Center for American Progress

Net Energy Metering

Growth and Accountability in the Distributed Solar Market

By Luke H. Bassett July 14, 2016

Americans are installing solar photovoltaic, or PV, systems and other distributed energy resources on their homes for a host of reasons—including cutting electricity bills, increasing property value, preventing electrical outages, acting on climate change, and keeping up with the Joneses. These solar PV systems rely on distributed energy resources, which may include electricity generation, storage, efficiency, or demand response technologies that are typically smaller in scale than traditional power plants and are located near consumers. These distributed energy technologies interact with each other behind the electricity meter and/or across the local distribution or broader grid. For the past several years, the U.S. distributed solar PV market—which is an increasingly common type of distributed energy resources—has experienced rapid growth, as costs for the systems have fallen dramatically and policies have incentivized deployment.[1] In terms of reducing carbon emissions and providing all Americans access to solar and other clean energy resources, the growth of distributed solar PV is a trend worth watching and encouraging.

Net energy metering, or NEM, policies have nurtured the growth of distributed solar PV and other distributed energy installations by enabling homeowners and businesses to measure the electricity their systems produce or store versus the electricity they draw from the grid and settling the difference on their electricity bill.[2] By reducing the amount NEM-participating customers pay their utility for electricity—or even requiring utilities to buy their customers' excess electricity—NEM policies have become one of many factors that have challenged the traditional utility business model, which relies on selling electricity at a certain rate to generate revenue.

The net metering policy landscape continues to change quickly—often reactively—and varies greatly from state to state. Recently, under pressure from electric utilities, some state public utility commissions, or PUCs, have started to reconsider how to set electricity rates in order to ensure utilities can cover costs and realize a reasonable return on their investments. Each state's PUC regulates utilities' retail sales of electricity to consumers; protects consumers from overcharging; and ensures infrastructure investments meet reliability, environmental, and other policy goals. Some PUCs have amended NEM policies with the goal of reducing the financial incentive for consumers to install solar PV systems on their homes. Elsewhere, regulators, solar companies, utilities, and consumers are working together to create successor policies to NEM that will encourage solar PV growth while also addressing different stakeholder views on how to account and pay for the services provided by distributed and grid resources. A few states have yet to adopt NEM or other policies that incentivize clean energy deployment.

State-level debates about the future of net metering reflect the broader forces reshaping the U.S. power sector. At the heart of the debate is the value of services that the traditional electricity grid provides; the value of solar PV to the grid and the environment; and whether these values complement or compete with each other. This issue brief examines the role of net metering in incentivizing solar PV deployment and its implications for fair electricity rate design.

Context: Declining emissions, falling costs, and a growing solar PV market

Electric utilities, solar PV companies, state utility commissions, and other stakeholders are engaged in a heated debate about the relative costs and benefits of distributed solar PV to the electricity system, as well as to society overall. Three trends in the United States energy system provide important context for this debate:

- Declining U.S. energy-related carbon emissions
- Declining costs of solar PV systems
- Corresponding growth of solar PV installations

In 2015, U.S. energy-related greenhouse gas emissions declined to 12 percent below 2005 levels,[3] a welcome sign of the ongoing transition to a low-carbon electricity sector and the continued decoupling of economic growth from emissions trends. This new data also clarifies the challenge before us: Efforts to lower carbon emissions need to accelerate rapidly to meet President Barack Obama's 2025 goal of cutting emissions to 26 percent to 28 percent below 2005 levels.[4] To reach these goals—and the even more challenging targets beyond 2025—the United States needs to utilize every low-carbon energy generation source available, including distributed solar PV systems. An analysis of global energy pathways to decarbonization by midcentury indicates that the majority of forecasts add solar PV and thermal systems at rates in the range of 50 gigawatts to 150 gigawatts per year—far above historic trends for solar additions but within the normalized range of additions for conventional power generation technologies.[5]

To better understand the debate over policies incentivizing the deployment of distributed solar PV, it is important to understand the dramatic changes taking place in the solar industry. Since 1998, the reported prices for installing a residential solar PV system have fallen by 50 cents per watt per year on average, including a decline of 42 cents per watt, or 9 percent, from 2013 to 2014.[6] The differences among installed residential solar PV prices across U.S. states—$1.40 per watt between the highest, California, and lowest, Delaware—indicate a broad range of market, policy, labor, and project factors.[7] A National Renewable Energy Laboratory report on PV system installation prices illustrates that the 45 percent to 65 percent reduction in PV module prices contributed most to overall price decreases since the fourth quarter of 2009.[8] Balance of system costs, or so-called soft costs—which include permitting, installation labor, sales taxes, supply chain costs, among others—continue to make up as much as 64 percent of the total cost of new solar PV systems.[9] The cost of solar PV systems has fallen dramatically, but most consumers, particularly homeowners, need incentives to help cover upfront costs.

The U.S. solar PV market is in an early stage, with a cumulative capacity of just more than 25 gigawatts for residential, nonresidential, and utility-scale PV systems.[10] In 2015, the residential PV market installed more than 2 gigawatts of capacity, driven largely by the California market and representing a continued trend of 50 percent annual growth during the past four years.[11] Although electric utilities have raised concerns about the disruptive effect of solar PV for their business models, the portion of retail electricity sales reduced by the addition of distributed solar PV remains low: less than 2 percent in all states, other than Hawaii, and 0.3 percent of sales nationally through 2014.[12] Residential electricity sales saw reductions due to distributed solar PV installations of less than 1 percent in all but four states, with a 0.4 percent reduction nationally.[13] Over the two decades of growth in solar PV installations, energy efficiency programs have contributed more significantly to falling retail electric sales at roughly 15 times the effect from all solar PV systems through 2014—and at rates projected to accelerate in response to market shifts, federal and state policies, and consumer choices.[14]

Looking forward, U.S. solar PV growth projections remain optimistic but difficult to predict.[15] Several federal, state, local, and tribal policies will continue to drive that growth, with states such as Hawaii, California, Massachusetts, New Jersey, and others serving as test beds for solar PV deployment policymaking. The future of the PV market will be shaped by the interaction among these policies, as well as challenges to—or strengthening of—any single policy, such as net energy metering.

What is net energy metering?

First introduced in Minnesota in the 1980s, net energy metering enables customers with distributed solar PV to not only use the energy they generate but also to sell excess electricity to their utility at retail rates and earn credits on their bill.[16] These NEM credits have encouraged the adoption of solar PV systems by helping homeowners' spread out payments for upfront installation costs, which typically range between $17,000 and $24,000.[17] In the case of leased solar PV systems, third-party companies earn revenue partially based on the excess electricity NEM policies require utilities to buy. As of February 2016, 41 states, the District of Columbia, and four U.S. territories have implemented some variety of NEM policy, and additional utilities operate NEM programs in certain states without statewide policies. Currently, only Alabama, Tennessee, and South Dakota have no NEM policies, mandatory, voluntary, or otherwise.[18]

Although NEM policies share some basic accounting, each state has variations that—when considered with the different solar resources and incentive policies across the United States—have led to a highly location-specific market for solar PV systems. Net metering often includes specifications for which technologies qualify as sources; how customers are compensated for the excess electricity they generate; and whether customers or utilities own the renewable energy credits, or RECs, generated and applicable toward state renewable portfolio standards. State NEM policies may also limit the size of individual systems, as well as the statewide net metering amounts.[19]

Capacity limits have served as markers for solar PV generation growth by restricting individual customers from overutilizing NEM and unfairly profiting from excess energy generation, setting a pace for the integration of distributed resources onto the grid, and signaling a limit up to which markets should grow before utility commissions reconsider their NEM policies overall. Individual capacity limits restrict the size of a solar PV system that customers may install and connect to the grid. The limits often vary based on the utility, customer class—either residential or commercial—or the generation technology. Similarly, certain states have authorized NEM for customers who want to utilize multiple meters on one property, meters on different properties, or meters and solar PV systems owned or shared by multiple parties. Statewide system capacity restrictions limit the overall amount of connections of a specific distributed technology to the grid in order to maintain grid reliability and retain revenue flows for utilities.[20]

Recognizing their importance to spur or limit solar PV growth, capacity limits have become a focal point of political pressure on utility commissions from the solar industry and utilities alike. In states seeking to continue their NEM programs while adapting them to changing market dynamics, capacity limits are one of several policy attributes used to debate the merits of NEM as a whole.[21] When considered in the broader context of retail electricity rates and their design, NEM policies become even more challenging and politicized, as seen recently in Nevada's dramatic reversal.

Case Study: A reversal of net energy metering in Nevada

Over the past few years, Nevada has become a focal point in the debate over NEM policies and the growth of distributed solar PV. Nevada originally enacted NEM laws in 1997[22] and became a fast-growing solar PV market—increasing capacity by more than 80 percent from January 2014 through January 2016[23]—due to its policy incentives and obvious solar resource potential.[24] In 2013, Gov. Brian Sandoval (R) and the Nevada Legislature required the state PUC to study and determine appropriate rates for net-metered systems. Following the 2014 outside study,[25] several changes to its NEM cap,[26] and a record low price for utility-scale solar PV set by NV Energy in summer 2015,[27] the Nevada PUC made news in late 2015 by adopting a phased-in service charge increase and decreasing credits for excess generation for NEM customers.[28] Those changes, along with the elimination of grandfathering existing NEM rates into the new rate structure, halted growth in distributed solar PV deployment. Within a short time, solar companies cut PV installation jobs across the state.[29]

Two sets of cost and benefit assumptions underlay the Nevada NEM policy debate and reflect the larger debate over the future of NEM and the value of distributed and grid resources. The 2014 study the PUC commissioned analyzed several costs to utilities that the installation of NEM-supported solar PV avoided, including added power plants and power lines, losses incurred in electricity distribution, providing reliability reserves, and additional system capacity to meet peak energy demands. It also assumed certain prices—$100 per megawatt hour—for competing technologies, such as utility-scale solar, going forward through 2020.[30] The Nevada PUC subsequently shifted course and adopted a limited accounting of these costs and benefits, naming only avoided energy generation and distribution line losses.[31] Due to the record low prices set for utility-scale solar in summer 2015, and using its traditional rate-design cost categories, the PUC decided that NEM was no longer feasible,[32] and it adopted a monthly charge for NEM customers and a substantially lower NEM credit rate.[33] Rather than accounting for individual costs and benefits for both distributed and grid energy resources—the prices of which will likely continue to change—the PUC applied its traditional rate design and reinforced uneven costs and benefits for all ratepayers, a key theme of the NEM and utility business model debate.[34]

By rejecting more detailed cost and benefit assumptions, the NEM debate in Nevada obscured the value of solar PV systems to net-metered customers and non-net-metered customers. Even more significantly, however, the Nevada PUC's decision to eliminate grandfathering of existing NEM contracts exposed approximately 17,000 customers to the new 12-year phase-in rate increases. NV Energy will ultimately charge its solar customers a fixed service fee of nearly $40 per month and decrease the NEM credits it provides to 2.6 cents per kilowatt hour—down from current rates of 11 cents per kilowatt hour.[35]

The effect of net energy metering on rate design

Given the early stage of the solar PV market, the politicization of NEM policies in many states, including Nevada, is striking. Solar companies and utilities alike argue that NEM's fairly straightforward formula—electricity generated minus electricity consumed equals revenue—hides different values and costs that their respective sides of the electricity meter take into account. The nation has already seen spirited debates over NEM policies, as groups on both sides of the meter have argued for and against revising or replacing NEM policies via actions taken by state PUCs, such as in Nevada,[36] state legislatures, such as in Maine,[37] or by voters, such as those in Florida.[38] (See text box)

Recent state debates over net energy metering

In addition to Nevada, several other states have taken up the NEM debate, with 35 policy actions in 22 states catalogued in the first quarter of 2016 alone.[39] Some major actions include:

Arizona: Two utilities filed rate cases proposing changes to net metering that shift compensation to mirror utility-scale renewable energy rates.[40]

California: The California Public Utilities Commission issued a net metering successor policy covering the state's three investor-owned utilities that incorporates an interconnection fee, certain service charges for electricity consumed from the grid, and requirements to adopt a time-of-use rate when that rate becomes available.[41]

Florida: A utility-backed group succeeded in placing a ballot measure that guarantees a state constitutional right to own or lease solar PV systems without legalizing third-party ownership.[42]

Hawaii: The PUC ended net metering, allowing the grandfathering of current systems and tolerance for systems in the application queue.[43]

Maine: Gov. Paul LePage (R) vetoed a bill establishing a wholesale market-based NEM successor that combined generation from distributed solar PV and utility-scale solar systems for sale in New England's power markets.[44] Because utilities have met their NEM caps, potential investors and owners are halting plans to expand solar PV installations there without NEM or successor incentives to build.[45]

New York: Under the PUC's Reforming the Energy Vision process, utilities and solar companies proposed a NEM successor policy that lowers NEM incentives and adds developer fees over time until credits equal a value of distributed solar determined by the commission.[46]

Vermont: The state proposed NEM rules that apply customer generation credits only to grid-electricity consumption—not other associated service charges—and would adjust credits based on system size, siting, and other factors.[47]

Accounting for solar PV in rate design

At issue in these states and many others is how to set electricity rates for NEM customers and nonparticipants that accurately reflect and distribute the costs and benefits of both distributed- and grid-provided power; maintain the grid and the reliability it provides; and recoup investments made by utilities in the grid and by NEM customers in their solar PV systems. Bearing in mind the standard set at the federal level, PUCs determine whether retail electricity rates are "just and reasonable," often drawing on extensive analyses of fuel, capital infrastructure, efficiency losses, and other costs, as well as benefits such as equity, bill and revenue stability, and customer service.[48] Traditional central, utility-focused rate design covers fixed costs associated with generation, transmission, and distribution infrastructure investments, as well as variable costs for fuel, operations, and maintenance. These rate designs typically addressed the just and reasonable standard by allocating costs across a utility's customers based on demand and type of customer.[49]

Net energy metering introduced a way of accounting for costs and benefits delivered by distributed technologies that the traditional rate design model either does not capture or bundles with other charges. Apart from the direct financial benefits to distributed solar PV system owners and lessees through reduced bills and the sale or lease revenue earned by solar companies and some utilities, NEM-incentivized solar PV installations also capture broader societal benefits. An increased reliance on solar power will reduce local pollution and carbon emissions from fossil fuel power plants while also enhancing grid reliability and power quality. These benefits help utilities avoid the cost of building new power plants; emission control technologies for fossil fuel plants; or other reliability and power quality equipment.[50] From the other side of the meter, the grid also delivers services to NEM customers by balancing intermittent electricity flow, providing a market for excess generation, enhancing power quality through voltage and frequency controls, and preventing outages.[51] And in both directions, customers cross-subsidize the services provided for and used by each other in uneven ways due to different locations, times of use, efficiency and distributed technologies used, and demand amounts.[52]

Quantifying relative costs and benefits of solar PV

In recent years, solar companies, utilities, nongovernment organizations, and PUCs have published several methodologies for assessing solar PV's range of costs and benefits, and although no single set has been widely adopted, many studies point to a broad set of benefits for NEM customers, nonparticipants, and utilities not explicitly accounted for in many rate designs. (See text box)

Cost and benefit analyses and rate designs

Recent articles on NEM policies have presented a range of different cost and benefit analysis methodologies assessing the effects of distributed solar PV systems. As part of several rate case proceedings and considerations of NEM policies, many state PUCs have commissioned cost-benefit analyses, with several different ranges and cost categories, as outlined in two recent Brookings Institution articles. The first article outlines several analyses that indicate net benefits due to NEM.[53] The second article's counterargument cites additional cost-benefit studies that point to net costs associated with the policy.[54] Further analyses have been conducted by solar companies, led by SolarCity, advocating for broader methodologies to account for distributed technology services to the grid;[55] utilities and industry advocates arguing for narrower sets of costs and benefits that reflect their integrated resource planning processes;[56 57] and even other advocacy groups that seek to circumvent the issue entirely by proposing alternate policies and accounting methodologies.[58] The number and variety of methodologies is overwhelming and often belies the nature of electricity rate design, which is specific to location, time, customer, and use.

A key distinction among methodologies includes whether studies prospectively account for costs and benefits or retrospectively assess costs of delivering service. The former study type has generally indicated broader benefits, while the latter has been used to illustrate the difference in utility revenue flows between NEM customers and non-NEM customers.[59] Many cost-benefit analyses promoting NEM rely on prospective planning-oriented studies.[60] Conversely, many arguments against NEM have utilized either limited prospective studies or retrospective cost of service analyses that compare revenue recovery under traditional utility rate design versus NEM policies.[61] The perspective and transparency of either method of analysis is crucial to the outcomes it provides decision-makers.

The resulting differences in perspective and accounting have led to intense debates over the existence of a so-called cost shift from NEM customers to non-NEM customers, including low-income residential customers. These elements played out in Nevada, when the PUC made decisions more closely aligned with the retrospective cost-of-service assessment submitted by the utilities, a study using four traditional cost components—facilities, customer service, demand-related costs, and energy—without retrospective or prospective analysis considering broader costs and benefits provided by distributed solar PV systems.[62] Furthermore, the utilities argued, "NEM ratepayers are subsidized by non-NEM ratepayers when a simple two-part rate design that relies primarily on volumetric rates to recover demand and fixed costs continues to be used."[63] This argument simplifies the many different ways in which ratepayers of different end-use types, locations, demand profiles, time-of-use profiles, and financial abilities share the burden of paying for the generation and transmission of electricity together. The rate designs championed under the traditional utility business model in many electricity markets no longer fully reflect or serve the diversity of customers, uses, and technologies involved in the electricity system. Net metering has provided one approach to addressing changing utility business models while promoting the growth of solar.

Similarly, utility or solar company advocates who do account for a broader range of costs and benefits on either side of the electric meter risk overstating their case if they do not recognize the interactions among different ratepayers and the shared commons the electricity system provides. Historically, utility commissioners and utilities designed electricity rates that are now seen as uneven or cross-subsidizing in order to account and pay for different demands placed on the grid by different users, at different times, and in different locations. Today, increasingly varied technologies are adding even more diversity to the grid—all while awareness of and demand for more diverse electricity services, such as solar PV, grow. Policies such as NEM, which are intended to incentivize the adoption of distributed solar PV systems, have also revealed new cross-subsidies applied to NEM-participating and nonparticipating ratepayers alike.[64]

Net metering has provided one approach to addressing changing utility business models while promoting the growth of solar.

The selective analysis of NEM costs and benefits and subsequent rate design decisions relying on this information have obscured price signals for the wide range of grid and distributed solar PV services. As in the case of Nevada, the lack of transparent and detailed accounting has halted or reversed market growth; provided political fodder for opposing sides in rate cases; undermined broad market participation from companies and customers alike; and removed accountability from the rate-design process.[65] It also fuels arguments against NEM on the basis of potential effects to utility shareholder returns due to reduced revenue flows from NEM customers.[66] Utilities have relied on consistent shareholder returns to access low-cost capital for investments in generation or grid infrastructure.[67] Accounting for avoided costs on both sides of the meter more clearly would enable utilities to plan for and structure infrastructure investments in ways more tailored to their demand growth.[68]

The NEM policy variations among states have contributed to nearly 50 unique markets for those seeking to install distributed solar PV systems.[69] These markets are at different stages of maturity in response to each state's solar resources, existing retail electricity prices, clean energy policies, and the degree to which solar companies and utilities have succeeded in working together with state regulators on NEM policies and their successors.[70] In combination with the inconsistent regulatory landscape from state to state, the reactive changes to NEM policies without grandfathering provisions for established customers in certain states have challenged the creation of open and transparent clean energy markets. These changes have also slowed solar companies' ability to steadily grow their businesses across multiple states; impeded access to distributed energy technologies such as solar PV systems for all consumers; and hampered states in reaching their clean energy goals.

Conclusion

As states revisit NEM policies, policymakers participate in a debate regarding the value of services provided by and for the electricity grid and distributed resources; utilities and solar PV companies; and NEM customers and nonparticipants. Electricity meters connect these entities in mutually reliant relationships. These relationships can be both physical—such as the flow of electricity to and from the grid and customers' meters—and financial—such as payment for the power quality services provided by one customer to other customers on the grid. The meter has become the central point for an entire ecosystem of services and technologies that unlock our low-carbon future.

Net energy metering is one of several policies enabling greater participation by homeowners and businesses in retail electricity markets and incentivizing the deployment of renewable generation. In the context of broader changes in those markets and the need to reduce carbon emissions, net energy metering has an important role as a means to deploy distributed solar PV; involve individuals in the market with the goal of increasing competition and affordability over time; and provide a path for other distributed energy resources to enter into use. At the same time, the need for utilities to provide electricity and grid-related services to their entire customer base at just and reasonable rates and in an inclusive manner remains clear. The discussion of distributed energy resources, grid services, and the utility business model will only become more complex as new technologies and services join the electricity system. Its importance will only grow as meeting U.S. carbon emission reduction goals becomes more urgent.

New utility business models and rate designs are proliferating in response to states revising NEM and other clean energy policies. The NEM debate is taking place alongside incredible technological, market, and policy developments that will also shape the electricity sector. Ranging from the need to help states meet their targets under the Environmental Protection Agency's Clean Power Plan to the rise of community solar as an option for involving more people in achieving larger economies of scale for solar PV installations, ratepayers, solar companies, utilities, and regulators will draw on more tools to deploy the clean energy technologies needed to reduce emissions, provide electricity to all Americans at fair rates, and continue growing the United States into a clean energy superpower.

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