COMMENTS OF ENERGY AND ENVIRONMENT LEGAL INSTITUTE TO THE FEDERAL TRADE COMMISSION ON SOLAR ELECTRICITY: PROJECT NO. P161200

AUGUST 19, 2016

On behalf of our members, the Energy and Environment Legal Institute respectfully submits these comments to the Federal Trade Commission on Project number P161200, Solar Electricity. The Energy and Environment Legal Institute (E&E Legal) is a 501(c)(3) organization engaged in strategic litigation, policy research, and public education on important energy and environmental issues. E&E Legal advocates responsible resource development, sound science, respect for property rights, and a commitment to markets.

The Federal Trade Commission held a one-day workshop to explore competition and consumer protection issues that arise when consumers generate their own electric power by installing solar photovoltaic (PV) panels. FTC requested comments on a broad slate of issues including:

1) The current state of the solar power industry, and anticipated technological advancements;
2) Current regulatory approaches to compensating consumers for the power they generate, with a particular focus on net metering laws and regulations;
3) Competition among solar DG firms, between solar DG firms and regulated utilities, and between solar generation and other power generation technologies; and
4) Consumer protection issues, including how consumers get the information necessary to decide whether to install solar PV panels.

We focus our comments on the second topic listed; compensation of consumers for the power they generate.

Background Information

The electric power sector is a critical infrastructure for the American economy. Electrification has been called one of the greatest engineering achievements of the 20th century. Unlike most other industries, technological advances are unbundling production and delivery operations, rather than leading to vertical integration. Retail electric utilities remain regulated monopolies in every state. Retail electricity rates are not set by open markets, but result from ratemaking proceedings overseen by state regulators (*e.g.*, public utility commissions (PUCs)) or local authorities.

In many jurisdictions, laws or regulations require distribution utilities that sell retail electric power to customers to compensate customers for the power they generate, typically from solar PV panels. Compensation can take the form of a reduction in a customer's bill if the customer consumes more electricity than he or she generates, or a payment from the utility if the customer generates more than he or she consumes. This practice is broadly known as "net metering."

Determining the correct rate for net metering is a complex issue. Most states that have adopted net metering have chosen to compensate solar DG customers at the retail rate the utility charges customers, but this is changing quickly. There regulatory or legislative activities in near every state questioning whether the retail rate, or some other, is the appropriate rate to ensure cross-customer fairness, economic efficiency and shared infrastructure sustainability.

The regulatory compact has resulted in regulated retail rates designed primarily to allow the utility to recover both fixed and variable costs, to ensure the continuing viability of the utility. Compensating solar DG customers at the retail rate allows these customers to avoid paying an appropriate share of the fixed costs of a system that was built to serve them, shifting these costs to customers who have not installed solar PV panels. Proponents of this view argue that the price utilities pay for solar DG should be closer to the (typically lower) price utilities pay for most other types of generation on the wholesale market.

Others argue that the utility should pay for customer-installed solar DG at the retail rate, because solar DG enables the utility to avoid more costs than it incurs and thus solar DG results in avoided costs for the utility, the correct price for solar DG ought to reflect the value of those avoided costs. We address issues with such benefit/cost analyses below.

Some also suggest the government should incentivize consumers to install solar PV panels by factoring the environmental benefits of solar power into ratemaking decisions. For example, because solar-generated electric power does not create the same pollution or other externalities as carbon-based sources of electric power, compensating solar customers at or above the retail rate may be a way to achieve desirable environmental objectives. We also address this issue below.

The question of how to compensate customers for the power they generate at their properties is complicated by the fact that the retail price in most jurisdictions is set by regulation, not directly by market forces. In jurisdictions that do not use variable retail rates, the regulated retail rate at any given moment does not typically reflect the prices that can vary every 15 minutes by 50 to 100%. For this reason, customers in these areas do not typically base their electricity consumption on retail rates that fluctuate to reflect the varying wholesale price of electricity. This can be dealt with by time of use or real time rates both for consumption and generation, but few jurisdictions employ either of these techniques.

Moreover, because retail rates often do not send customers accurate price signals, some utilities argue that retail rates need reform in addition to arguing that the net metering system needs revisions to allow utilities to recover fixed costs. On the one hand, rate reform may produce more efficient retail rates, even though a collateral effect may be a reduction in customer adoption of solar DG. On the other hand, rate reform may be a disguised effort by utilities to make solar DG less desirable relative to the status quo, thereby minimizing solar DG as a competitive threat.

There also may be competitive issues if a regulated public utility is permitted to use revenues from regulated retail sales to compete directly with solar DG firms by offering to install utility-supplied PV panels to its current customers, but anti-competitive issues can be resolved. Reliance on subsidiaries with appropriate firewalls have been successfully used to avoid anticompetitive behavior in other venues such as energy service and efficiency programs.

Net Metering: Pricing Solar DG at Retail

The FTC has asked a series of questions regarding compensating net metering consumers at retail rates. In many states, utilities that sell electric power to retail customers are required to compensate these customers for customer-generated power. The Commission invited public comment on questions relevant to this topic, including:

- Is net metering good policy? At the retail rate? At a different rate?
- Does retail net metering result in cross-subsidization? For example, if the fixed costs associated with building and maintaining the electricity grid are incorporated into the price per kilowatt hour (volumetric pricing), do non-solar customers end up cross- subsidizing solar DG customers because the latter do not pay a full share of fixed costs when they choose to rely on self-generation?
- Does cross-subsidization of one form or another always occur when retail rates are based only on volumetric charges and are time-invariant? Does cross-subsidization caused by net metering differ in any way from other forms of cross-subsidization inherent in regulated retail rates?
- Does it make sense for PUCs to target net metering for reform, or should they focus on reforming retail rates more generally to better reflect the varying costs of supplying electric power?
- Is there a way to prioritize among various reforms? Potential reforms may include a "value of solar" tariff; dual metering/net metering at something other than the retail rate; fixed charge reforms; smart meters/time-variant pricing.
- Does the analysis change when the distribution utility is vertically integrated? When the utility is investor-owned, municipally-owned, or a co-op? When consumers have retail choice? When retail pricing is time-variant?
- To what extent does the optimal approach depend on penetration levels for solar DG?
- Should environmental externalities affect retail pricing?

Nationwide utilities are spending billions to achieve that end. In 2015, electric companies invested $20 billion in the distribution system alone and this is expected to continue. Over the past five to six years, electric companies invested in the deployment of nearly 65 million digital smart meters to about 50 percent of U.S. households, one critical technology that enables net metering. Ironically, however, net metering policies permit distributed generators to avoid paying their share of the costs of these grid investments, leaving the costs to be paid by other electricity users. The growing use of distributed generation and its impact on electric utility customers means that net metering policies and regulations need to change to properly allocate costs and to minimize the impact on non-net metered customers. As implemented, net metering policies pose a threat by neglecting to fund the critical infrastructure called the electric grid. Net metering upends the historical regulatory compact, conflicts with federal law, and creates perverse economic inefficiencies. Net metering, as currently implemented in some states, is a regressive tax subsidizing the rich by picking the pockets of the poor. Nearly every state with a net metering policy is making or contemplating changes, either through their public utility commission or legislature. Most are, correctly, focused on the price to be paid for excess generation.

Summary

As described below, our comments can be summarized as:

- Net metering is neither good policy nor bad policy, but depends on consumer compensation rates and penetration level. The benefits and costs of net metering are unique to circumstance within each state and region, and varies over time and penetration level. Net metering policy must be analyzed in conjunction with other policies that affect price and consumer choice.
- Net metering as currently implemented results in cross subsidies

- Cross subsidization in net metering is different than many other subsidies in that it is particularly regressive and harms the poor disproportionately.
- Value of service tariffs should not be implemented for individual technologies (like solar) without changing the entire rate paradigm which currently is cost of service. Hybrid systems combining value and cost are likely more distorting.
- It makes sense for PUCs to reform net metering and many of them are.
- The FTC should focus on deceptive sales pitches by solar companies.
- Environmental externalities' valuation should not benefit net metering technologies alone. The inherent uncertainties, lack of comprehensive environmental analysis, and questionable analytics makes including externalities in rates more likely to send incorrect price signals than non-inclusion.

<u>Many, and most of more recent, studies do not show net benefits</u> As Lisa Woods, a nonresident Senior Fellow at Brookings and lead at the Institute for Electricity Innovation[1], points out "In reviewing NEM studies, Muro and Saha chose to focus on a handful of studies that show that net metering results in a benefit to all customers, to the exclusion of studies showing the opposite. In this small group of NEM studies, they included a study that E3 conducted for the Nevada Public Utilities Commission (PUC) in 2014–perhaps the most well-known and cited of the five studies included in the Muro/Saha paper. Very soon after the E3 Nevada study was published, the cost assumptions for the base-case scenario which showed a net benefit of $36 million to non-NEM customers (assuming $100 per MWh for utility-scale solar) were found to be incorrect, completely reversing the conclusion. The $36 million net benefit associated with NEM for private rooftop solar turned into a $222 million cost to non-NEM customers when utility-scale solar was priced at $80 per MWh. Today, based on the two most recent utility-scale contracts approved by the Nevada PUC, utility-scale solar has an average lifetime (i.e., levelized) cost of $50 per MWh, meaning that the NEM cost shift would be even greater. In February 2016, the Nevada PUC stated that "the E3 study is already outdated and irrelevant to the discussion of costs and benefits of NEM in Nevada…" Hence, because the E3 study for the Nevada PUC that the Muro/Saha paper included has been declared outdated and irrelevant to the discussion and because costs for utility-scale solar have declined significantly, that study does not show that NEM provides a net benefit to all.

By focusing on a select, and dated, group of studies that show that NEM benefits all customers (as stated by the authors); by excluding the E3 study for the California PUC, which is fundamental to the NEM cost shift debate; and by not providing an update on the NEM debate today" the Muro/Saha paper is misleading. We return to the issue of benefits and costs below.

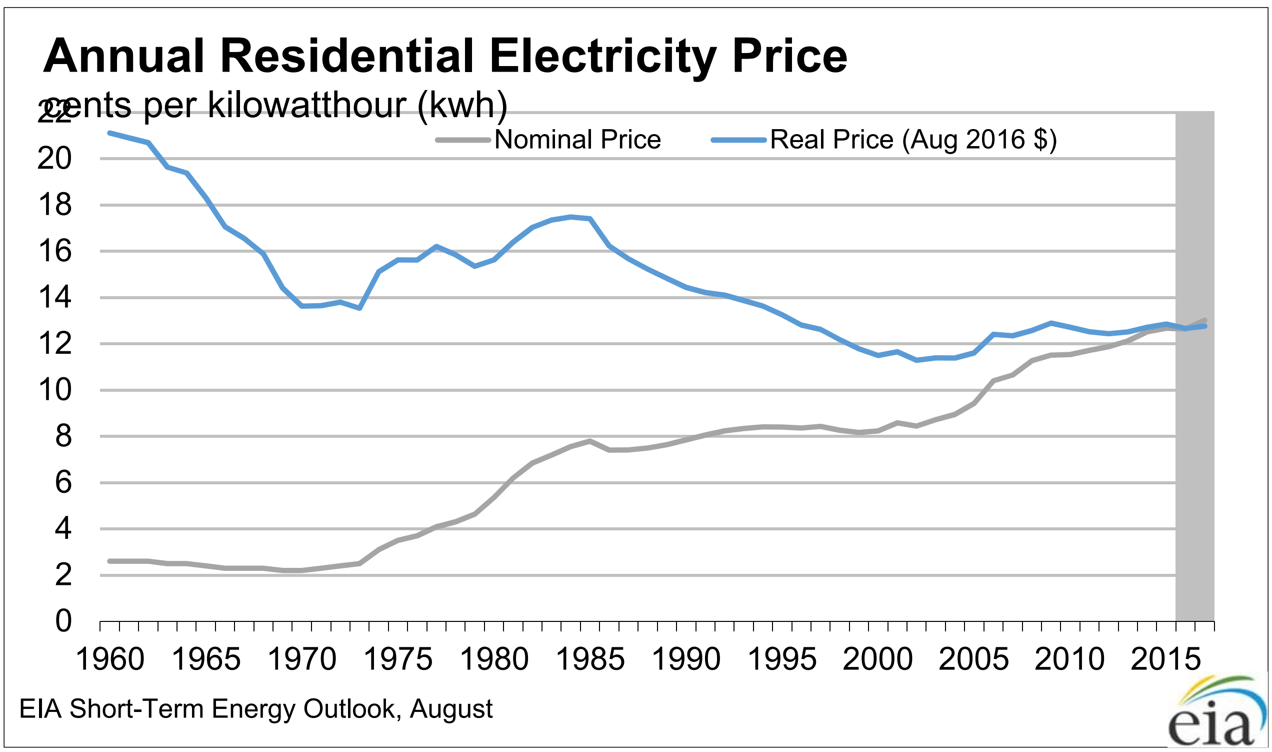
<u>Definition of Benefits is Dependent on Cost of Electricity and Value of Carbon</u> In most analyses of net metering, one consistent benefit is avoided costs of electricity from the incumbent utility. In other words, net metering customers benefit by not purchasing as much electricity from the utility by virtue of the self-generation, and the utility benefits by not purchasing (for ultimate resell) an equal amount of generation. Obviously the higher the utility cost (or more correctly price) the larger this benefit becomes.

Including historical and forward looking studies, the Muro/Saha paper cited studies done in seven states.[2] With the exception of Mississippi, each of the studied states have aggressive Renewable Portfolio Standards (RPS) which require utilities to purchase specified amounts from qualifying renewable resources. The remaining states, other than Mississippi, have more aggressive RPS than the average RPS, thus artificially raising the cost of electricity in those states.[3] Overall electric price in four of the seven states are above the national average by at least 25%. In the remaining three, prices at just below (by less than 10%) the national average, and since their RPS was put in place their electric price advantage has been rapidly eroding. Thus, a portion of "benefits" included in the analysis of NEM are actually costs imposed by RPS policy. Claiming benefits of NEM actually attributable to costs imposed by other policy is misleading at best.

Further by conflating historical looking studies with forward looking studies implies the benefit/cost is a fixed ratio regardless of the amount of NEM within a utility system and across utility systems. Each utility system has differences that make such conclusions meaningless.

Finally, many forward looking studies assume continued price increases for residential electricity. In reality, real prices for residential electricity have been remarkably stable, and have actually decreased since 1960, according to the Energy Information Administration (EIA)[4]. The following chart from EIA shows that, in constant dollars, residential electricity has dropped from over 21 to under 13 cents per kilowatt hour, and there is plenty of reason to believe that trend will hold. Most observers expect future residential price increases to result primarily from proposed policies, like EPA's so called Clean Power Plan, that favor one technology over others, or effectively ban certain fuels like coal, not from market driven changes and similar policies at the state level

Solar sales pitches that rely on 'ever increasing electric utility cost' should be a focus of FTC.



Looking just at the benefit of reducing carbon emissions (one of several environmental externalities), the benefit calculations are likely inflated. Valuing carbon emissions at the 'social cost of carbon' (SCC) requires an unambiguous value for the social cost of carbon. Most of the studies cited value carbon at the SCC as determined by EPA. The EPA's values range from $11 to over $212, depending on when the reduction occurs and discount rate asumed and other factors. Further, Reason Foundation Vice President Julian Morris "finds the administration's estimates of the social cost of carbon are "biased upwards" due to their reliance on three "simplistic models, all of which use estimates of climate sensitivity that are likely too high and two of which likely overestimate the economic impact of climate change."[5] This calls into question the values used for the social cost of carbon. Taken together, these two factors call into serious question the validity of the cited studies, something most state utility commissions are doing.

Less Costly Measures Are Available (Benefits exceeding costs is inadequate for public policy) Using benefit/cost analysis as the "be-all" is short sighted and often leads to poor policy. While necessary, it is insufficient. Use of benefit/cost alone ignores the equally important question of

Reference case & Phase 1 scenarios

Scenario	EPA Assumptions and Methodology	Cost per ton of CO_2 reduction ($/ton) *
Reference Case	MISO's MTEP-15 Business As Usual future assumptions**	-
Building Block 1	In 2020, apply a 6% heat rate improvement to all the coal-fired units at a capital cost of $100/kW (amortized over 10 years).	5
Building Block 2	Calculate and enforce, starting in 2020, a minimum fuel burn for existing CC units to yield an annual 70% capacity factor.	53
Building Block 3	Calculate and add the equivalent amount of wind MWs to meet the incremental regional non-hydro renewable target.	237 Present value calculation for costs is the driver for the higher cost.
Building Block 4	Calculate the amount of energy savings for the MISO footprint and incorporate it as a 20-year EE program in the model.	70
All Building Blocks	Application of all building blocks.	60
CO_2 Constraint	Application of a mass-based CO_2 reduction target, allowing the model to optimize.	38

* The cost per ton of CO_2 reduction is indicative – actual values may vary depending on different input assumptions, etc.
** Assumptions matrix is available at https://www.misoenergy.org/Events/Pages/PAC20140820.aspx

whether the benefits can be achieved at less cost. Are other techniques available that reduce carbon emissions, improve reliability, lower pollution levels at overall cost less than net metering? The answer is yes.

Returning to the question of the economic benefit of reduced carbon emissions, the Midcontinent Independent System Operator (MISO) analyzed various options to reduce carbon emissions in response to the Administration's proposed "Clean Power Plan." They compared the cost per ton of carbon reduced for a variety of generation and energy efficiency measures. They did not address NEM directly, but the results are still illustrative. The comparison of costs is shown in the figure, and illustrate that carbon can be reduced much more cheaply with easy operational changes like improving power plant heat rates or increased use of natural gas combined cycle than with most renewable technologies.[6] The benefit of reducing carbon dioxide, and by extension NEM benefits, can most likely be achieved without resorting to the most expensive form of electricity generation, which at least for the time being is residential solar.

Benefits Exceeding Cost for 'Society' Ignores Fairness and Equity A number of states have attempted to look at the question of rate impacts of net metering, specifically whether a subsidy or "cost shift" is occurring from non-participants to those participating in net metering. In using or comparing the results from the various studies, a few caveats need to be kept in mind: Most studies treat net metering subsidies in isolation and do not consider multiple and overlapping subsidies. For example, the federal Production Tax Credit provides a $22/MWh subsidy to certain renewable technologies, yet the analyses of net metering do not always account for that. Other forms of subsidy pancaking are ignored. Treatment of Net Energy Metering is within the context of complex rate structures and often lacks the transparency necessary for policymakers to make informed decisions. Further, some of the state analyses treat some assumptions as asymmetrically distributed; for example, benefits are assigned to solar under an assumption that PV panels "may" last longer than 30 years, but no debits are levied for panels lasting less than 30 years. Worse, some analyses discriminate in assigning "benefits" to only select groups of alternatives. One example of this is when the benefits of hypothetical emission savings are assigned to net-metered rooftop solar panels, but not to central station solar panels.

A 2010 E3[7] study, commissioned by the California Public Utilities Commission (CPUC), specifically looks at the quantifiable, incremental costs and benefits of net metering. The benefits are calculated as utility- avoided costs of energy and capacity procurement.

The CPUC called the E3 report methodology "the most rigorous and quantitative methodology ever conducted on the NEM mechanism." The costs and benefits are evaluated for both participants in net metering as well as other, non-participating electric utility customers and utilities. E3 also estimated incremental operational costs to the utility of net metering, which would theoretically include incremental interconnection, integration and billing costs; however, only data for billing costs were available. Integration costs were not quantified. One example of integration cost is the additional natural gas fuel burned to balance and backup intermittent solar and wind.

Another oft-cited study, by LBNL in 2010,[8] did not examine the value of net metering of solar to non-participating electric utility customers; instead, the authors reviewed the impact of retail rate design on hypothetical net metering bill savings. Overall, they concluded that if a feed-in tariff[9] were employed to compensate net metering customers rather than rate-based compensation, the prices would need to be well above the current avoided cost to continue to drive solar market growth.

In January 2012, R. Thomas Beach and Patrick G. McGuire of Crossborder Energy[10] reevaluated their own and LBNL's earlier analyses. In 2012, they looked only at the PG&E utility territory, which includes more than two thirds of the net costs of net metering for non-participants, as well as for all electric utility customers across the state of California. They updated the analyses because, since the 2010 studies, the CPUC significantly restructured PG&E residential rates, which lowered net metering rates and reduced the rate impacts of those customers to non-participants. Beach and McGuire also incorporated new avoided cost modeling that assumes greater benefits of net metering (as discussed above), largely because of a separate state mandate, the Renewable Portfolio Standard. E3 had calculated that residential NEM customers impose a net cost of $0.19 per kWh of power they export to the grid, a significant level given that the average IOU residential rate is in the range of $0.17 to $0.19 per kWh.

One key point on which several studies agree is that, in the final analysis, any "cost shift" resulting from NEM is a function of rate design. Rate design is the purview of public utility commissions in each state and Boards for publicly owned utility.

Other studies have attempted to quantify the value (but not costs) of distributed solar photovoltaics in geographically diverse areas, each of which is summarized briefly below.

In 2006, Clean Power Research, LLC,[11] performed an analysis of the value of distributed solar photovoltaics to Austin Energy and the City of Austin (i.e., to the utility and to electric utility customers), to support the municipal utility's plan to install 100 MW of solar by 2020 (the study was updated in 2012).[12] The authors considered and documented methodologies to determine the values of energy production, generation capacity, T&D deferrals, reduced transformer and line losses, environmental benefits, and natural gas price hedge. The authors found a solar net present value of $1,983–$2,938/kW or, on a levelized basis, $0.109–$0.118/kWh—higher than electricity rates at the time.

The additive avoided transmission and distribution (T & D), operation and maintenance (O & M), capacity, and energy cost values ranged from $0.0791 to $0.1411/kWh in 2008 dollars (for reference, current customers under the Standard rate plan pay $0.09417/kWh November–April and $0.0968–-$0.17257/kWh—depending on usage—from May to October). Most of the value comes from avoided energy purchases, followed by O&M, capacity, and T&D savings.

In 2011, Richard Perez, Ken Zweibel, and Thomas E. Hoff[13] attempted to describe the combined value that solar energy delivers to utilities' electric utility customers (energy, capacity) and society's taxpayers (environmental, fuel price mitigation,[14] outage risk protection, and long-term economic growth), specifically in the New York City area. Perez et al. assess the following costs and values for solar in New York (costs are described as the stream of revenues/incentives needed for a solar developer to break even—$0.20–$0.30/kWh—plus up to $0.05/kWh in infrastructure and operational costs to manage non-controllable solar costs and continue to reliably meet demand.[15] However, the study does not specifically call out net metering or break out the components of the costs to electric utility customers and taxpayers, so it is impossible to understand how net metering credits, billing costs, etc., are being considered in the analysis.

In 2012, Richard Perez[16] teamed with Thomas E. Hoff and Benjamin L. Norris in order to study the values that a fleet of distributed solar systems in various configurations delivers to utilities, electric utility customers, and taxpayers in Pennsylvania and New Jersey. The Clean Power Research report estimated levelized values for a fleet of 30-degree-south- tilted distributed solar arrays (which yielded the highest values of all the different configurations) in seven different locations across New Jersey and Pennsylvania: The sum of all values ranges from $256/MWh to $318/MWh in the various locations studied. The authors note that Market Price Reduction and Economic Development Value provide the most benefit; the former (average $55/MWh) attributable to coincidence between locational marginal price and solar output, and the latter (average $44/MWh) reflecting the tax revenue enhancement of local jobs created—even under the conservative assumption that 80 percent of the related manufacturing jobs would remain out of state. As with most studies that attempt to value "jobs created," the report failed to account for jobs lost because of higher overall energy costs, or the jobs created in the base case of traditional utility operation.

<u>The More Things Change, The More They Stay The Same</u> The following discussion illustrates that rate design as it relates to NEM is constantly in a state of flux. That's because the utility business models, technologies, relative costs, and customer values are constantly in a state of flux. It is the responsibility of rate setting authorities to account for that flux while insuring that costs incurred by providers are reasonable and are allocated in a fair and impartial manner.

Duke Energy Corp. asked North Carolina utility regulators to allow it to pay businesses and homeowners less than retail rate for the solar power they generate. The utility wants to overhaul a pricing rule that allows owners of rooftop solar systems to sell the surplus electricity they generate to Duke at 11 cents per kilowatt-hour, the retail bundled rate. Rob Caldwell, Duke's vice president of renewable generation development, said that the company wants to pay only the generating cost, which is between 5 and 7 cents per kilowatthour regionally. James McLawhorn, director of the electric division of the Public Staff, agreed that the rapid spread of small solar producers is making their fee schedule a concern, because other power customers are subsidizing the higher payments that utilities make for power purchases. (The Public Staff is an independent state agency that advocates for consumers in utility rate cases.)[17]

In Arizona, according to Arizona Public Service (APS), the state's largest utility, each solar customer avoids about $1,000 annually in costs for operating the grid, which residents with net metering use to buy and sell power. As more solar systems are installed, the utility's costs are spread across fewer users. This will cause power rates to spiral up, primarily harming poor and middle-class residents who spend a larger share of their income on energy. Net metering is already costing the average power user a $16.80 premium per year. In 2013, Arizona Public Service asked the state utility commission to address the cost shift by modifying net metering for future solar adopters. The utility proposed compensating solar customers for their power at the wholesale rather than retail rate, or alternatively, adding a flat charge to their bills to account for the fixed costs they are not sharing. After extensive debate, the commission adopted a plan that would add roughly $5 monthly ($0.70 per kW of installed capacity) to solar customers' bills. While this surcharge would do little to mitigate the entirety of the cost shift, the commission voted to implement this proposal pending the utility's next rate review in 2015. The approval can be viewed from two perspectives: First, the principle was approved that solar net metering should pay their share of infrastructure costs. Second, the actual charge needs to be calculated more rigorously. That more rigorous analysis should include all of the factors noted at the beginning of this section, and include less-expensive alternatives, not just a simple comparison of hypothetical benefits and costs.

Utilities are beginning to own and operate distributed PV assets. Programs developed across the country over the last year include in Arizona, Georgia and Texas. In New York, Con Edison has proposed a residential solar and storage program as one of its demonstration projects.

California received proposals from its IOUs and other stakeholders on future net metering tariffs in late 2015. Proposals included buy-all, sell-all options for customers, new charges and fees, and reduced compensation for net excess generation

Utilities across the country also continue to propose substantial increases in residential fixed customer charges. Fixed charge increases remain the most frequent proposed policy change impacting the residential solar NEM market.

Several utilities have proposed new rate structures which add demand charges for NEM customers. Demand charges are based on peak energy usage over a billing period. States with pending utility proposals for new residential demand charges as of 2015 include Arizona, California, Kansas, Oklahoma, and Texas. A few examples of the dynamic net metering environment in the states follow.

In August 2015, Nevada reached its 235 MW net metering cap. Revised net metering tariffs were to take effect after the cap was reached. Until the Public Utilities Commission approves revised tariffs, new systems are being net metered under existing policies. NV Energy’s proposed successor tariffs feature a new rate class for net metering customers with both time-of-use (TOU) and demand charges.

In late 2015, Nevada eliminated net metering for both existing and future distributed solar customers. The decision not to grandfather existing customers into the former net metering policy led the Governor's New Energy Industry Task Force to recommend that the legislature grandfather existing net metering customers.

In June 2016, Arizona Public Service (APS) filed for a number of major rate design changes for both distributed solar owners and general residential customers. The proposal included three residential rate options, each with time-of-use rates and demand charges. APS also proposed reducing the rate paid to consumers for real-time excess generation under its net metering tariff.

The Massachusetts Legislature enacted compromise legislation that increases net metering caps but reduces the net excess generation payment rate for private systems. State employees are developing a replacement program.

In May, the New Hampshire General Court passed a bill doubling the state's net metering aggregate cap and directing the Public Utilities Commission to develop alternative net metering tariffs. Results are expected in March 2017. Customers signing up for net metering before the aggregate cap is reached will be grandfathered into the existing policy.

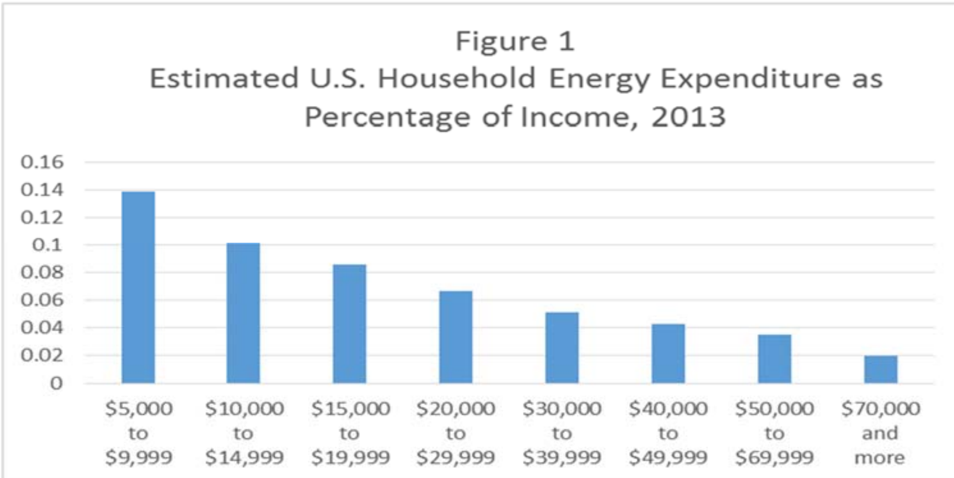
In June, Rhode Island enacted a number of changes to the state's solar policies. The bill increased the system size limit for net metering, established community net metering, and allows for third-party ownership.

No doubt, the electric power industry is undergoing a period of profound transformation–the fuels and technologies used to generate electricity is getting cleaner and more distributed; the energy grid is becoming more digital; and customers have different expectations.

Collaboration, good public policy, and appropriate regulatory policies are critical to a successful transformation of the power sector. In the context of net energy metering, this means reforming policy and rates so that private rooftop solar customers who use the energy grid pay for their use of the grid.

Net Metering Can Be Highly Regressive

According to Bureau of Labor Statistics data, a household earning less than $10,000 (pre tax) spends 14% of its income on energy utilities, while a household earning over $70,000 spends just 2% of its income, as shown in Figure 1.



Source: Bureau of Labor Statistics, Consumer Expenditure Survey, http://www.bls.gov/cex/2010/Standard/quintile.pdf, downloaded January 2014

The higher costs of electricity under net metering and affiliated policies will thus place a disproportionate burden on people on low-incomes. In other words, these policies are regressive. Since the price elasticity of demand for electricity is low,[18] consumers facing higher prices for electricity will spend more on electricity and therefore have less to spend on other goods.

By reducing net disposable income, inefficient net metering is likely to harm the health of lower income consumers and may even cause an increase in premature deaths.[19] The U.S. Environmental Protection Agency notes that: “people's wealth and health status, as measured by mortality, morbidity, and other metrics, are positively correlated. Hence, those who bear a regulation's compliance costs may also suffer a decline in their health status, and if the costs are large enough, these increased risks might be greater than the direct risk-reduction benefits of the regulation.”[20]

As such, incorrect net metering pricing is in conflict with the EPA’s policy for protecting “Environmental Justice,” as described in *Plan EJ 2014:*[21]

- *Protect the environment and health in overburdened communities.*
- *Empower communities to take action to improve their health and environment.*
- *Establish partnerships with local, state, tribal, and federal governments and organizations to achieve healthy and sustainable communities.*

The lack of treatment of these important distributional aspects of net metering is also inconsistent with Office of Management and Budget Circular A-4, which states that “Where **distributive** effects are thought to be important, the effects of various regulatory alternatives should be described quantitatively to the extent possible, including the magnitude, likelihood, and severity of impacts on **particular groups**. You should be alert for situations in which regulatory alternatives result in significant changes in treatment or outcomes for **different groups**…”[22] (emphasis added)

Renewable energy generation as encouraged by current net metering policies is not likely to provide estimated emissions benefits and will negatively affect reliability. Pricing environmental externalities is fraught with risk.

Net metering policies often account for theoretical benefits resulting from increased use of renewables in terms of total fuel consumed, reduced emissions, and employment effects (so called "green jobs"). Using theoretical or rules of thumb usually overstates benefits and underestimates costs, in several key areas:

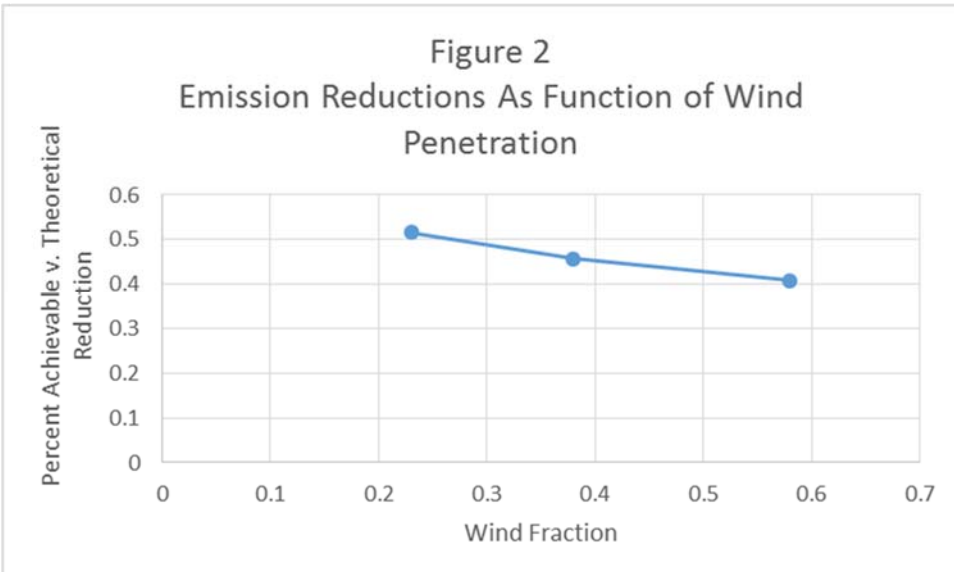
- Double counting benefits of energy efficiency and inappropriate netting of market-driven and state program-driven efficiency: this overstates benefits of net metering and thus distorts resulting pricing.
- Not counting integration costs of intermittent renewable technology: this understates costs; and overestimating emission reductions associated with renewable technology and practical conflicts with grid operation: this overstates benefits net metering and thus distorts resulting pricing.
- Not including reliability impacts: this overstates benefits net metering and thus distorts resulting pricing.
- Not counting net employment impacts: this overstates benefits net metering and thus distorts resulting pricing.

First, states that have already implemented aggressive energy efficiency or renewable programs, such as renewable portfolio standards, do not net out of the calculation of benefits of net metering. This double counting results in an overestimate of the benefits attributable to the proposed regulation.

Net metering advocates ignore heat rate improvements (efficiency enhancements) occurring at existing power plants, simply because heat rate improvements are already a key focus of existing power plants that are operated as profit centers. Fuel consumption is by far the largest expense item faced by power plant operators, representing perhaps 55 to 75% of total cost.[23] Power plant operators seeking to increase the profitability of their plant thus have a natural incentive to improve heat rate. And heat rate improvements continue to be undertaken, although the rate of improvement has been declining for other reasons (such as a shift to a different operational mode due to nuclear power coming on line, and increased amounts of variable generation and abatement of criteria pollutants).[24]

Economically rational conservation of energy consists of actions and investments that make economic sense. Some state-level programs include measures that require cross subsidies, encourage free ridership and rent seeking, or must be paid for through a coercive levy, and are not truly economically sound.[25] Pancaking net metering policy on top of these already market distorting programs results in further distortions.

The intermittent nature of power sources most often implemented under net metering (mostly solar photovoltaic) means that it is necessary always to have available other power sources capable of supplying *and balancing* the total peak load of electricity. Moreover, to avoid disruption in supply, these sources must be readily available, which means effectively that they are constantly spinning and consuming fuel. When solar output increases, generation companies curtail generation from other sources, known as "intermediate load units," sufficient to accommodate the solar power. When the solar output drops, generation from the intermediate load units is increased or otherwise brought back on line as needed. The process by which generation is ramped up and down at a plant due to wind or any other factor is called "cycling." Integrating erratic and unpredictable renewable resources with established coal and natural gas generation resources requires the electricity generators to cycle their intermediate load coal and natural gas-fired units. This cycling results in significantly less efficient performance of EGUs powered by fossil fuels.[26] The net result is increased emissions and fuel use, with attendant costs. These costs are seldom included in analyses of net metering. These costs increase, per kWh, at a rate faster than the growth in renewable generation. The curve of emission reductions per kWh versus wind penetration is downward sloping. While every grid is different and has different slopes and intercepts, Figure 2 illustrates this phenomenon using the Irish Grid.[27] The vertical axis shows the percent reduction achieved compared to "perfect" subsitution with full avoidance of fossil fuel for each KWh of wind. While differeing in magnitude, the phenomennon holds for solar, but there is inadequate data to illiustrate it given the rapid and recent growth.



Source: ESB National Grid, 2004

An Idaho Public Utility Commission decision places a cost on the integration of variable sources of about $21/MWh.[28] While the integration costs would vary from state to state, and over time, this is one important indicator of the magnitude of integration costs.

Net metering advocates tout gross employment effects of renewable energy programs, not net estimates accounting for jobs lost due to higher energy prices. In study after study in Europe and in the U.S., more jobs are lost than created.

Two published studies provide documentation of this net loss in employment: the first from Spain, and the second looking at Italy. Gabriel Calzada Álvarez of the University of King [Rey] Juan Carlos, Spain found that for every renewable energy job that the state manages to finance, Spain's experience (cited by President Obama as a model) reveals with high confidence, by two different methods, that the U.S. should expect a loss of at least 2.2 jobs on average, or about nine jobs lost for every four created.[29]

Carlos Stagnaro of the Institute Bruno Leoni found a similar tradeoff in Italy. Dr. Stagnaro and colleagues found that for every "green job" created, 4.8 "regular" jobs were destroyed.[30] Lost jobs represent an opportunity cost given that renewable energy subsidies divert money from other investment.

Given that renewables impose balancing needs on interstate grids, made up mostly with fossil fuel generation and likely in a different state than where the renewable is consumed, which state is debited with the additional cost caused by the renewables?

Modeling of blackouts and brownouts indicates that the higher the percentage of intermittent power on the grid, the greater the unreliability of the grid and the greater the likelihood of blackouts and brownouts.[31] This risk increases exponentially, not linearly, with increasing levels of intermittent generation. Reliability degradation imposes a significant cost to consumers and the economy but is not included in most analyses of net metering.

The National Electricity Reliability Council (NERC) has recognized the operational impact of variable energy resources such as wind and solar. "NERC's 2013 Summer Assessment recognized the growing presence of wind and solar resources as a North American issue: Operationally, an increase in wind and solar resources continues to challenge operators with the inherent swings, or ramps, in power output. In certain areas where large concentrations of wind resources have been added, system planners accommodate added variability by increasing the amount of available regulating reserves and potentially carrying additional operating reserves."[32]

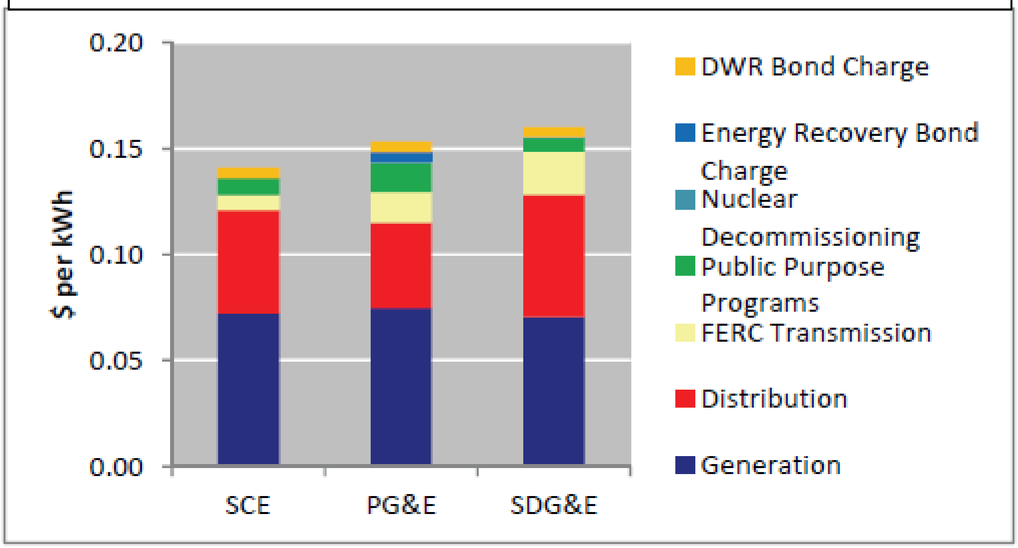
When utilities are required to purchase DG power at retail rates without accounting for infrastructure costs, this amounts to a subsidy from non–net metered customers to net metered customers. Often lost in the message is that there are numerous other subsidies and preferential treatments that, combined (stacked one on top of another), are *egregiously extravagant* and often counterproductive (by virtue of reducing incentive to innovate.) Such net metering conflicts with the general nature of the Public Utility Regulatory Act (PURPA) requirement on utilities to purchase "qualifying facility" output at no more than "avoided cost." Purchasing such generation does not avoid the cost of transmission and distribution. Thus paying retail rates is above market rates. Utilities have a historic agreement with state regulatory agencies to serve all their customers at just and reasonable rates. This obligation has been turned on its head into a mandate to buy power even when not economic or just and reasonable.

The issue lies with what is a fair and equitable price to pay customer-generators for their output. That is not a trivial matter, and the issue grows exponentially with more net metering. In some parts of Hawaii, distributed generation accounts for close to 30 percent of total capacity. In Wisconsin, for instance, the average retail price is 400 percent more than wholesale. A study prepared for Arizona Public Service showed that the amount that net metered customers pay is below the utilities' costs for serving those customers. Utilities must then charge higher amounts to non–net metered customers to cover those fixed costs. A California study reported that customers who do not install net metering will be paying an extra $1.1 billion in shifted costs annually by 2020.

Customers with DG systems still rely on the power grid. By its nature, electricity—regardless of how it is generated—has unique properties that do not allow it to be easily or economically stored for later use. It must be generated and delivered at the precise moment it is needed. Because the majority of rooftop solar and DG systems do not have battery storage, net-metered customers remain connected to the local electric grid and use the grid to buy power from their local electric company during times when their systems are not producing enough energy to meet their needs. Net metered customers also use the grid to sell power to their electric company when their systems are producing more electricity than is needed at that moment. Since net-metered customers are both buying and selling electricity, they are relying on the grid as much or more than customers without such systems, but not paying for grid support. Net metered customers also impose costs to reconfigure the electric network to handle two-way power flow. Finally, a variety of regulatorily imposed public goods programs, such as low-income assistance, are included in retail rates. These costs are not recovered when net metered customers are reimbursed at the retail rate.

Figure 3 shows the rate component for three utilities in California.[33] While it varies from utility to utility, and from state to state, the energy component shown in blue (generation) typically makes up only 40 to 60 percent of the total cost.

Figure 3
Rate Component for Three Utilities in California



Based on rates in California, a typical customer paying a $400 total bill would pay about $225 dollars for generation; $125 dollars for distribution, including social programs; and about $50 for transmission. Similarly, and based on rates in Potomac Electric Power Company (PEPCO), a typical customer paying $336 in total bill would pay about $259 dollars for generation; $69 dollars for distribution, including social programs; and $8 for transmission.[34]

Current net metering policies are doubly regressive, being generally available to and used by the well off, and placing additional cost burdens on the less fortunate.

Current net metering policies should continue to be reformed by state PUCs and local public utilities with prices set fairly and reasonably. As rooftop solar and other DG systems become more developed, net metering policies and rate structures should be updated so that everyone who uses the electric grid helps pay to maintain it and to keep it operating reliably at all times. This will ensure that all customers have safe and reliable electricity and that electric rates are fair and affordable for all customers.

Under net metering, utilities in Arizona pay over three times the cost for electricity than from the competitive market. Regulators then pass these added costs onto non-solar customers in order to maintain reliable service. This cost shift from solar users to their non-solar neighbors is the core of the debate about net metering. Restructuring these billing issues in a reasonable and fair manner, while promoting long-term stability and grid reliability, is essential.

Other states and regions have similar differences. The average U.S. residential price of electricity is currently around 12.5 cents per kWh.[35] According to published data as of November 2013, the market price of energy from wholesale generators is averaging, in most locations, between 2 and 3 cents per kWh during off-peak periods and between 4 and 5 cents per kWh during on-peak periods. Net metering requires utilities to buy energy at two to six times the market price. These prices are eventually paid by their non–net metered customers.[36]

Fair and Equitable Solutions?

Fair policy would ensure that fair and equitable rates be set that both encourage cost-effective solar and DG while assuring that all customers who benefit from the distribution grid help to pay the costs involved. Retail electricity rates include costs approved by the utility regulatory commission for the wholesale cost of electricity and the costs of planning, building, and maintaining the electrical grid. When solar panel customers are paid under current net metering rates, they are not paying for the wires, poles, meters, or hardware and "smart grid" operation necessary to provide reliable, around-the-clock electricity—even when their operation causes part of that cost.[37] Currently, those costs are unfairly and unreasonably shifted onto their neighbors in a non-transparent manner. As a California study shows, the costs can involve billions of dollars, yet the lack of transparency makes it difficult for policymakers to fully understand the economic and policy implications involved. The issue becomes more important as more solar panels are installed.

Other Considerations

Net metering policies currently fail to pay for costs of the grid, while they shift costs to other customers and lack the transparency necessary for policy makers to make informed decisions. Other considerations also militate for reform of state level net metering policies.

Current net metering policies tend to emphasize the role of solar customers as energy producers, while failing to recognize their place as energy consumers. Homes and businesses with solar panels are still reliant on the grid for more than half of all hours. PV panel output only weakly coincides with peak needs throughout the grid. Wholesale prices vary throughout the day, but retail prices—the basis of net metering rates—seldom do.

In Hawaii, distribution circuits for the local utility have effectively maxed out their ability to accommodate more residential solar power on about 25 percent of Oahu. The utility has expressed worries that circuits will be at capacity for residential solar within six months. Adding more to the already taxed system could lead to damaged homes and appliances, and put the safety of utility employees at risk. The latter is exacerbated by the two-way power flow associated with net metering. By 2014, almost 10 percent of the utility's customers will be equipped with solar panels, and without distribution grid upgrades, all customers will suffer.

Hawaii is experiencing the challenges of integrating intermittent renewables onto the electrical grid, and these challenges are spreading across the country as solar net metering adoption accelerates. "The Grid was not built for renewables," Trieu Mai, a senior analyst at the National

Renewable Energy Laboratory, told the L.A. Times.[38] Some fear we are nearing a point at which grid operators have to pay renewable energy providers *not* to produce power, a situation already happening elsewhere, including Ontario, Canada, and Great Britain.[39]

Net metering advocates also claim that net metering limits or avoids the need for new power plants and new distribution and transmission facilities. This is not usually the case. Solar production only weakly correlates with peak utility demand, leaving utilities to maintain adequate capacity—both generation and transmission/distribution—for availability during other periods. In fact, as experiences in Hawaii and Germany demonstrate, the widespread introduction of intermittent generation can impose substantial new costs to maintain power quality and reliability.[40] "We want to support renewable energy," said Hawaii state Rep. Marcus Oshiro. "But not at the expense of all the taxpayers who are heavily subsidizing this one component. We cannot sustain this rate of expenditure for this one sector," Oshiro said. "It is about time they get off the training wheels and run on their own." In Hawaii, the number of solar systems has doubled since 2007. Solar tax credits are up from $34 million in 2010 to $173 million in 2012.[41]

As reported by BusinessWeek, Germany is currently considering a new customer charge to help pay for these new costs that have been caused by the rapid expansion of renewable power there.[42]

In addition to physical considerations, there are legal and regulatory complications. Writing in Harvard Business Law Review Online,[43] David B. Raskin wrote:

Net metering raises a number of legal issues that are just beginning to be explored. The definition of "net metering service" in the Energy Policy Act of 2005 indicates that Congress did not endorse the subsidy described above.[44] Section 111(d)(11) of the Public Utility Regulatory Policies Act (PURPA)[45] was added in 2005 to a list of retail ratemaking practices that state utility commissions are required to evaluate for use in their jurisdictions. This provision defines "net metering service" as follows:

Net Metering – Each electric utility shall make available upon request net metering service to any electric consumer that the electric utility serves. For purposes of this paragraph, the term "net metering service" means service to an electric consumer under which electric energy generated by that electric consumer from an eligible on-site generating facility and delivered to the local distribution facilities may be used to offset energy provided by the electric utility to the electric consumer during the applicable billing period.[46]

The [Federal Energy Regulatory Commission (FERC)], however, permits net meter customers to avoid this price cap. The FERC holds that unless a retail customer with on-site generation is a net supplier of energy to the grid over the state retail billing period (almost always one month), no sale takes place under PURPA or the Federal Power Act, even if there are substantial deliveries of energy to the grid during the month.[47] In the absence of a "sale" to the utility, FERC deems that no mandatory purchase of energy is taking place under PURPA and the avoided cost price cap does not apply.[48]

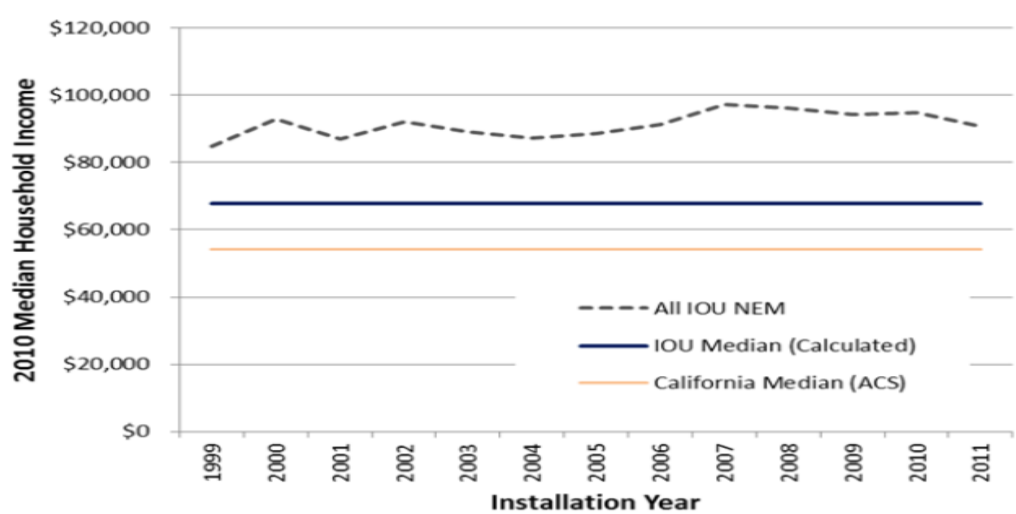
The FERC's theory, that the existence of a "sale" can be determined by netting metered inflows and outflows over the course of a month, was recently rejected in two appellate cases involving FERC's use of this same theory to determine whether a retail sale has occurred when generators acquire energy for station service purposes, the mirror image of the net *metering situation.[49] In these two cases, the D.C. Court of Appeals held that netting could not be used to determine whether a sale has taken place and that there is a sale whenever energy is delivered from the generator to the utility and vice versa.[50] The FERC's disclaimers of jurisdiction in MidAmerican and SunEdison may therefore be subject to a renewed challenge, which, if successful, would require net metering rules to be changed at the state level.*

It would be better if changes in net metering policies were to take place in each state legislature and public utility or service commission, and account for each state's uniqueness and existing electric grid characteristics, rather than in one-size-fits-all FTC regulations.

Finally, there are equity concerns with current net metering policies. Net metering is "doubly regressive"—first by effectively excluding some customers from net metering because of its high initial cost, including lease and credit requirements; second by hitting those least able to afford the associated cost increases.

A report issued by the California Public Utilities Commission forecasts that net metering will cost the state $1.1 billion per year in 2020.[51] It also finds that the average net metering customer in California has an income almost twice the state's average,[52] confirming claims that net metering entails a wealth transfer from low- to high-income consumers.

Figure 1: NEM 2010 Household Income by Installation Year Compared to IOU and California Median Income



Discussion of the Importance and Value of the Electric Grid

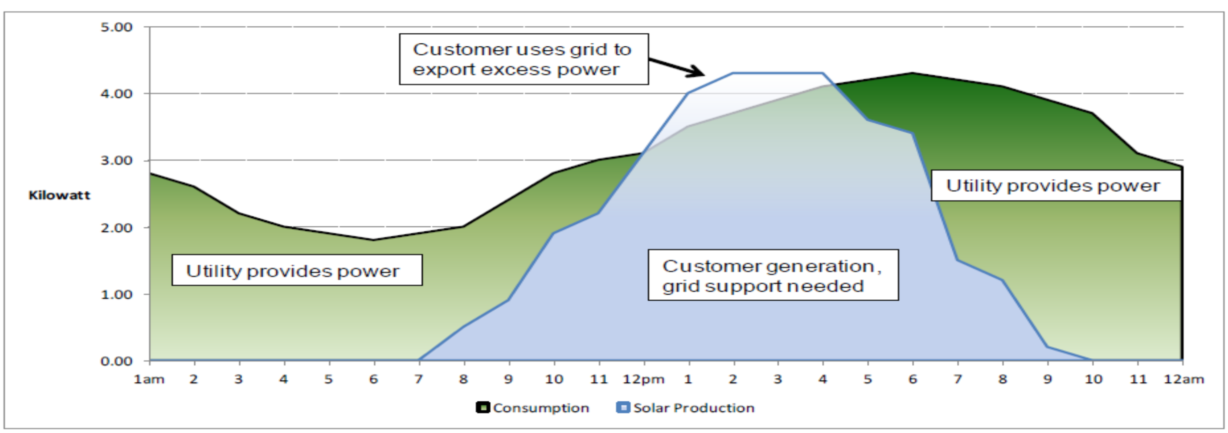
DG customers derive valuable benefits from staying connected to the utility's grid.[53] While advocates claim such customers are "free from the grid," that is not true—not even for those DG customers who produce the same amount of energy that they consume in any given day or other time interval, because output and consumption do not match on an instantaneous basis.[54] DG customers that are connected to the host utility's distribution system 24/7 still utilize grid services. The point is to pay for the value of these grid services. The utility's cost of providing grid services consists of at least four components:

- balance supply and demand in sub-second intervals to maintain stable frequency (i.e., regulation service);
- resell energy during hours of net generation and deliver energy during hours of net consumption;
- provide the energy needed to serve the customer's total load during times when on-site generation is inoperable because of equipment maintenance, unexpected physical failure, or prolonged overcast conditions (i.e., backup service);
- provide voltage and frequency control services and maintain high alternating current quality.

A typical residential or small commercial customer with solar panels will have an hourly pattern of energy production and consumption such as that shown in Figure 1, from an analysis performed by Lisa Wood and Robert Borlick.[55]

The green area represents the energy consumed by the customer. The blue curve shows the energy produced by the solar panels. The area below the blue curve and above the green line is the excess energy "sold" to the utility. The customer's consumption and generation are almost never equal; the customer will be taking net energy from the grid during many hours of the day. For example, the customer depicted in Figure 1 takes power from the grid in all hours except from noon to about 4:30 pm.

Figure 1: Typical Energy Production and Consumption for a Small Customer with Solar PV



Even if the customer's total energy production over a monthly billing cycle exactly matches its total consumption over that cycle, that customer still uses the above grid services during that time interval.

So, what value does a customer with solar PV generation derive from remaining connected to the grid? The following figure provides a typical breakdown of components to a consumer's electric bill in the Potomac Electric Power Company service territory of Washington, D.C., and parts of Maryland.

Account Details

Services for Jul 8, 2010 to Aug 6, 2010:
Summer rates in effect

Distribution Services:		
Customer Charge		6.65
Energy Charge	First 400 KWH x 0.0051000	2.04
	Next 1873 KWH x 0.0191030	35.78
Energy Assistance Trust Fund	at 0.0007500 per KWH	1.70
Sustainable Energy Trust Fund	at 0.0013000 per KWH	2.95
Public Space Occupancy Surcharge	at 0.0018300 per KWH	4.16
Delivery Tax	at 0.0070000 per KWH	15.91
Residential Aid Discount Surcharge	at 0.0000500 per KWH	0.11
Total Charges - Distribution		**69.30**
Generation Services:		
Minimum Charge	Includes First 30 KWH	3.34
Energy Charge	Next 2243 KWH x 0.1114700	250.02
Procurement Cost Adjustment	at 0.0024330 per KWH	5.53
Total Charges - Generation		**258.89**
Transmission Services:		
Minimum Charge	Includes First 30 KWH	0.12
	Next 2243 KWH x 0.0034400	7.71
Total Charges - Transmission		**7.83**
CURRENT CHARGES THIS PERIOD		**$336.02**

Based on PEPCO rates, a typical customer paying a $336 total bill would pay about $259 dollars for generation; $69 dollars for distribution, including social programs; and $8 for transmission.[56]

The costs that the DG customer does not pay for distribution and transmission, which can be significant, will be shifted to other retail customers. In this example, each DG customer shifts up to $950 per year in costs to other retail customers. Put another way, the non–net metered pay a subsidy to the net metered. This cost shift can be substantial and is simply not equitable.

The grid provides a lower-cost option to a solar PV customer compared to what it would cost that customer to use some combination of energy storage and/or thermal generation (e.g., a large battery pack), which can cost that customer substantially more than the $70 charge shown in the example.[57] This is why most DG customers remain voluntarily connected to the grid today and utilize grid services.

The balancing and backup services that the grid provides to DG customers are needed and have substantial value. It does not make economic sense for a DG customer to self-provide these services. It is unfair for DG customers to avoid paying for these grid services, thereby shifting the cost burden to non-DG customers. Obviously, DG customers should pay their fair share of the cost of the grid services that the host utility provides and that are voluntarily used by the customer.

Analysis of Net Metering From a Competitive Market Perspective

The regulatory compact is undergoing structural change. The utilities no longer have a regulated monopoly for the three main elements of electricity service. Only "open access" to transmission (owned by the utility in contract with customers) and obligation to serve at distribution remain.

Even those are undergoing institutional change. Subsidies and tax credits abound favoring one technology over another, irrespective of actual performance. Similarly, subsidies and tax preferences favor some organizational types over others.

In an interesting twist in Arizona, both sides of the argument claim that they are just trying to promote free-market principles as they relate to solar energy, although net metering advocates miss the fact they are relying upon major subsidies from others and miss the fact they are using utility property without paying for it. (Who does the T&D infrastructure belong to? It belongs to the utility, acting—under the regulatory agreement—on behalf of consumers.)

Solar advocates in the state claim that APS is essentially a monopoly trying to strong-arm competition and eliminate consumer choice. The group Tell Utilities Solar Won't Be Killed (TUSK) is appealing to free-market advocates by comparing the choice of solar energy for consumers to that of a charter school for concerned parents. They fail to acknowledge that solar customers still use the public system.

The problem with this free- market argument by solar subsidy backers is that solar owners get a 30 percent rebate (in the form of an investment tax credit from the federal government on most installations) on top of any state and local funding, along with the generous mandated net metering payout outlined earlier. Further, the "free market" argument for net metering ignores the property right for the existing grid and delivery system. Arguments that ignore that property right, and assign zero value (by virtue of claiming free right of use) is essentially a taking. Those costs are then passed on to their neighbors in the form of higher taxes and larger utility bills. The incentives provided for solar adopters, then, add to the invalidity of any "free market" arguments.

Another change taking place is an attempt to shift from a cost of service basis to a value of service basis. Under the historical regulatory compact, utilities were granted exclusive access to a geographic area, in exchange for the obligation to serve those within the area and based on rates determined as the reasonable cost to serve. Today, solar supporters argue that elements of the rates should be priced based on their value to the customer, which often is different than the cost to the provider. But a mixed market, partially based on regulatorily determined costs and partially based on value, is likely to result in mixed market signals—even though it would be preferable to a faux market established by fiat.

All Americans use power. Not all, however, can afford to buy their way into the financial incentives that come from purchasing, or even leasing, and installing solar units for their homes or businesses. Restructuring net metering compensation to consider the cost of grid maintenance and development incurred by utilities when supporting solar users aims to remove some of the distortion caused by inefficient subsidy initiatives.

Ideally, no source of electricity would be given preferential treatment. There would be no subsidies, no government stimulus, and no rebates. All sources would compete on an even footing in a free market, subject to performance-based environmental standards. Further, this is a distributional factor, not a technology-choice factor. It is as much "against" the utility compact, as it is "for" specific technologies. Ironically, many of the environmental benefits of alternative energy forms are used to justify "social justice" programs, but the results of net metering work in direct opposition to such programs, even granting the assumptions of environmental arguments.

By revising net metering policies, states can ensure that middle- to low-income families (those hurt most by high utility rates) are not subsidizing their wealthier neighbors who see solar power and all of its related government payouts and mandates mainly as a lucrative investment. Government programs that confer benefits on some at the expense of others are not free-market solutions, and only hinder the effective progress of solar power and other options in becoming competitive in the marketplace.

Three basic approaches to net metering are under examination across the nation, each of which seeks to ensure that a DG customer using grid services pays its fair share of the costs of those services while still receiving fair compensation for the energy that it produces.

- Redesign retail tariffs such that they are more cost-reflective (including adoption of one or more demand charges) until a value-based, all-inclusive market can be established;
- Charge the DG customer for its gross consumption under its current retail tariff and separately compensate the customer for its gross (i.e., total on-site) generation; and
- Impose transmission and distribution (T&D) connection and demand charges on DG customers.

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[1] https://www.brookings.edu/opinions/why-net-energy-metering-results-in-a-subsidy-the-elephant-in-the-room/

[2] Vermont, Nevada, Mississippi, Maine, Minnesota, Massachusetts, and New York.

[3] 29 states (and the District of Columbia and Puerto Rico) require utility companies to deliver specified minimum amounts of electricity from "renewable" sources, including wind and solar power. Analysis by Manhattan Institute has revealed a pattern of starkly higher rates in most states with RPS mandates compared with those without mandates. https://www.manhattaninstitute.org/html/highcostrenewableelectricitymandates5987.html

[4] http://www.eia.gov/forecasts/steo/realprices/

[5] http://reason.org/news/show/social-cost-of-carbon-study

[6]https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/PAC/2014/20140917/20140917%20PAC%20Item%2002%20GHG%20Regulation%20Impact%20Analysis%20-%20Study%20Results.pdf

[7] Energy and Environmental Economics, Inc. (2010). *Net Energy Metering (NEM) Cost Effectiveness Evaluation* (E3 study). Available at http://www.cpuc.ca.gov/PUC/energy/DistGen/nem_eval.htm.

[8] Barbose, Galen, Naïm Darghouth, and Ryan Wiser (2010). *The Impact of Rate Design and Net Metering on the Bill Savings from Distributed PV for Residential Customers in California*. Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory.

[9] A feed-in tariff (FIT) is a policy mechanism designed to accelerate investment in renewable energy technologies, by offering long-term above-market fixed prices to renewable energy producers.

[10] Beach, Thomas R. and Patrick G. McGuire (2012). *Re-evaluating the Cost-Effectiveness of Net Energy Metering in California*. Berkeley, CA: Crossborder Energy.

[11] Braun, Jerry, Thomas E. Hoff, Michael Kuhn, Benjamin Norris, and Richard Perez (2006). *The Value of Distributed Photovoltaics to Austin Energy and the City of Austin.* Napa, CA: Clean Power Research, LLC.

[12] Harvey, Tim, Thomas E. Hoff, Leslie Libby, Benjamin L. Norris, and Karl R. Rabago (2012): *Designing Austin Energy's Solar Tariff Using a Distributed PV Value Calculator*. Austin, TX and Napa, CA: Austin Energy and Clean Power Research.

[13] Hoff, Thomas E., Richard Perez, and Ken Zweibel (2011). *Solar Power Generation in the US: Too Expensive, or a Bargain?* Albany, NY: Clean Power Research, LLC.

[14] It is important to note that fuel price hedging almost always only considers the value of avoided price increases, but ignore the lost opportunity of future price reductions, as have been experienced in the past few years in the natural gas market.

[15] Hoff, Thomas E., Marc Perez, and Richard Perez (2010). *Quantifying the Cost of High PV Penetration*. Proc. Of ASES National Conference, Phoenix, AZ.

[16] Hoff, Thomas E., Benjamin L. Norris, and Richard Perez (2012). *The Value of Distributed Solar Electric Generation to New Jersey and Pennsylvania.* Albany, NY: Clean Power Research, LLC.

[17] http://www.charlotteobserver.com/2014/01/22/4632118/duke-energy-to-seek-reduction.html#.UuVSZdLTkrg

[18] U.S. Energy Information Administration, Price Elasticities for Energy Use in Buildings in the United States, October 2014, at p. 5. (Report available at: http://www.eia.gov/analysis/studies/buildings/energyuse/pdf/price_elasticities.pdf>)

[19] Lutter and Morrall note that "[r]egulations to promote health and safety that are exceptionally costly relative to the expected health benefits may actually worsen health and safety, since compliance reduces other spending, including private spending on health and safety. Past studies relating income and mortality give estimates of the income loss that induces one death—a value that we call willingness-to-spend (WTS)—to be around $9 to $12 million ($US 1990)." R. Lutter and J.F. Morrall, "Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation," *Journal of Risk and Uncertainty* Vol. 8-1 pp. 43–66 (1994). There is extensive academic literature regarding the effect of loss of wealth on health. *See*, *e.g.*, Ralph L. Keeney, "Mortality Risks Induced by Economic Expenditures," *Risk Analysis* 10(1), pp. 147–159 (1990); Krister Hjalte et al. (2003). "Health–health analysis—an alternate method for economic appraisal of health policy and safety regulation: Some empirical Swedish estimates," *Accident Analysis & Prevention* 35(1), pp. 37–46; W. Kip Viscusi "Risk-Risk Analysis," *Journal of Risk and Uncertainty* 8(1), pp. 5–17 (1994); Viscusi and Richard J. Zeckhauser, "The Fatality and Injury Costs of Expenditures," *Journal of Risk and Uncertainty* 8(1), pp. 19–41 (1994); U.S.EPA, Economic Analysis and Innovations Division, "On the relevance of risk-risk analysis to policy evaluation," August 16, 1995, http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0311-1.pdf/$file/EE-0311-1.pdf (accessed January 23, 2011); F.S. Arnold, *Economic Analysis of Environmental Policy and Regulation*, (New York: John Wiley and Sons, Inc., 1995); K.S. Chapman and G. Harihan "Controlling for Causality in the Link from Income to Mortality", *Journal of Risk and Uncertainty*, 8(1), 1994, pp. 85–93; J. Graham, B. Hung-Chang and J.S. Evans, "Poorer Is Riskier," *Risk Analysis*, 12(3), 1992, pp. 333–337; R.L. Keeney, "Mortality Risks Induced by the Costs of Regulations," *Journal of Risk and Uncertainty*, 8(1), 1994, pp. 95–110; L.B. Lave, *The Strategy of Social Regulation: Decision Frameworks for Policy*, (Washington, D.C.: The Brooking Institution: 1981); S. Peltzman, "The Effects of Automobile Safety Regulation", Journal of Political Economy, 83(4), 1975, pp. 677–725; P.R. Portney and R.N. Stavins, "Regulatory Review of Environmental Policy: The Potential Role for Health-Health Analysis", *Journal of Risk and Uncertainty*, 8(1), 1994, pp. 111–122; V.K. Smith, D.E. Epp and K.A. Schwabe, "Cross-Country Analyses Don't Estimate Health-Health Responses," *Journal of Risk and Uncertainty*, 8(1), 1994, pp. 67–84;A. Wildavsky, "Richer is Safer," *The Public Interest*, 60, 1980, pp. 23–39.

[20] U.S.EPA, Economic Analysis and Innovations Division, "On the relevance of risk-risk analysis to policy evaluation," August 16, 1995, http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0311-1.pdf/$file/EE-0311-1.pdf (accessed January 23, 2011).

[21] Office of Environmental Justice, *Plan EJ 2014*, U.S. Environmental Protection Agency, Washington, D.C. September 2011http://www.epa.gov/environmentaljustice/resources/policy/plan-ej-2014/plan-ej-2011-09.pdf

[22] Office of Management and Budget, *Circular A-4 Re: Regulatory Analysis*, White House, September 17, 2003, p.14, Available at: http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a004/a-4.pdf

[23] Sam Korellis, "Coal-Fired Power Plant Heat Rate Improvement Options, Part 1", *POWER, November 2014, pp.30-35.*

[24] Ibid.

[25] For example, programs that pay a total of $4–5 for compact fluorescent light (CFL) bulbs to replace incandescent, when CFL bulbs can be purchased for under $2, are likely not economically rational.

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[32] North American Electric Reliability Corporation and California Independent System Operator Corporation, 2013 Special Reliability Assessment: Maintaining Bulk Power System Reliability While Integrating Variable Energy Resources – CAISO Approach, November 2013, p. 2.

[33] http://www.cpuc.ca.gov/NR/rdonlyres/1C5DC9A9-3440-43EA-9C61-065FAD1FD111/0/AB67CostReport201.pdf

[34] http://www.cleancurrents.com/residential-wind-power/understanding-your-bill/

[35] Energy Info. Admin., Table 5.6.A Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, (Nov. 20, 2013), http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a.

[36] *The Regulatory Challenge Of Distributed Generation*, David B. Raskin, Harvard Business Review OnLine, V.4, p. 38.

[37] For example, costs for backup and balancing services on the grid are largely attributable to renewable generation's intermittency and increase overall cost. This does not happen with non–net metered customers.

[38] http://articles.latimes.com/2013/dec/02/nation/la-na-grid-renewables-20131203

[39] http://www.telegraph.co.uk/earth/energy/windpower/8770937/Wind-farm-paid-1.2-million-to-produce-no-electricity.html AND http://www.thestar.com/news/queenspark/2013/09/11/ontario_paying_for_wind_turbines_to_not_produce_electricity.html

[40] http://www.businessweek.com/printer/articles/666655?type=bloomberg

[41] http://www.foxnews.com/politics/2013/07/31/states-argue-for-cutting-off-solar-subsidies/

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[43] http://www.hblr.org/2013/12/the-regulatory-challenge-of-distributed-generation/

[44] Energy Policy Act of 2005, Pub. L. No.109-58, sec. 1251, § 111(d), 119 Stat. 962 (codified as amended at 16 U.S.C. 2621(d)(11)).

[45] Op. Cit. Pub. Util. Reg. Policies Act of 1978, Pub. L. No. 95-617, § 111(d), 92 Stat. 3117, 3142-43 (codified as amended at 16 U.S.C. § 2621(d)(10)(E)(11)).

[46] § 111(d); 16 U.S.C. § 2621(d)(10)(E)(11)

[47] *MidAmerican Energy Co.*, 94 F.E.R.C. P 61,340 (2001); *Sun Edison LLC*, 129 F.E.R.C. P 6,1146 (2009)

[48] *Id*

[49] *S. Cal. Edison Co. v. FERC*, 603 F.3d 996 (D.C. Cir. 2010); C*alpine Corp. v. FERC*, 702 F.3d 41 (D.C. Cir. 2012)

[50] *S. Cal Edison Co.* 603 F.3d at 1000-01; *Calpine Corp.* 702 F.3d at 45

[51] Cal. Pub. Utils. Comm'n, California Net Energy Metering, Draft Cost- Effectiveness Evaluation (2013), http://www.cpuc.ca.gov/NR/rdonlyres/BD9EAD36- 7648-430B-A692-8760FA186861/0/CPUCNEMDraftReport92613.pdf. p.6.

[52] Ibid.

[53] A recent Forbes article, "Distributed Generation Grabs Power from Centralized Utilities," August 8, 2013, ignores and fails to mention the grid services that are provided to DG customers continuously by the host utility.

[54] The term DG refers to small retail customers with on-site generation that are net metered.

[55] *Value of the Grid to DG Customers*, Updated October 2013, Prepared by Lisa Wood and Robert Borlick, available at http://www.eei.org/issuesandpolicy/generation/NetMetering/Pages/default.aspx.

[56] http://www.cleancurrents.com/residential-wind-power/understanding-your-bill/

[57] The Electric Power Research Institute (EPRI) is developing estimates of the cost of self-providing grid services and expects to release its results in 2014.