power is generated at or near peak times when the cost to the utility of procuring additional power is most expensive.
- Net energy metering represents an attempt to balance the true costs and benefits of the energy being produced and that which is consumed in a way that is simple, fair, and convenient for both the utility and its customers. Therefore, any tariff should fully compensate solar DG customers for the value their systems provide.
- Adopting a transparent, comprehensive standard valuation methodology such as the IREC model can help ensure full accounting of both the costs and benefits of solar DG. While the calculations necessary to develop a value of solar differ from those needed to assess the cost to serve solar DG customers, IEI specifically endorses the Commission’s

intent to include a VOS study as part of its examination of the costs and benefits associated with distributed generation and net metering.²

- Because locational factors can affect solar valuations, access to location-specific utility data should be made available to stakeholders as part of the development of new tariff mechanisms.

² Indeed, in its May 31, 2017 Order involving the method and avoided cost calculation for Consumers Energy Company to comply with the Public Utility Regulatory Policies Act in Case No. U-18090, the Commission noted that a VOS analysis as part of the PURPA review would be “potentially duplicative, given the directive under the new energy legislation, which requires the Commission to create a distributed generation program and examine costs associated with distributed generation and net metering MCL 460.1173 and MCL 460.6a(14). Accordingly, the Commission anticipates that VOS issues, as well as other avoided costs associated with distributed generation generally, will be examined as part of these proceedings.” (2)

PART I: Rapid Growth of Solar Distributed Generation: The Growing Concern Over Cross-Subsidization

Driven by declines in the cost of solar components, greater competition among solar installers, and growing familiarity with solar DG and its benefits, national solar DG has expanded by more than 50 percent annually over the last four years, with 2,158 MW of solar DG added in 2015 (2) and 2,583 MW installed in 2016 (3). In Michigan, solar DG systems installed through NEM programs grew 20 percent from 2014 to 2015, adding 2570 kW in 2015 (4).

This growth has been facilitated by the expansion of state-based NEM programs. As of 2016, 41 states, the District of Columbia, and four US territories had NEM policies (Figure 1) (5). These programs allow customers who deploy solar DG systems to directly offset their electricity usage and receive a credit for any excess electricity they generate. These credits may be applied to “net” out electric bills, essentially allowing these customers to run their meters backward during periods of surplus generation. The National Association of Regulatory Utility Commissioners (NARUC) concludes that NEM policies are simple, easily understood by ratepayers, and the least expensive means by which a utility can implement a compensation methodology for a distributed energy resource (6).

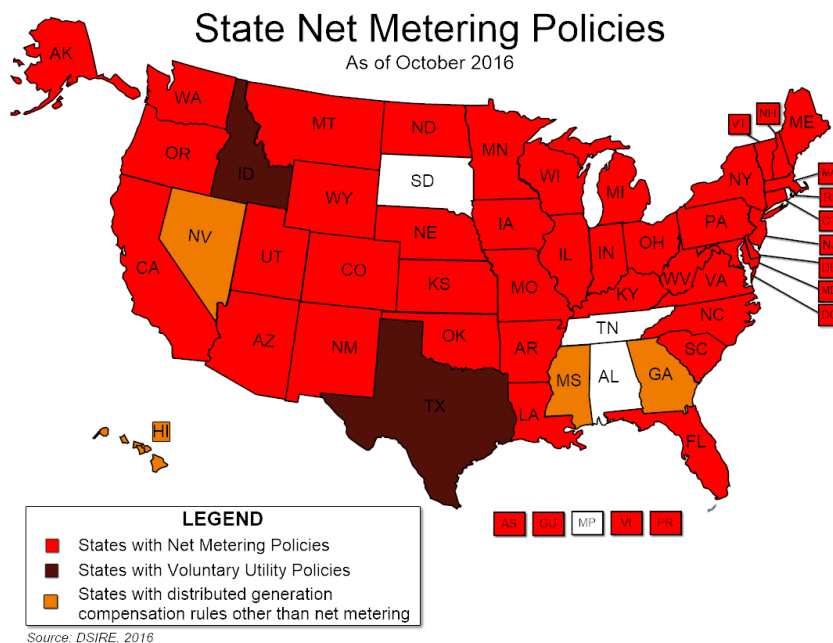


Figure 1. State net energy metering policies

Concerns Over Potential Cost-Shifts and Cross Subsidization

There is growing concern among utilities and some others that customers participating in NEM programs reap economic advantages over non-participating customers. As more customers take advantage of NEM, utilities are confronted with loss of revenue and a concern that the fixed

costs for maintaining and administering the power system will be spread among a declining number of non-NEM ratepayers. Under this view, customers who install solar DG systems and take advantage of NEM avoid paying other costs associated with operating and maintaining the electric power system, including costs for backup power, transmission and distribution. In addition, opponents argue that customers with installed solar DG systems do not pay their fair share of billing, metering and administrative services. Some utilities assert that “cross-subsidization” occurs because NEM customers continue to use the electric grid to receive power when their systems are not producing, but the credits they receive for sending their excess power back to the grid allow them to avoid paying their share of the fixed costs. Acting on these concerns, a total of 212 state and utility-level distributed solar policy and rate changes were proposed in 2016 (7), with Indiana recently rolling back its NEM program.

While it is true that NEM customers receive credits that reduce or eliminate their monthly electric bill, solar DG provides measurable and monetizable benefits to the power system – benefits that should be considered when evaluating the true impact of solar DG and NEM on ratepayers and society as a whole.

Solar DG both reduces demand for power from the utility and provides power to the grid when the systems generate more power than is used at a residential or commercial site. Typically, solar DG systems produce power during periods of the day when electricity is more expensive and demand is starting to peak. When this electricity is exported to the grid, the utility does not have to generate that electricity at more distant power plants, purchase power during times it is most expensive, or deliver it using the transmission and distribution system. Under NEM, customers supplying excess power receive a bill credit to offset their demand, which is often used at off-peak times when power is relatively cheap. As such, NEM represents an attempt to balance the true costs and benefits of the energy being produced and consumed in a way that is simple and convenient for both the utility and its customers.

In addition, while NEM policies may affect the economic returns for both ratepayers and utilities, the total impact of these policies is no more, and sometimes significantly less, than other factors that influence ratepayer bills and utility revenues. The Lawrence Berkeley National Laboratory (LBNL) and National Renewable Energy Laboratory (NREL) conducted an analysis of the financial impact of increasing amounts of solar DG on both ratepayers participating in and those not participating in solar DG (8). The study concluded that:

- Cross-subsidies, wherein a customer pays more or less than their allocated share of embedded costs, are pervasive and in some cases intentional within traditional rate design.
- Customers who install solar DG systems sometimes pay considerably more than their allocated share of embedded costs.
- Cost-shifting and cross-subsidies are not the same thing. The alleged cost-shift on which utilities and others focus their critiques of NEM may actually serve to reduce what, in the absence of NEM, would have been an even larger cross-subsidy. This is because many

solar DG customers tend to be relatively high-use customers who already pay more than their allocated share of embedded utility costs. In these cases, the supposed cost-shift only serves to slightly decrease the subsidization of costs for non-solar DG customers.

- Energy efficiency programs implemented over the past two decades have reduced U.S. retail electricity sales by roughly 4.3 percent through 2014. This is roughly 15 times larger than the cumulative impact from all solar DG systems installed nationwide.³

Efforts to Address Cross-Subsidization Concerns

Policymakers, utilities, public utility commissions and customers have an interest in understanding the actual costs imposed on the power system by solar DG as well as the value of the benefits solar DG provides. Determining the “real value” provided by solar DG to the electricity system is fundamental to establishing rates and tariffs that are just and reasonable. Determining the value of solar is also central to integrated resource planning exercises, particularly as distributed energy resources begin to supplant energy and capacity traditionally provided by central base load plants.

To address the many issues involved in valuing the exchange of energy between solar DG systems and the grid, NARUC recently released a manual (9) to guide the process of how distributed energy resources (DER), including solar DG, should be compensated. NARUC acknowledges that it is the responsibility of utilities to fairly value these resources in servicing their customers, and to ensure such valuations fully reflect the grid and societal benefits DER provide. The NARUC manual finds that:

“...a growing number of parties involved in the DER debate acknowledge DER can provide material benefits beyond just those enjoyed by the customer behind whose meter the DER is sited... Some jurisdictions, utilities, researchers, and advocates have also concluded or posited that responsible encouragement of other types of DER adoption leads to positive cost benefit results. In this respect, when using the traditional model for rate design, which does not compensate (or charge) particular customers for producing particular benefits (or costs) for the grid... a regulator would be missing that portion of the cost benefit analysis for DER... At the very least, neglecting DER benefits could represent a lost opportunity to meet customer needs on a more cost-effective basis. To put it another way, if a regulator conducted a detailed planning process beyond the distribution grid using today’s technology, theoretically, some level of DER (beyond [energy efficiency]) could be used in a targeted basis throughout the grid to reduce costs.”

³ There are two lessons to draw from the comparison to energy efficiency. First, those installing energy efficiency upgrades reduce utility revenues by decreasing the number of kilowatt hours sold. This is similarly true for those installing distributed generation systems. It is unclear why the loss of sales – and subsequent spreading of fixed grid costs – is treated differently between those who use less utility-generated power through conservation versus those who use less utility-generated power by generating a portion of their own power on site. Second, reducing energy use is proven to have broad benefits for all ratepayers, including those customers who do not install efficiency upgrades themselves, by delaying or in some cases eliminating the need for costly new generation. As customers continue to spend their own money to install distributed generation systems, in the long-term, ratepayers as a whole will similarly see savings associated with the reduced need for new utility-generated power.

For example, several states are exploring how to use DER to avoid infrastructure investments.”

In December 2016, Michigan Governor Rick Snyder signed into law the Clean and Renewable Energy and Energy Waste Reduction Act and updates to the state’s general public utilities act, which took effect on April 20, 2017. Among other things, the laws begin to address how solar DG should be valued by requiring that the MPSC conduct a study to determine the appropriate tariff for distributed generation to ultimately replace current NEM policy. The new law requires an examination of the cost of service for distributed generation using standard ratemaking principles.

PART II: Determining the True Value of Solar

At the heart of any effort to develop “an appropriate tariff reflecting equitable cost of service for utility revenue requirements for customers who participate in a net metering program or distributed generation program,” as required by MCL 460.61(14), is an understanding and analysis of the various costs and benefits solar DG provides to the grid. Identified solar DG benefits include:

- **Avoided energy:** The value of energy (including fuel and operation/maintenance costs) and displacement of peak load that would otherwise need to be produced without solar DG. This calculation is based on the estimated present value of the avoided cost of generation levelized over 30 years from the generation source most likely to be displaced. It should include fuel, operation, and maintenance costs, and should be made with reference to the time-of-day value of energy.
- **Avoided generation capacity:** The value of displacing additional generation needed to meet peak loads and reserve capacity. Despite being intermittent, solar DG allows a utility to avoid acquiring a certain amount of additional capacity.
- **Avoided transmission and distribution system losses:** The value of avoided electricity losses from transmission and distribution lines conveying electricity. System line losses average 7 percent, but losses are higher during periods of peak demand. Because solar DG electricity production correlates with periods of peak demand, value of solar calculations should reflect the added value of these decreased marginal line losses.
- **Transmission and distribution capacity:** The value of eliminating or deferring the need for additional transmission and distribution capacity as well as the value of relieving congestion. Solar DG is usually located in close proximity to load, thereby reducing the use of the transmission and distribution system. The reduction in use results in avoided or deferred capital, operation, and maintenance costs as well as reduced congestion. This value may take into account the avoided costs of upgrades to wiring, transformers, voltage-regulation devices, and control systems.
- **Grid support services:** The value of providing ancillary services including reactive supply and voltage control, frequency regulation, and balancing supply and demand.

- Solar DG will provide increasingly valuable grid support services as its use increases with the deployment of smart inverters and energy storage systems (10).
- **Fuel hedge value:** The value of reduced reliance on fuel-based generation, including natural gas, coal, and diesel fuels that are susceptible to market price volatility (11). Solar DG provides electricity at a long-term fixed cost, reducing financial risk from exposure to fuel price volatility.
 - **Price suppression:** The value of reducing the demand for electricity from the grid and lowering the market price of electricity. Solar DG, like wind energy and utility-scale solar energy, reduces overall load, which suppresses the wholesale cost of electricity (12).
 - **Grid reliability and resiliency:** The value of improving the performance of the grid in terms of reduced number and duration of outages.
 - **Environmental and health benefits:** The value of an array of quantifiable and monetizable environmental benefits. These include a) reducing the cost of environmental compliance and environmental controls; b) reducing greenhouse gas emissions (e.g., carbon dioxide); c) reducing criteria air pollutant emissions (e.g., particulates, nitrogen oxides, sulfur dioxide); d) reducing the costs associated with negative health impacts and higher mortality rates; e) assisting in the attainment of renewable portfolio requirements; and f) water savings.
 - **Societal benefits:** The value solar DG provides through the implementation of broad, consensus-based social and political goals as well as direct and indirect benefits to the economy. According to the U.S. Department of Energy, the solar workforce grew by 25 percent in 2016, adding around 73,000 new jobs (13). More than half of these new jobs involve primarily installing residential solar DG systems.

Solar DG can also trigger additional costs, including:

- **Utility revenue loss:** The loss of sales of electricity.
- **Administrative costs:** Includes utility accounting, metering and billing services that must be adjusted to accommodate programs to compensate solar DG customers.
- **Interconnection costs:** Only relevant if the solar DG customer does not pay the full cost of interconnection.
- **Integration costs:** The expenditures a utility incurs to integrate solar DG into the overall grid.
- **Rebate and incentive costs:** The costs of program offerings by utilities for solar DG customers that reduce net revenue.

While monetizing some costs and benefits – such as avoided energy fuel and capacity costs – is straightforward, establishing the value of other costs and benefits – such as increased resiliency, environmental and health savings, and social benefits – can be more difficult. As a result of this variability, it is sometimes difficult to compare the growing number of value of solar studies that have been published in recent years. It is possible, however, to draw general conclusions regarding the value of solar and the impact of NEM on ratepayers. Looking at more than 30 recent studies, IEI found that a preponderance of these studies - whether by public utility commissions, utilities, national laboratories, or firms specializing in energy accounting –

conclude that the value of solar is higher than NEM rates. This indicates that the economic benefits of NEM outweigh the costs to the utility and that, rather than imposing a net cost, NEM is in most cases a net benefit.

Examining Value of Solar Studies

In seeking to develop general principles on the value of solar, IEI examined three recent meta-analyses evaluating a total of more than 40 solar studies from across the nation.⁴ In addition, IEI itself reviewed nine additional studies published since 2015 and not included in any of the previous meta-analyses.

In general, the majority of the studies conclude that the total value of the benefits solar DG provides exceed the retail cost of electricity to ratepayers, and that the value of solar is greater than the compensation to solar DG customers under NEM policies. In other words, customers deploying solar DG and participating in NEM programs are actually cross-subsidizing non-participating customers. In contrast, the limited number of studies that calculate the value of solar to be less than retail electricity rates typically do not include a full and complete measurement of solar benefits. These studies are often conducted by or for utilities (15).

The following value of solar meta-analyses were surveyed for this report:

1. Brookings Institution, 2016 (16)

The developing national literature on the costs and benefits of NEM conclude that the economic benefits of NEM outweigh the costs and impose no significant additional costs on ratepayers who do not install solar DG systems. This analysis surveyed studies conducted by regulators in ten states between 2013 through 2015 in addition to less-formal studies conducted by other states and those by nonprofit organizations, think tanks, and universities. The authors conclude that “[far] from a net cost, net metering is in most cases a benefit – for the utility and for non-solar ratepayers.” The analysis notes that while the value of solar DG will decline at much higher levels of penetration due to the reduced value of peak energy production, at existing levels of penetration (i.e., less than 1 percent), both solar DG ratepayers participating in NEM and ratepayers without solar DG experience economic benefits.

2. Environment America Research and Policy Center, 2016 (17)

This meta-analysis reviews 16 value of solar studies. Twelve of the studies conclude that residential and commercial customers who deploy solar DG provide more services and deliver more benefits to the electricity grid and to society than they receive through NEM. These benefits are in the form of avoided energy costs, reduced line losses, avoided capital investments, reduced price volatility, increased grid resiliency, avoided environmental compliance costs,

⁴ A meta-analysis is a method for systematically synthesizing pertinent qualitative and quantitative data from multiple studies to develop a single conclusion that has greater statistical power (14).

avoided greenhouse gas emissions, reduced air pollution, and local economic development (Figure 2).

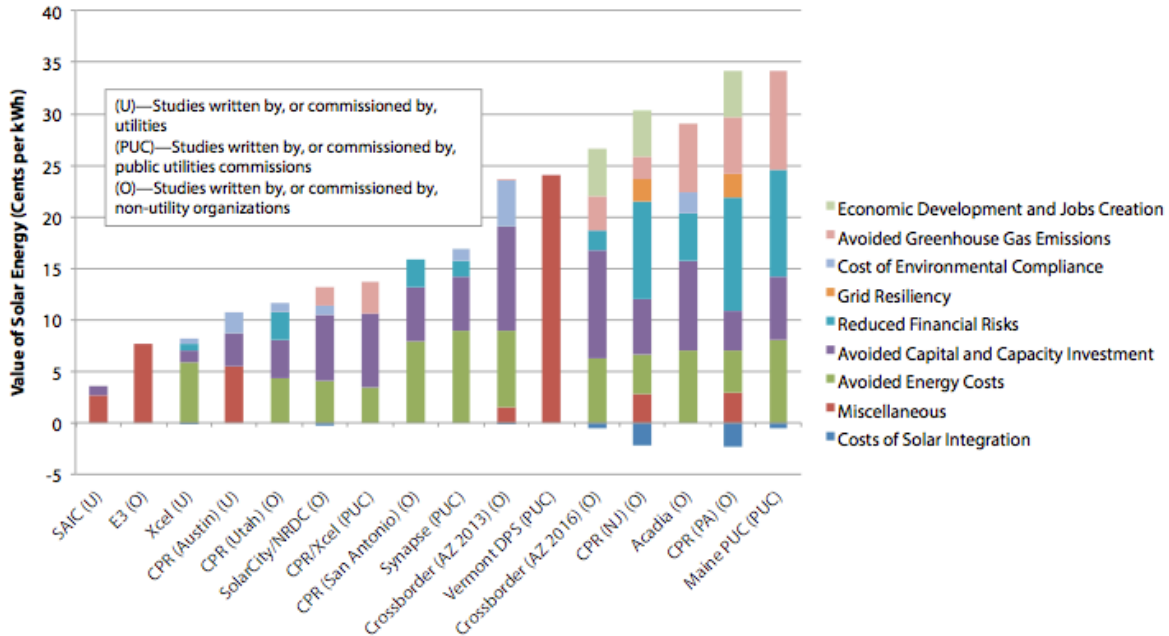


Figure 2. Components of value of solar studies surveyed by Environment America Research and Policy Center.

The studies found that the value of solar ranged from 3.56 cents per kWh to 33.60 cents per kWh, depending on which costs and benefits were included, as well as location-specific differences such as electricity prices and energy markets. Notably, three of the four studies that found that the costs of solar DG outweighed its benefits were commissioned by utilities and did not include many of the environmental or societal benefits of solar DG. Those studies are:

- a) A 2013 study by Science Applications International Corporation (SAIC) for the Arizona Public Service Company, an investor-owned utility, valued avoided capacity investment costs for generation, distribution and transmission at 2.7 cents per kWh and added 0.8 cents per kWh for other avoided costs. No other benefits of solar DG were considered.
- b) A 2013 study by Xcel Energy, an investor-owned utility, analyzed 59 MW of solar DG deployed in Colorado in 2012 and 81 MW of solar DG that would be installed by the end of 2014. The study valued avoided energy costs, avoided capacity costs, reduced financial risks, and avoided compliance costs at 8.04 cents per kWh. More recently, Xcel Energy participated in value of solar proceedings in Minnesota and calculated a higher value of solar (12.75 cents per kWh) due to the inclusion of avoided greenhouse gas emissions.
- c) A 2013 study by Clean Power Research for Austin Energy, a municipal-owned utility, valued avoided energy costs, capital investments, capacity costs, and environmental compliance costs at 10.7 cents per kWh – only slightly below the retail price of electricity.

3. **Rocky Mountain Institute, 2013 (18)**

This meta-analysis by the Electricity Innovation Lab at the Rocky Mountain Institute (RMI) involved utility, regulatory and industry experts who reviewed 16 value of solar studies published between 2005 and 2013 to better understand the “categorization, methodological best practices, and gaps around the benefits and costs” of solar DG. Similar to the Environment America analysis, the RMI study found a value of solar ranging from 3.56 cents per kWh to 33.93 cents per kWh. This variability was primarily attributable to the number of identified benefits of solar DG that were monetized and included in the studies. RMI found that although there is general agreement on the approach taken to estimate the energy and capacity benefits of solar DG, there is significantly less agreement on the ways to estimate the benefits provided to grid support services, decreased financial and security risk, and environmental benefits.

4. **Institute for Energy Innovation, 2017**

In addition to considering existing meta-analyses, IEI also surveyed more recent studies to update existing value data. The recent studies reviewed by IEI include:

- 2015: Maine. Submitted to the Maine Public Utility Commission (19)
- 2015: Tennessee Valley Authority (20)
- 2016: Arizona. Submitted to the Arizona Corporation Commission by Crossborder Energy for The Alliance for Solar Choice (21)
- 2016: Nevada. Submitted to the Public Utilities Commission of Nevada by Energy + Environmental Economics (E3) (22)
- 2016: Nevada. Conducted by SolarCity and the Natural Resources Defense Council (23)
- 2016: Texas. Austin Energy 2016 update (24)
- 2016: Minnesota. Submitted to Minnesota Public Service Commission by Xcel Energy (25)
- 2015: Michigan. Submitted to Traverse City Light and Power 2015 by Utility Financial Solutions (26)
- 2016: Michigan. Submitted to Marquette Board of Light & Power by Utility Financial Solutions (27)

Similar to the range of studies included in the other meta-analyses, the studies reviewed by IEI reveal a wide array of differing assumptions and methodologies, yielding solar valuations that ranged from 6.64 cents per kWh to 33.7 cents per kWh. As in the other studies, there was a correlation between the number of benefits identified and monetized and the calculated value of solar. The two Michigan value of solar studies, for example, failed to include a number of solar benefits included in many other studies, including grid services, hedge value against fuel price inflation, market price suppression value, and environmental benefits.

Monetized Benefits and Calculated Net Value of Solar for Recent Studies

Monetized Benefit	ME 2015 MPUC	TVA 2015	AZ 2016 Crossborder	NV 2016 E3	NV 2016 Solar City/NRDC	TX 2016 AE	MN 2016 Xcel	TCL&P 2015 UFS	MBLP 2016 UFS
Cost of solar integration									
Avoided energy generation									
Avoided generation capacity									
Avoided transmission/distribution capacity									
Avoided transmission/distribution losses									
Grid services									
Fuel price hedge									
Market price suppression									
Reliability/resiliency									
Avoided environmental compliance costs									
Avoided carbon dioxide emissions									
Avoided criteria pollutant emissions									
Avoided water pollution and use									
Societal benefits/economic development									
Net Value of Solar (cents per kWh)	33.7	7.2⁵	28	Negative⁶	12.9	10.9⁷	12.75	6.7	6.64

⁵ Initial estimates that included other benefits and savings placed the value of solar at 13.11 cents per kWh.

⁶ Energy + Environmental Economics determined there was a cost-shift in Nevada from non-NEM customers to NEM customers.

⁷ Austin Energy recalculates and reestablishes its value of solar tariff annually.

Establishing a Uniform System of Valuation for Solar DG

As is evident, there is considerable variability in the methods used to undertake value of solar calculations. While locational factors influencing markets and energy pricing will always vary and must be taken into account, a standard methodology would make these studies much more valuable to regulators, utilities, and other interested parties. Such an approach would enable “apples-to-apples” comparisons, inform energy resource planning efforts, and increase customer confidence.

“Accuracy in resource and energy valuation is the cornerstone of sound utility ratemaking and a critical element of economic efficiency.” - IREC

An increasing number of efforts seek to address the variability of between studies and encourage greater consistency, particularly in terms of the costs and benefits included and the value imputed to those costs and benefits. In 2014, for example, NREL published a study classifying the costs and benefits of solar DG systems into seven categories and described the methods, data, and tools that could be applied within these categories to calculate the value of solar (28). These categories include energy, transmission and distribution losses, transmission and distribution capacity, generation capacity, ancillary services, fuel price hedging and market price suppression, and environmental considerations.

IREC Value of Solar Methodology

The Interstate Renewable Energy Council (IREC) extrapolated a set of best practices based on its review of 16 recent VOS studies, resulting in a standard valuation methodology for regulators to consider when conducting value calculations (29). IREC also recommends that regulators consider both the value of solar (to utilities, customers, and society) as well as the impact of solar DG and NEM on electricity rates of non-solar customers. Use of the IREC methods would support growing efforts among states to determine avoided costs, undergo integrated planning efforts, and appropriately design rates. A model approach would also mitigate the potential for process criticism by providing a transparent approach rather than using proprietary, specialized designs offered by utilities and consultants.

IREC’s report describes the costs and benefits of solar DG. These benefits include, as described above, avoided energy costs, avoided additional generation capacity, avoided transmission and distribution system losses, avoided additional transmission and distribution capacity, grid support services, reduced financial risk, electricity price suppression, improved grid reliability and resiliency, environmental benefits, and societal benefits. IREC also identifies baseline assumptions critical to the analysis and offers the following recommendations:

- **Timeframe:** A 30-year lifecycle analysis period. Solar DG technology has an expected service lifetime of 30 years. IREC argues, therefore, that the measure of costs and benefits should be levelized over that entire 30-year period.

- **Discount rate:** A discount rate close to the rate of inflation for solar DG (i.e., less than 6 percent). Typical utility discount rates are 6 to 9 percent. These higher discount rates may favor fossil fuel generation because much of the cost is incurred over the lifetime of the generator (e.g., for fuel and operation and maintenance costs). In contrast, solar DG technologies are capital intensive, but involve no continuous fuel costs. A lower discount rate is more appropriate for resources with high initial costs and low continuing or end-of-life costs.
- **Amount of generation:** Monetize only the value of electricity exported to the grid.
- **Technology cost comparison:** Conduct cost comparisons to either a natural gas simple-cycle combustion turbine or a more efficient combined-cycle gas turbine with natural gas prices forecasted 5 to 10 years forward.
- **Hourly load shapes:** Match hourly system loads with hourly output from solar DG.
- **Line losses:** Marginal line losses should be included because they are higher during times of system peak load and may be more fully avoided by solar DG systems than other load reduction mechanisms like energy efficiency or demand response.
- **Solar DG penetration:** The effects of solar DG should be considered at various levels of penetration because the value of solar DG is likely to be reduced at high levels of solar DG utilization.

Adopting a transparent, comprehensive standard valuation methodology such as the IREC model can help ensure full accounting of both the costs and benefits of solar DG. This is particularly important as the lack of methodological consistency between studies may impede the penetration of solar DG by obscuring and rendering uncertain the full value of the positive social, economic, environmental and health attributes of solar DG.

PART III: Developing an Appropriate Distributed Generation Tariff

In conducting a study on an appropriate tariff as required under Michigan's new energy law, IEI recommends that the Commission use, as a starting point, the fact that the majority of studies conducted to date have found that solar DG customers participating in net metering programs represent a net benefit to the overall grid. Solar DG both reduces demand for power from the utility and provides power to the grid when the systems generate more power than is used at a residential or commercial site. This surplus power is generated at or near peak times, when the cost to the utility of procuring additional power is most expensive.

Indeed, because the value of the credits provided under net metering programs is typically less than the value of the solar energy provided to the grid, a majority of the studies done to date have concluded that net metered customers are effectively subsidizing those without solar DG, helping to keep rates for all customers lower than they otherwise would be. As such, rather than being a subsidy for those who install solar, NEM represents an attempt to balance the true costs and benefits of the energy being produced and that which is consumed in a way that is simple, fair,

and convenient for both the utility and its customers. Any tariff, therefore, should fully compensate solar DG customers for the value their systems provide.

Finally, while the calculations necessary to develop a value of solar differ from those needed to assess the cost to serve solar DG customers, IEI endorses the Commission's intent to include a VOS study as part of its examination of the costs and benefits associated with distributed generation and net metering. To ensure consistency and allow for accurate comparison with other VOS studies, IEI further recommends that the Commission conduct this VOS analysis using IREC's methodology that includes the full range of energy, capacity, grid services, financial, and environmental benefits.

Finally, because locational factors can affect solar valuations, access to location-specific utility data should be made available to stakeholders as part of the development of new tariff mechanisms.

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