BROOKINGS

Report

Rooftop solar: Net metering is a net benefit

Mark Muro and Devashree Saha Monday, May 23, 2016

Rooftop solar is booming in U.S. cities.

One of the most exciting infrastructure developments within metropolitan America, the installation of over a million solar photovoltaic (PV) systems in recent years, represents nothing less than a breakthrough for urban sustainability — and the climate.

Prices for solar panels have fallen dramatically. Residential solar installations surged by 66 percent between 2014 and 2015 helping to ensure that solar accounted for 30 percent of all new U.S. electric generating capacity. And for that matter, recent analyses conclude that the cost of residential solar is often comparable to the average price of power on the utility grid, a threshold known as grid parity.

So, what's not to like? Rooftop solar is a total winner, right?

Well, not quite: The spread of rooftop solar has raised tricky issues for utilities and the public utilities commissions (PUCs) that regulate them.

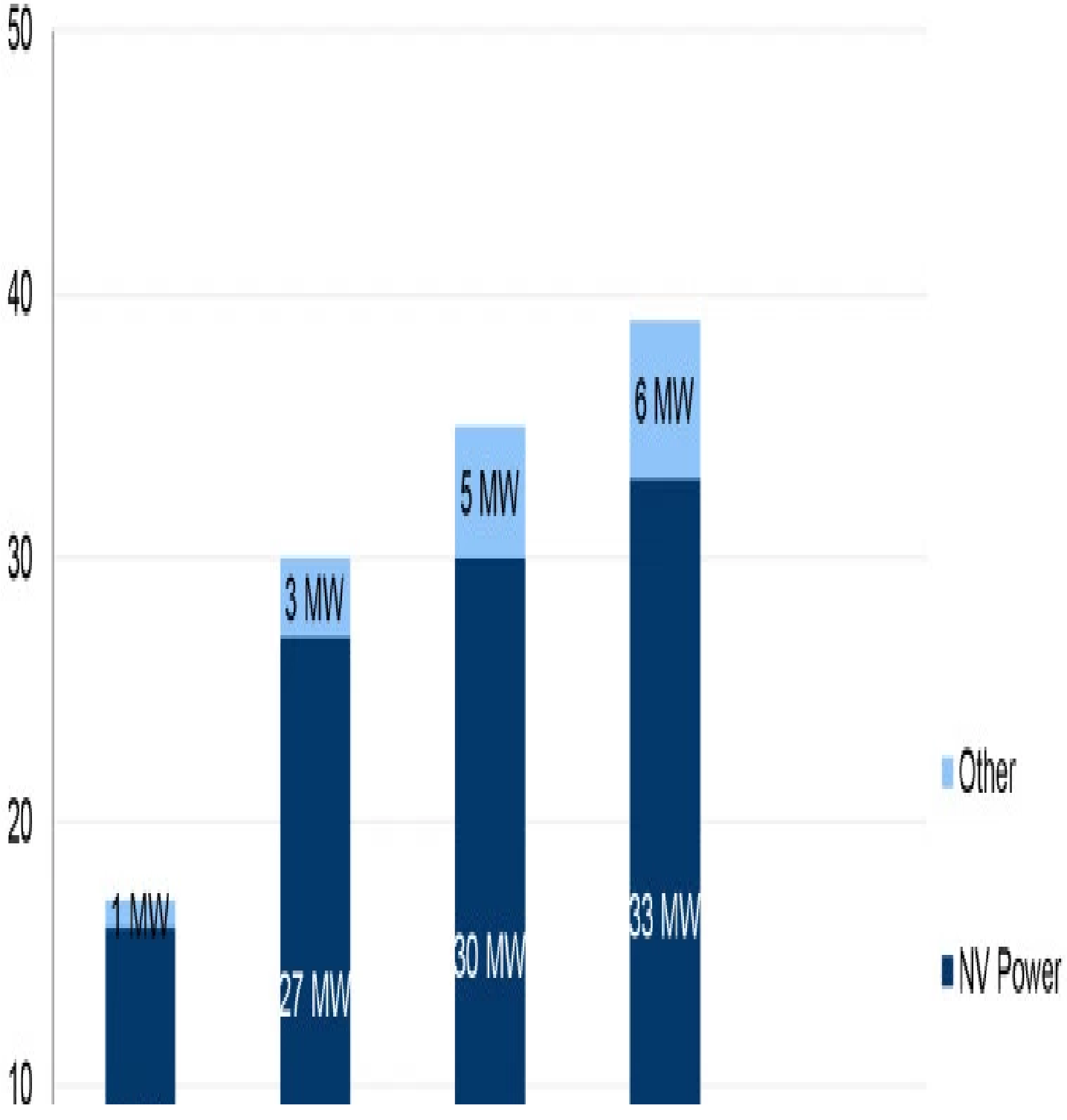
Specifically, the proliferation of rooftop solar installations is challenging the traditional utility business model by altering the relationship of household and utility—and not just by reducing electricity sales. In this respect, the solar boom has prompted significant debates in states like New York and California about the best rates and policies to ensure that state utility rules and rates provide a way for distributed solar to flourish even as utilities are rewarded for meeting customer demands. Increasingly, this ferment is leading to thoughtful dialogues aimed at devising new forms of policy and rate design that can—as in New York—encourage distributed energy resources (DERs) while allowing for distribution utilities to adapt to the new era.

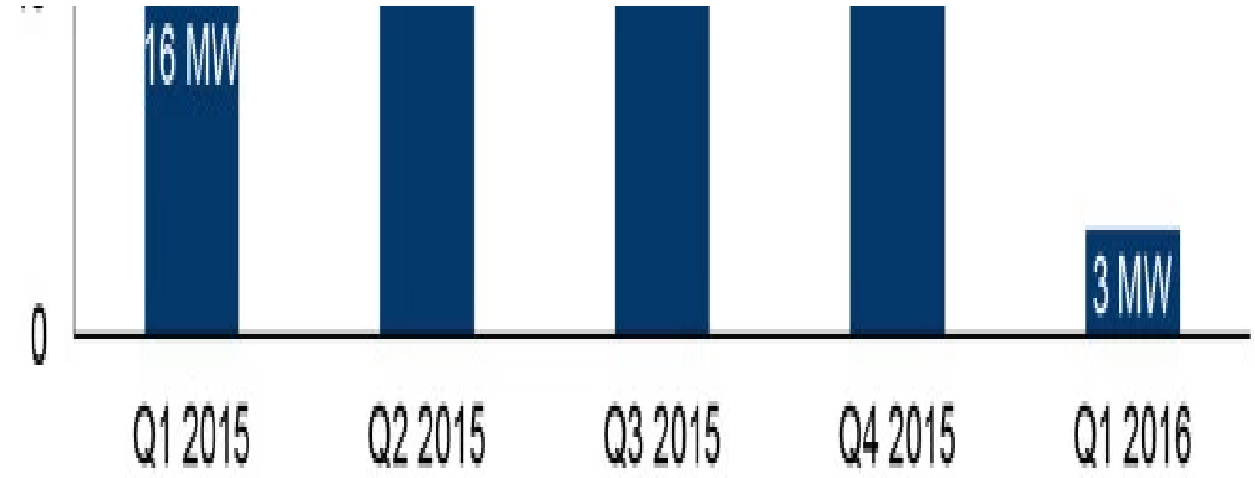
However, in some states, the ferment has prompted a cruder set of backlashes. Most pointedly, some utilities contend that the "net-metering" fees paid to homeowners with rooftop installations for excess solar power they send back to the grid unfairly transfer costs to the utilities and their non-solar customers.

And so in a number of states, utility interests have sought to persuade state regulators to roll back net-metering provisions, arguing they are a net cost to the overall electricity system. Most glaringly, the local utility in Nevada successfully wielded the cost-shift theory last winter to get the Nevada Public Utilities Commission to drastically curtail the state's net-metering payments, prompting Solar City, Sunrun, and Vivint Solar—the state's three largest providers of rooftop panels—to leave the Nevada market entirely. The result: New residential solar installation permits plunged 92 percent in Nevada in the first quarter of 2016.

Permits issued for Nevada residential PV by service territory

Q1 2015 - Q1 2016 (MW)





Source: Bloomberg New Energy Finance, Construction Monitor

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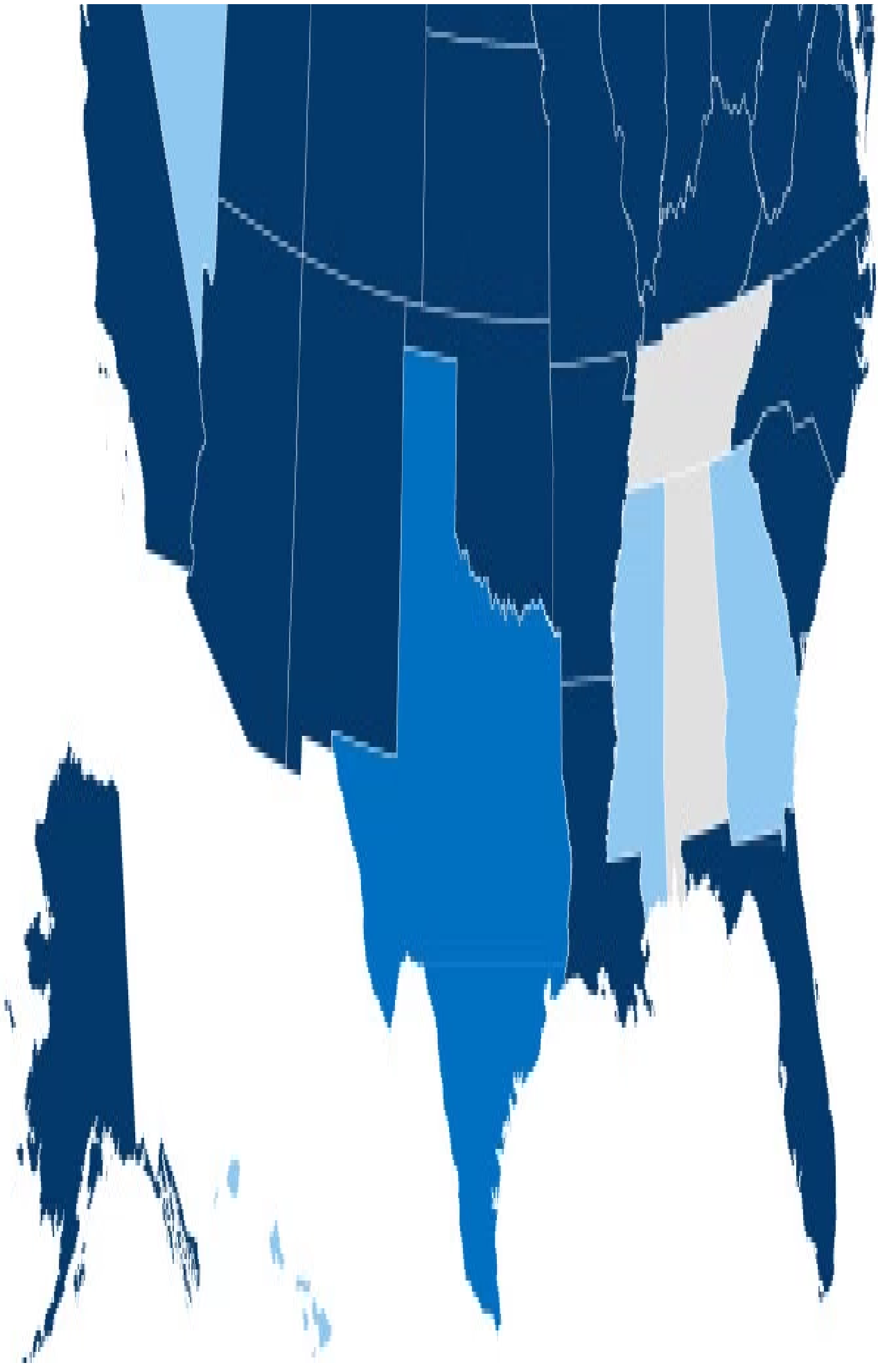
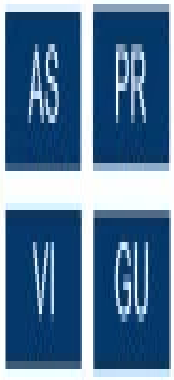
All of which highlights a burning question for the present and future of rooftop solar: Does net metering really represent a net cost shift from solar-owning households to others? Or does it in fact contribute net benefits to the grid, utilities, and other ratepayer groups when all costs and benefits are factored in? As to the answer, it's getting clearer (even if it's not unanimous). Net metering — contra the Nevada decision — frequently benefits all ratepayers when all costs and benefits are accounted for, which is a finding state public utility commissions, or PUCs, need to take seriously as the fight over net metering rages in states like Arizona, California, and Nevada. Regulators everywhere need to put in place processes that fairly consider the full range of benefits (as well as costs) of net metering as well as other policies as they set and update the policies, regulations, and tariffs that will play a critical role in determining the extent to which the distributed solar industry continues to grow.

41 States, DC, and four U.S. territories have mandatory net metering rules





Legend

- State-developed mandatory net metering rules for certain utilities
- No statewide mandatory net metering rules, but some utilities offer net metering
- Statewide distributed generation compensation rules other than net metering
- No statewide distributed generation compensation rules

Source: "The 50 States of Solar," by NC Clean Energy Technology Center and Meister Consultants Group

Fortunately, such cost-benefit analyses have become an important feature of state rate-setting processes and offer important guidance to states like Nevada. So what does the accumulating national literature on costs and benefits of net metering say? Increasingly it concludes— whether conducted by PUCs, national labs, or academics — that the economic benefits of net metering actually outweigh the costs and impose no significant cost increase for non-solar customers. Far from a net cost, net metering is in most cases a net benefit—for the utility and for non-solar rate-payers.

Of course, there *are* legitimate cost-recovery issues associated with net metering, and they vary from market to market. Moreover, getting to a good rate design, which is essential for both utility revenues and the growth of distributed generation, is undeniably complicated. If rates go too far in the direction of "volumetric energy charges"—charging customers based on energy use—utilities could have trouble recovering costs when distributed energy sources reach higher levels of penetration. On the other hand, if rates lean more towards fixed charges—not dependent on usage—it may reduce incentives for customers to consider solar and other distributed generation technologies.

Moreover, cost-benefit assessments can vary due to differences in valuation approach and methodology, leading to inconsistent outcomes. For instance, a Louisiana Public Utility Commission study last year found that that state's net-metering customers do not pay the full cost of service and are subsidized by other ratepayers. How that squares with other states' analyses is hard to parse.

Nevertheless, by the end of 2015, regulators in at least 10 states had conducted studies to develop methodologies to value distributed generation and net metering, while other states conducted less formal inquiries, ranging from direct rate design or net-metering policy changes to general education of decisionmakers and the public. And there is a degree of consensus. What do the commission-sponsored analyses show? A growing number show that net metering benefits all utility customers:

- In 2013 Vermont's Public Service Department conducted a study that concluded that "net-metered systems do not impose a significant net cost to ratepayers who are not net-metering participants." The legislatively mandated analysis deemed the policy a successful component of the state's overall energy strategy that is cost effectively advancing Vermont's renewable energy goals.

- In 2014 a study commissioned by the Nevada Public Utility Commission itself concluded that net metering provided $36 million in benefits to all NV Energy customers, confirming that solar energy can provide cost savings for both solar and non-solar customers alike. What's more, solar installations will make fewer costly grid upgrades necessary, leading to additional savings. The study estimated a net benefit of $166 million over the lifetime of solar systems installed through 2016. Furthermore, due to changes to utility incentives and net-metering policies in Nevada starting in 2014, solar customers would not be significantly shifting costs to other ratepayers.

- A 2014 study commissioned by the Mississippi Public Services Commission concluded that the benefits of implementing net metering for solar PV in Mississippi outweigh the costs in all but one scenario. The study found that distributed solar can help avoid significant infrastructure investments, take pressure off the state's oil and gas generation at peak demand times, and lower rates. (However, the study also warned that increased penetrations of distributed solar could lead to lower revenues for utilities and suggested that the state investigate Value of Solar Tariffs, or VOST, and other alternative valuations to calculate the true cost of solar.)

- In 2014 Minnesota's Public Utility Commission approved a first-ever statewide "value of solar" methodology which affirmed that distributed solar generation is worth more than its retail price and concluded that net metering undervalues rooftop solar. The "value of solar" methodology is designed to capture the societal value of PV-generated electricity. The PUC found that the value of solar was at 14.5 cents per kilowatt hour (kWh)—which was 3 to 3.5 cents more per kilowatt than Xcel's retail rates—when other metrics such as the social cost of

carbon, the avoided construction of new power stations, and the displacement of more expensive power sources were factored in.

- Another study commissioned by the Maine Public Utility Commission in 2015 put a value of $0.33 per kWh on energy generated by distributed solar, compared to the average retail price of $0.13 per kWh — the rate at which electricity is sold to residential customers as well as the rate at which distributed solar is compensated. The study concludes that solar power provides a substantial public benefit because it reduces electricity prices due to the displacement of more expensive power sources, reduces air and climate pollution, reduces costs for the electric grid system, reduces the need to build more power plants to meet peak demand, stabilizes prices, and promotes energy security. These avoided costs represent a net benefit for non-solar ratepayers.

These generally positive PUC conclusions about the benefits of net metering have been supported by research done by a national lab and several think tanks. Important lab research has examined how substantially higher adoption of distributed resources might look.

In a forward-looking analysis of the financial impacts of net-metered energy on utilities and ratepayers, Lawrence Berkeley National Lab found that while high use of net-metered solar generation may decrease utility shareholders' earnings, it will have a "relatively modest" impact on ratepayers. The report examined solar penetration levels that are "substantially higher than [those that] exist today" — 10 percent compared to today's 0.2 percent — and concluded that "even at penetration levels significantly higher than today, the impacts of customer-sited PV on average retail rates may be relatively modest." The report further said that utilities and regulators "may have sufficient time to address concerns about the rate impacts of PV in a measured and deliberate manner"

Similarly, a growing number of academic and think tank studies have found that solar energy is being undervalued and that it delivers benefits far beyond what solar customers are receiving in net-metering credits:

- For instance, a review of 11 net metering studies by Environment America Research and Policy Center has found that distributed solar offers net benefits to the entire electric grid through reduced capital investment costs, avoided energy costs, and reduced environmental compliance costs. Eight of the 11 studies found the value of solar energy to be higher than the average local residential retail electricity rate: The median value of solar power across all 11 studies was nearly 17 cents per unit, compared to the nation's average retail electricity rate of about 12 cents per unit.

- A 2015 cost-benefit study of net metering in Missouri by the Missouri Energy Initiative found that even accounting for increased utility administrative costs and the shifting of some fixed expenses, net metering is a net benefit for all customers regardless of whether they have rooftop solar. The study used values for two kinds of costs and two benefits and concluded that net metering's "net effect" is positive. The typical solar owner pays only 20 percent less in fixed grid costs and costs the utility an estimated $187 per interconnection. Meanwhile, solar owners benefit the system through reduced emissions and energy costs.

- Likewise, a study by Acadia Center found the value of solar to exceed 22 cents per kWh of value for Massachusetts ratepayers through reduced energy and infrastructure costs, lower fuel prices, and lowering the cost of compliance with the Commonwealth's greenhouse gas requirements. This value was estimated to exceed the retail rate provided through net metering.

- In yet another study, researchers at the University at Albany, George Washington University, and Clean Power Research have found that solar installations in New York deliver between 15 and 40 cents per kWh to ratepayers. The study noted that these numbers provide economic justification for the existence of incentives that transfer value from those who benefit from solar electric generation to those who invest in solar electric generation.

In short, while the conclusions vary, a significant body of cost-benefit research conducted by PUCs, consultants, and research organizations provides substantial evidence that net metering is more often than not a net benefit to the grid and all ratepayers.

As to the takeaways, they are quite clear: Regulators and utilities need to engage in a broader and more honest conversation about how to integrate distributed-generation technologies into the grid nationwide, with an eye toward instituting a fair utility-cost recovery strategy that does not pose significant challenges to solar adoption.

From the state PUCs' perspective, until broad changes are made to the increasingly outdated and ineffective standard utility business model, which is built largely around selling increasing amounts of electricity, net-metering policies should be viewed as an important tool for encouraging the integration of renewable energy into states' energy portfolios as part of the transition beyond fossil fuels. To that end, progressive regulators should explore and implement reforms that arrive at more beneficial and equitable rate designs that do not prevent solar expansion in their states. The following reforms range from the simplest to the hardest:

- **Adopt a rigorous and transparent methodology for identifying, assessing, and quantifying the full range of benefits and costs of distributed generation technologies**. While it is not always possible to quantify or assess sources of benefits and costs comprehensively, PUCs must ensure that all cost-benefit studies explicitly decide how to account for each source of value and state which ones are included and which are not. Currently methodological differences in evaluating the full value of distributed generation technologies make comparisons challenging. States start from different sets of questions and assumptions and use different data. For instance, while there is consensus on the basic approach to energy value estimation (avoided energy and energy losses via the transmission and distribution system), differences arise in calculating other costs and benefits, especially unmonetized values such as financial risks, environmental benefits, and social values. In this regard, the Interstate Renewable Energy Council's "A Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation" and the National

Renewable Energy Laboratory's "Methods for Analyzing the Benefits and Costs of Distributed Photovoltaic Generation to the U.S. Electric Utility System" represent helpful resources for identifying norms in the selection of categories, definitions, and methodologies to measure various benefits and costs.

- **Undertake and implement a rigorous, transparent, and precise "value of solar" analytic and rate-setting approach that would compensate rooftop solar customers based on the benefit that they provide to the grid.** Seen as an alternative to 'traditional' net-metering rate design, a "value of solar" approach would credit solar owners for (1) avoiding the purchase of energy from other, polluting sources; (2) avoiding the need to build additional power plant capacity to meet peak energy needs; (3) providing energy for decades at a fixed prices; and (4) reducing wear and tear on the electric grid. While calculating the "value of solar" is very complex and highly location-dependent, ultimately PUCs may want to head toward an approach that accurately reflects all benefits and costs from all energy sources. Value of solar tariffs are being used in Austin, Texas (active use) and Minnesota (under development).

- **Implement a well-designed decoupling mechanism that will encourage utilities to promote energy efficiency and distributed generation technologies like solar PV, without seeing them as an automatic threat to their revenues.** As of January 2016, 15 states have implemented electric decoupling and eight more are considering it. Not surprisingly, it is states that have not decoupled electricity (such as Nevada) that are fighting net metering the hardest. Typically, decoupling has been used as a mechanism to encourage regulated utilities to promote energy efficiency for their customers. However, it can also be used as a tool to incentivize net metering by breaking the link between utility profits and utility sales and encouraging maximum solar penetration. Advocates of decoupling note that it is even more effective when paired with time-of-use pricing and minimum monthly billing.

- **Move towards a rate design structure that can meet the needs of a distributed resource future.** A sizable disconnect is opening between the

rapidly evolving new world of distributed energy technologies and an old world of electricity pricing. In this new world, bundled, block, "volumetric" pricing—the most common rate structure for both residential and small commercial customers—can no longer meet the needs of all stakeholders. The changing grid calls, instead, for new rate structures that respond better to the deployment of new grid technologies and the proliferation of myriad distributed energy resources, whether solar, geothermal, or other. A more sophisticated rate design structure, in this regard, would take into consideration three things: (1) the unbundling of rates to specifically price energy, capacity, ancillary services, and so on; (2) moving from volumetric bloc rates to pricing structures that recognize the variable time-based value of electricity generation and consumption (moving beyond just peak versus off-peak pricing to fully real-time pricing); and (3) moving from pricing that treats all customers equally to a pricing structure that more accurately compensates for unique, location-specific and technology specific values.

- **Move towards a performance-based utility rate-making model for the modern era.** Performance based regulation (PBR) is a different way of structuring utility regulation designed to align a utility's financial success with its ability to deliver what customers and society want. Moving to a model that pays the utility based on whether it achieves quantitatively defined outcomes (like system resilience, affordability, or distributed generation integration) can make it profitable for them to pursue optimal grid solutions to meet those outcomes. The new business model would require the PUC and utilities to make a number of changes, including overhauling the regulatory framework, removing utility incentives for increasing capital assets and kilowatt hours sold, and replacing those incentives with a new set of performance standard metrics such as reliability, safety, and demand-side management. New York's Reforming the Energy Vision proceeding is the most high-profile attempt in the country to implement a PBR model.

Options also exist for utilities to address the challenges posed by net metering:

- Utilities, most notably, have the opportunity to adjust their existing business models by themselves owning and operating distributed PV assets (though not to the exclusion of other providers). On this front, utilities could move to assemble distributed generation systems, such as for rooftop solar, and sell or lease them to homeowners. In this regard, utilities have an advantage over third-party installers currently dominating the residential rooftop solar industry due to their proprietary system knowledge, brand recognition, and an existing relationship with their customers. Utilities in several states such as Arizona, California, and New York are investigating or have already invested in the opportunity.

- Furthermore, utilities can also push the envelope on grid modernization by investing in a more digital and distributed power grid that enables interaction with thousands of distributed energy resources and devices.

Ultimately, distributed solar is here to stay at increasing scale, and so state policies to support it have entered an important new transitional phase. More and more states will now likely move to update their net-metering policies as the cost of solar continues to drop and more homeowners opt to install solar panels on their homes.

As they do that, states need to rigorously and fairly evaluate the costs and benefits posed by net metering, grid fees, and other policies to shape a smart, progressive regulatory system that works for all of the stakeholders touched by distributed solar.

Utilities should have a shot at fair revenues and adequate ratepayers. Solar customers and providers have a right to cost-effective, reliable access to the grid. And the broader public should be able to expect a continued solar power boom in U.S. regions as well as accelerated decarbonization of state economies. All of which matters intensely. As observes the North Carolina Clean Energy Technology Center and Meister Consultants Group: “How key state policies and rates are adapted will play a significant role in determining the extent to which the [solar PV] industry will continue to grow and in what markets.”