Department of Energy
Washington, DC 20585

February 21, 2019

The Honorable Nancy Pelosi
Speaker of the U.S. House of Representative
Washington, DC 20515

Dear Madam Speaker:

This letter report provides findings in response to legislative language set forth in Senate Report No. 114-236, 114th Cong., 1st Sess. dated Apr. 14, 2016 which asked the Department of Energy (DOE) to conduct a study that would "determine the costs and benefits of net metering and distributed solar generation to the electrical grid, utilities, and ratepayers."

For the purposes of this report, net energy metering (NEM) is:

> "service to an electric consumer under which electric energy generated by that consumer from an eligible on-site generating facility [*e.g.*, a rooftop photovoltaic array] and delivered to the local [electric] distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period."[1]

After reviewing responses to DOE's public Request for Information (RFI) on NEM,[2] 15 recent NEM-related cost-benefit studies,[3] and other NEM-related literature, we have come to a number of conclusions:

1. *NEM was widely adopted by states[4] as a simple way to reimburse solar customer/generators who feed their excess electricity into the grid.* When most NEM

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[1] 16 USC 2621(d)(11) This definition is drawn from the definition of "net metering service" at section 111(d)(11) of the Public Utility Regulatory Policies Act of 1978 (as amended by section 1251 of the Energy Policy Act of 2005), codified at 16 U.S.C. § 2621(d)(11).

[2] Comments received in response to the RFI can be accessed at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

[3] *See* ICF, *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar*, May 2018 (ICF Review).

[4] As of November 2017, 38 states plus the District of Columbia had adopted some form of mandatory NEM rules for electric utilities. (*See* http://www.dsireusa.org/) However, many of these states have subsequently modified their rules substantially, and some have dropped NEM altogether in favor of an alternative approach. See Tom Stanton, "NEM 2.0 and Successor Tariffs: Which States are Doing What?" National Regulatory Research Institute webinar (Mar. 14, 2018). http://nrri.org/wp-content/uploads/2018/03/20180309-Stanton-and-Barber-NEM-and-Successor-Tariffs.pdf.

plans were first adopted, residential photovoltaic technology costs were high and its market penetration was minimal. Since then costs have fallen, and distributed market penetration is approaching 1% of retail sales. However, market penetration varies strongly by location. In 2016, only California and Hawaii had residential small-scale solar PV generation exceeding 3 percent of residential retail sales, and the majority of states were around 1 percent or less.[5] Nevertheless, NEM program caps are being approached or exceeded in several states, which often triggers requirements for program reviews.[6] Across the residential, commercial, and industrial sectors, the U.S. Energy Information Administration (EIA) estimates that growth will continue. By 2030, total market penetration could reach 2.6% of retail sales,[7] and could be significantly higher in certain locations.

2. *Multiple studies have found that basic NEM tariffs (paying solar customers at retail rate for electricity sent to the grid) results in cost-shifting between non-solar customers and solar customers.*[8] The vast majority of retail rate design has been based on volumetric rates that attempt to recover energy costs as well as fixed and demand costs (generation, transmission, and distribution) within the volumetric rate, rather than by disaggregating fixed and variable costs. With NEM tariffs, solar customers continue to receive fixed-cost services, but may avoid paying part of the costs of those services if fixed and volumetric energy costs are not disaggregated. When customers reduce volumetric payments and are not charged for fixed costs under standard rate design (either due to solar, storage, or efficiency measures), other customers that continue to pay full volumetric costs may bear a disproportionate share of costs for service. One study reviewed twelve available estimates and found that subsidies to net metering customers range from $444 to $1752 per year.[9] Less affluent customers who cannot afford rooftop solar or do not own residences frequently cross-subsidize more affluent customers.[10] It is, however, unclear at what point this cost shifting would result in significant impacts on retail rates. One study indicated for the majority of states and utilities, the effects of distributed solar on retail electricity prices will likely remain negligible for the foreseeable future.[11]

3. *Basic NEM tariffs do not provide effective incentives for solar customers to maximize the value of the electricity they generate.* NEM gives solar customers the incentive to

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[5] Energy Information Admin. (EIA), *Electric Power Annual 2016.*
[6] Stanton, *supra*, n.4, at 5.
[7] EIA, *Annual Energy Outlook 2018*, tables 8 & 16.
[8] *See, e.g.*, Energy Environment Economics, Inc., *California Net Energy Metering Ratepayer Impacts Evaluation* (Oct. 2013); California Public Utilities Commission Office of the Ratepayer Advocates *Proposal of the Office of Ratepayer Advocates for Net Energy Metering Successor Standard Contract or Tariff* (July 10, 2014).
[9] Barbara Alexander *et al.*, "Rethinking Rationale for Net Metering: Quantifying Subsidy from Non-Solar Customers," Pub. Util. Fortnightly (Oct. 2016.).
[10] See, *e.g.*, *California Net Energy Metering Ratepayer Impacts Evaluation, supra* n.8; Severin Borenstein, *Private Net Benefits of Residential Solar PV: The Role of Electricity Tariffs, Tax and Rebates,* 4 JJ. of the Ass'n. of Envtl. & Resource Economists, no. S1 (Sept. 2017).
[11] Galen Barbose, *Putting the Potential Rate Impacts of Distributed Solar into Context,* Lawrence Berkeley Nat'l Laboratory, at 10-11 (Jan. 2017).

produce as much electricity as possible, regardless of the time and location value of the electricity generated or the need of the electric grid for the electricity.[12]

The value of electricity varies over the course the day as demand varies and as different generation sources are used. As demand increases through the typical day, electricity generators bring more and more expensive generation online and meet higher amounts of demand. Generally speaking, peak electricity demand is the most expensive and valuable electricity during the day.

Volumetric rates do not provide price incentives to avoid electricity consumption when electricity is expensive to produce. Instead of providing price incentives to produce electricity when electricity is the most valuable, NEM provides the same rate throughout the day as incentive for rooftop solar generators. This means that no matter how cheap or how expensive the electricity, the NEM customer is paid the same amount. This does not create incentives for NEM customers to help meet system peaks or economize the electrical generation system. This results in sub-optimal location of solar panels and a lack of incentives for solar customers to purchase batteries.

4. *NEM-based PV programs can also have significant operational impacts at the utility or grid level as its penetration increases.* Because NEM-based PV programs may do little to guide the timing, size, or location of the development of distributed PV capacity, they can lead to unstable electricity flows on affected distribution circuits and trigger the need for new utility investments in distribution controls.[13] However, the implementation of new IEEE 1547-2018 standards may mitigate some of these impacts by standardizing grid-support services.[14] Proponents of NEM-based PV acknowledge that such impacts may occur but argue that its deployment results in total benefits to ratepayers and society that exceed its costs.[15]

   NEM-based PV programs can also contribute to area-wide grid management challenges, such as the steep "ramps" in net electricity demand that occur late

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[12] This raises the possibility that a NEM-based generation array could be sized much larger than required to serve the owner's electricity requirements. FERC has sought to prevent such outcomes, however, by ruling that it would assert jurisdiction over the rate for such sales "if the end-use customer participating in the net metering program produces more energy than it needs over the applicable billing period, and thus is considered to have made a net sale of energy to a utility." *Sun Edison LLC*, FERC Docket No. EL09-31-000, 129 FERC ¶ 61,146 at P 18 (2009).

[13] Nat'l Ass'n of Regulatory Util. Comm'rs, *Distributed Energy Resources Rate Design and Compensation Manual*, at 131.

[14] Re IEEE 1547-2018, s*ee* IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (IEEE Standard 1547-2018), available at https://standards.ieee.org/standard/1547-2018.html.

[15] *See, e.g.*, *Sunrun Comments in Response to US Department of Energy Request for Information on Net Metering Cost-Benefit Studies* and *Comments of Joint Solar Parties in Response to DOE Request for Information*, Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), both available at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

afternoons on many days in California, when solar output tapers off while peak demand is still increasing due to warm temperatures and customers coming home at the end of their work day. These ramps require the California Independent System Operator (CAISO) and utilities to bring very large amounts of conventional generation capacity into operation very quickly and may lead to thermal stress that shortens the operating life of the affected generation units.

5. *Distributed solar generation can provide a number of important benefits.* Figure 1 below shows 18 different value categories identified in recent cost-benefit studies. Some of the value categories are an attribute of distributed energy resources, while others such as avoided environmental costs are true of distributed solar as well as utility-scale solar.

   One of the most important points about these different value categories is that the magnitudes of the values are very location specific. As the Joint Solar Parties note in their comment on the RFI, "[i]t is important to emphasize that the results of benefit-cost studies are highly dependent on the specific facts, including the utility's rate and rate design, [Distributed Energy Resource (DER)] penetration levels, and existing and planned grid conditions."[16]

   For example, distributed solar in a highly constrained urban center may delay the need for infrastructure investment. Alternatively, if a feeder is near capacity, increased distributed solar on the feeder may necessitate infrastructure investments.[17] The location and context is critical in considering various costs and benefits of NEM and distributed solar generation.

   Figure 1. Value categories included in 15 recent studies.[18]

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[16] *Comments of Joint Solar Parties in Response to DOE Request for Information,* Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0062.

[17] *See, e.g.*, Am. Pub. Power Ass'n, *RE: Costs and Benefits of Net Energy Metering: Request for Information* (Oct. (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0033.

[18] Source of this table is ICF Review, *supra* n.3, at ii. In the left-most column, G = Generation, T = Transmission, D = Distribution, C = Costs, and S = Societal.

		Arkansas - Crossborder Energy 2017	Nevada - E3 2016	Louisiana - Acadian Consulting Group 2015	South Carolina - E3 2015	Mississippi - Synapse 2014	Vermont - VT Public Service Dept 2014	Washington DC - Synapse 2017	Georgia - Southern Company 2017	Hawaii - Clean Power Research 2015	Maine - Clean Power Research 2015	Oregon - Clean Power Research 2015	Minnesota - Clean Power Research 2015	Utah - Clean Power Research 2014	New York - NYBCA Framework 2016 + VDER	California - LNBA Framework 2016	Total
Utility System Impacts																	
G	Avoided Energy Generation	•	•	•	•	•	•	o	o	•	o	o	•	o	o		15
	Avoided Generation Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Environmental Compliance	•	•			•	•	•	o		•	o		•		o	10
	Fuel Hedging	•			•	•		•		o	•	o	•	•			9
	Market Price Response	•					•	•		o	•				o		6
	Ancillary Services		•		•	o		o	o	o					o	o	8
T	Avoided Transmission Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Line Losses	•	•		•	•	•	•	o			o		•	o	o	11
D	Avoided Distribution Capacity	•	•	•	•	•	•	•		o	o	o	o	•	o	o	14
	Avoided Resiliency & Reliability	o				o		o							o	o	5
	Distribution O&M			•					o						o	o	4
	Distribution Voltage and Power Quality									o	o	o	o		o	o	6
C	Integration Costs	•	•	•	•	o		•	o	o	•	o	o		o	o	13
	Lost Utility Revenues	•	•	•	•	•	•								o		7
	Program and Administrative Costs		•	•	•	•	•	o							o		7
Societal Impacts																	
S	Avoided Cost of Carbon	•					•	•		o	•		o		o	o	8
	Other Avoided Environmental Costs	•	•			o		o		o	•		o		o	o	9
	Local Economic Benefit	•				o		o									3

Included	•
Included/represented in another category	•
Discussed but not monetized/quantified	o
For NY, included in VDER Phase One	o

6. *As a result of the impacts noted above as well as other impacts, many states have either phased out "NEM 1.0" in favor of one or another NEM-successor regulatory approach or framework, or are considering such actions.* There are many alternatives. Some states are exploring the use of valuation methodologies based on a calculation of system costs and benefits, which can be used to inform ratemaking processes aimed at moving beyond NEM. Such calculations are examined in the *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar* (enclosed), which includes examples from 15 states. Other states have taken or are considering regulatory actions to modify NEM-based compensation schemes using a range of approaches. Examples of such approaches by nine states are discussed below to illustrate their diversity and the range of challenges they address. These examples, however, are not intended to be either representative or exhaustive. The states are listed below in alphabetical order.[19]

Arizona. In 2014, the Arizona Corporation Commission (ACC) became concerned that under its existing NEM rule, customer-generators could obtain multi-year contracts for the sale of electricity to the utility, and that given the prospects for

[19] The legislative language to which this report responds can be understood to cover NEM plans adopted by local, tribal, and territorial governmental entities, as well as those adopted by states. The examples discussed above pertain only to states. However, it is unlikely that broadening the scope to include local, tribal, and territorial governmental entities would appreciably change the conclusions.

continuing reductions in the cost of PV technology and other possible changes in electricity markets (*e.g.*, fuel price changes), such contracts could easily become well above-market years before their expiration – at the expense of other customers.

In December 2016, the ACC voted to replace net metering with a net billing approach that would compensate customers for excess energy exported to the grid at an adjustable avoided cost rate.[20] The ACC decided that relying on an easily-updated historical proxy to set the rate would yield more realistic results than basing the rate on long-term projections of avoided costs. The new avoided cost rate is to be determined in each utility's rate case, using a proxy based on a weighted average of the price of electricity from utility-scale solar resources brought online by the utility during the preceding five years.

California. In 2016, California's total PV penetration (including utility-scale systems) reached an estimated 9 percent.[21] In 2014, the California Public Utilities Commission (CPUC) initiated a reconsideration of the then-existing NEM rule, with several objectives: It sought to align NEM customer costs more closely with non-NEM customer costs; support customers' transition to time-of-use rates for electricity purchased from state-regulated utilities; make programs for customer-owned PV systems available to disadvantaged communities and residents of multi-family buildings; and provide addition protection measures for customers participating in NEM-related programs.

On July 1, 2017, the CPUC adopted a net metering successor tariff that links the rates for customer-generators' electricity purchases from, and sales to, their local utility to the changing wholesale prices of electricity. Under the new tariff, new customer-PV generators will pay:

- A one-time interconnection fee, estimated at $75-$150;
- Several small non-bypassable per-kilowatt-hour (kWh) charges on electricity consumed from the grid (~$0.02-0.03/kWh), to cover utilities' public-purpose programs, nuclear decommissioning costs, transition-to-competition costs, and the costs of certain Department of Water Resources bonds; and
- A time-of-use rate for electricity consumed from the grid.[22]

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[20] Ariz. Corp. Comm'n, *Commission Passes Historic Decision to Protect Solar Interests and Provide Equity for all Customers* (Dec. 21, 2016), http://www.azcc.gov/Divisions/Administration/news/2016Releases/12-21-2016%20Value%20and%20Cost%20of%20Solar%20decision.pdf.

[21] ICF Review, *supra* n.3, at 34.

[22] Cal. Pub. Utils. Comm'n, *Net Energy Metering (NEM)*, http://www.cpuc.ca.gov/General.aspx?id=3800.

As before, customer-generators are paid for exports to the grid at the same price per kWh charged for retail sales – but now the price varies, depending on the time-of-use rate applicable at the time the export occurs.

This regime is likely to evolve further over the next few years. The CPUC plans to review the NEM successor tariff in 2019 and explore compensation structures other than NEM, and to consider an export compensation rate that takes into account locational and time-differentiated values.[23]

In a parallel effort, the CPUC is developing a framework for valuing the diverse costs and benefits associated with the deployment of multiple DERs (including distributed PV), taking into account potential synergies offered by some combinations of DERs, and that the impacts of a given DER asset can vary greatly depending on where it is located in a given distribution system.[24]

Hawaii. In 2014, the state's electricity regulators initiated a proceeding to investigate its NEM and DER policies, after finding that "high distributed PV penetration levels and remuneration rates [had] contributed to the increase in technical and financial issues for utilities."[25] (In 2016, Hawaii's estimated PV penetration was 22 percent.[26]) In October 2015, the Hawaii PUC voted to end net metering for PV in favor of two alternative options: a customer grid-supply (CGS) option and a self-supply option.[27] Under the grid-supply option, eligible customers receive credits on their electric bills for excess electricity sent to the grid or energy delivered by the utility to the customer-generator, whichever is less, at a fixed rate approved by the PUC through October 20, 2022.[28] The fixed rate ranges from $0.15/kWh - $0.28/kWh, depending on the island where the PV asset is located. The self-supply option is for PV customers that do not export power and provides expedited review and approval for interconnection.[29]

In October 2017, as the grid-supply program reached capacity, the PUC approved a successor program known as "CGS+," which compensates PV customers with required grid support equipment for export at fixed rates, and a similar "smart export" program for customers with PV and battery storage.[30] The Hawaiian Electric

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[23] Cal. Pub. Utils. Comm'n,, *Net Energy Metering Rulemaking (R.14-07-002).* Available at: http://www.cpuc.ca.gov/general.aspx?id=3934.

[24] *See* Juliet Homer *et al.*, *State Engagement in Electric Distribution System Planning* (Dec. 2017), http://eta-publications.lbl.gov/sites/default/files/state_engagement_in_dsp_final_rev2.pdf.

[25] *Id.* at 2.1.

[26] ICF Review, *supra* n.3, at 27.

[27] *In the Matter of Public Utilities Commission Instituting a Proceeding to Investigate Distributed Energy Resource Policies Docket No. 2014-0192, Decision Order No. 33258.* (Oct. 12, 2015), https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A15J13B15422F90464.

[28] *Hawaiian Electric, Customer Grid-Supply,* https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-renewable-programs/customer-grid-supply.

[29] *Id.*

[30] Hawaii Pub. Utils. Comm'n, *HPUC Expands Options for Customers to Install Rooftop Solar and Energy Storage* (Oct. 20, 2017),

Company said the Commission "approved these new rooftop PV programs to support the continued growth of rooftop PV and ensure safe, reliable service and fair treatment for all customers. The decision is the result of the PUC's effort to develop long-term technical and policy solutions that will support the continued growth of rooftop PV in Hawaii."[31]

Indiana. Indiana Senate Bill 309, enacted in May 2017, gradually reduces the rate paid to net metering customers and phases out retail rate net metering by July 1, 2022 (or when customer-owned PV reached 1.5 percent of an affected utility's peak summer load, whichever is earlier). New distributed generation compensation arrangements will be set through individual utility ratemaking proceedings. However, the new rate(s) must equal 1.25 x the average wholesale price paid by the utility for electricity.[32]

Maine. The state's estimated PV penetration in 2016 was 1 percent,[33] triggering a requirement to review the state's NEM rule. In March 2017, the Maine PUC issued an order replacing net metering with a "buy-all, sell-all" compensation structure, which treats customer-owned electricity production and consumption separately, and gradually reduces the rate utilities pay for electricity produced by customer-generators. Under this rate structure, instead of offsetting electric usage, customers sell to the utility all of the solar energy they generate at one rate and buy all the energy they consume from the utility at a higher rate. Existing customers with systems installed before 2018 may stay on the old structure for up to 15 years.[34]

Massachusetts. In 2016, the state legislature enacted bipartisan legislation to amend Massachusetts' net metering law. The objectives were to enable "the continued support of solar power generation and a transition to a stable and equitable solar market at a reasonable cost to ratepayers" and the new law directed utilities to calculate "market net metering credits" at approximately 60 percent of previous rates.[35] In January 2018, the Massachusetts Department of Public Utilities (DPU) approved "demand charges" for net metering customers of Eversource utilities operating in the state, and eliminated optional time-of-use rates for residential customers.[36] The DPU's adoption of demand charges for residential customer-generators is innovative. Utilities must maintain the physical capacity to deliver

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https://www.hawaiianelectric.com/Documents/clean_energy_hawaii/producing_clean_energy/20171020_hawaii_PUC_rooftop_solar_and_storage_press_release.pdf.

[31] https://www.mauielectric.com/customer-service/frequently-asked-questions?SortBy=&page=2.

[32] *Senate Enrolled Act No. 309: An Act to amend the Indiana Code concerning utilities*, https://iga.in.gov/static-documents/7/d/0/3/7d037e18/SB0309.05.ENRH.pdf.

[33] ICF, *op. cit.*, at 27.

[34] Nat'l Renewable Energy Lab, *Midmarket Solar Policies in the United States: Maine*, https://www.nrel.gov/solar/rps/me.html.

[35] Commonwealth of Mass., Session Laws, Acts (2016), Chapter 75, *An Act Relative to Solar Energy* (Apr. 11, 2016), https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter75.

[36] Commonwealth of Mass. Dep't of Pub. Utils., D.P.U. 17-05-B, Order Establishing Eversource's Rate Structure (Jan. 5, 2018), https://eeaonline.eea.state.ma.us/EEA/FileService/FileService.Api/file/FileRoom/9170110.

electricity to a given customer at the customer's maximum level of demand, even though the customer may require significantly less electricity during most of the hours in a given period. With the approval of state regulators, many utilities have long included demand charges as a component of the rates paid by commercial and industrial customers, but such charges have seldom been used for residential customers. In recent years, some utilities and states (such as Massachusetts) have considered or adopted demand charges for some residential customers, particularly customers with widely fluctuating electricity demand, such as customer-generators.[37]

Nevada. A state law, AB 405, reaffirmed net metering for PV systems up to 25 kilowatts (kW) in capacity.[38] Under the new rules, the first 80 MW of new net metered systems will have monthly generation and consumption netted, and any remaining excess generation will be credited at 95 percent of the retail rate. The latter rate will decline by 7 percent for every additional 80 MW, to a floor of 75 percent of the retail rate. For customer-owned non-PV systems up to 25 kW, exported generation is credited at the avoided cost rate.[39]

New Hampshire. The state's Office of Strategic Initiatives released a 10-year energy strategy on April 17, 2018. The New Hampshire Public Utilities Commission will work with stakeholders to collect data and other inputs concerning the impacts of net metering, implement pilot programs, and produce a DER valuation study. The Commission will also open a new proceeding in which it will revisit its existing NEM rule. The considerations of concern in the development of the new rule include the need "to provide predictability to stakeholders, protect investments made by all stakeholders, and avoid cost-shifting among ratepayers."[40] Additionally, "[a]ll existing net metered systems are grandfathered through 2040 at current rates."[41]

Vermont. In 2016, Vermont's PV penetration reached an estimated 6 percent.[42] Effective January 1, 2017, any electric customer in Vermont qualifies for net metering after obtaining a Certificate of Public Good from the Vermont Public Service Board (PSB). Solar systems 15 kW or less follow an expedited process;

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[37] For a detailed discussion of demand charges, *see* Nat'l Ass'n of Regulatory Util. Comm'rs, *NARUC* Manual *on Distributed Energy Resources Rate Design and Compensation*, at 98-116, https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0.

[38] *Assembly Bill No. 405 (SB 405)* (June 15, 2017), https://www.leg.state.nv.us/Session/79th2017/Bills/AB/AB405_EN.pdf.

[39] State of Nev. Pub. Utils. Comm'n, *Net Metering*, http://puc.nv.gov/Renewable_Energy/Net_Metering/.

[40] N.H. Office of Strategic Initiatives, *New Hampshire 10-Year State Energy Strategy* (Apr. 2018), at 8, https://www.nh.gov/osi/energy/programs/documents/energy-strategy.pdf.

[41] *Id.* at 37. *See also* State of New Hampshire Public Utilities Commission, DE 16-576, *Development of New Alternative Net Metering Tariffs and/or Other Regulatory Mechanisms and Tariffs for Customer-Generators, Order Accepting Settlement Provisions, Resolving Settlement Issues, and Adopting a New Alternative Net Metering Tariff*, Order No. 26,029 (June 23, 2017), https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/ORDERS/16-576_2017-06-23_ORDER_26029.PDF.

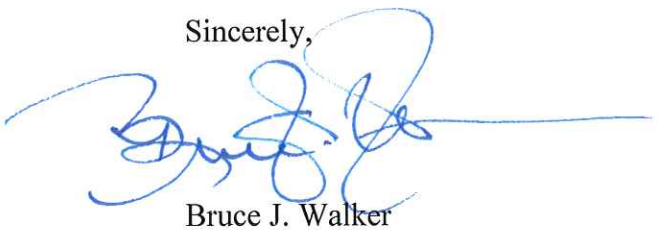
[42] ICF Review, *supra* n.3, at 27.

systems up to 150 kW may apply online; and systems greater than 150 kW must make a filing for the certificate.[43]

7. *DOE recognizes that the line between State and Federal jurisdiction over net metering transactions could shift.* Under the Federal Power Act (FPA), FERC has exclusive jurisdiction over wholesale sales of electric power, while states have jurisdiction over retail sales. Nevertheless, in two Commission opinions pertaining to particular parties, FERC determined that there is no wholesale sale within the meaning of the FPA unless the retail customer with on-premises generation is a *net* supplier of energy to the utility within the state retail billing period (usually one month). *See MidAmerican Energy Co.*, 94 FERC ¶ 61,340 (2001); *Sun Edison LLC*, 129 FERC ¶ 61,146 (2009). The Commission justified this determination on prior rulings involving the opposite situation: when a generator consumes energy from the grid from "station power" use in some hours, but has a net sale to grid over a monthly billing period. However, two D.C. Circuit Court of Appeals cases have since rejected FERC's station power netting theory. *See S. Cal. Edison Co. v. FERC*, 603 F.3d 996 (D.C. Cir. 2010); *Calpine Corp. v. FERC*, 702 F.3d 41 (D.C. Cir. 2012). In both cases, the court held that netting within a billing period cannot be the determining factor for whether a sale has taken place. FERC's attempts, therefore, in its net metering decisions to disclaim jurisdiction over net metering transactions on the theory that no sale has taken place, could be challenged and overturned.

   Regardless of whether states or FERC regulate net metering, DOE strongly urges that the appropriate regulatory bodies ensure that net metering rates are just and reasonable and do not discriminate by shifting costs from net metering customers to low-income and other non-net metering customers as mentioned in designated paragraph 2 above. Also, DOE strongly urges states to ensure that deployments will be designed and located so as to enhance the resilience and reliability of local and regional grids.

Sincerely,



Bruce J. Walker
Assistant Secretary
Office of Electricity

Enclosure

[43] *See* Vt. Pub. Util. Comm'n, Rule 5.100, https://puc.vermont.gov/sites/psbnew/files/doc_library/5100-PUC-nm-effective-07-01-2017_0.pdf.

Department of Energy
Washington, DC 20585

February 21, 2019

The Honorable Marcy Kaptur
Chairwoman
Subcommittee on Energy and Water Development
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

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[1] 16 USC 2621(d)(11) This definition is drawn from the definition of "net metering service" at section 111(d)(11) of the Public Utility Regulatory Policies Act of 1978 (as amended by section 1251 of the Energy Policy Act of 2005), codified at 16 U.S.C. § 2621(d)(11).

[2] Comments received in response to the RFI can be accessed at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

[3] *See* ICF, *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar*, May 2018 (ICF Review).

[4] As of November 2017, 38 states plus the District of Columbia had adopted some form of mandatory NEM rules for electric utilities. (*See* http://www.dsireusa.org/) However, many of these states have subsequently modified their rules substantially, and some have dropped NEM altogether in favor of an alternative approach. See Tom Stanton, "NEM 2.0 and Successor Tariffs: Which States are Doing What?" National

plans were first adopted, residential photovoltaic technology costs were high and its market penetration was minimal. Since then costs have fallen, and distributed market penetration is approaching 1% of retail sales. However, market penetration varies strongly by location. In 2016, only California and Hawaii had residential small-scale solar PV generation exceeding 3 percent of residential retail sales, and the majority of states were around 1 percent or less.[5] Nevertheless, NEM program caps are being approached or exceeded in several states, which often triggers requirements for program reviews.[6] Across the residential, commercial, and industrial sectors, the U.S. Energy Information Administration (EIA) estimates that growth will continue. By 2030, total market penetration could reach 2.6% of retail sales,[7] and could be significantly higher in certain locations.

2. *Multiple studies have found that basic NEM tariffs (paying solar customers at retail rate for electricity sent to the grid) results in cost-shifting between non-solar customers and solar customers.*[8] The vast majority of retail rate design has been based on volumetric rates that attempt to recover energy costs as well as fixed and demand costs (generation, transmission, and distribution) within the volumetric rate, rather than by disaggregating fixed and variable costs. With NEM tariffs, solar customers continue to receive fixed-cost services, but may avoid paying part of the costs of those services if fixed and volumetric energy costs are not disaggregated. When customers reduce volumetric payments and are not charged for fixed costs under standard rate design (either due to solar, storage, or efficiency measures), other customers that continue to pay full volumetric costs may bear a disproportionate share of costs for service. One study reviewed twelve available estimates and found that subsidies to net metering customers range from $444 to $1752 per year.[9] Less affluent customers who cannot afford rooftop solar or do not own residences frequently cross-subsidize more affluent customers.[10] It is, however, unclear at what point this cost shifting would result in significant impacts on retail rates. One study indicated for the majority of states and utilities, the effects of distributed solar on retail electricity prices will likely remain negligible for the foreseeable future.[11]

3. *Basic NEM tariffs do not provide effective incentives for solar customers to maximize the value of the electricity they generate.* NEM gives solar customers the incentive to

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[5] Energy Information Admin. (EIA), *Electric Power Annual 2016*.
[6] Stanton, *supra*, n.4, at 5.
[7] EIA, *Annual Energy Outlook 2018*, tables 8 & 16.
[8] *See, e.g.*, Energy Environment Economics, Inc., *California Net Energy Metering Ratepayer Impacts Evaluation* (Oct. 2013); California Public Utilities Commission Office of the Ratepayer Advocates *Proposal of the Office of Ratepayer Advocates for Net Energy Metering Successor Standard Contract or Tariff* (July 10, 2014).
[9] Barbara Alexander *et al.*, "Rethinking Rationale for Net Metering: Quantifying Subsidy from Non-Solar Customers," Pub. Util. Fortnightly (Oct. 2016.).
[10] See, *e.g.*, *California Net Energy Metering Ratepayer Impacts Evaluation*, *supra* n.8; Severin Borenstein, *Private Net Benefits of Residential Solar PV: The Role of Electricity Tariffs, Tax and Rebates,* 4 JJ. of the Ass'n. of Envtl. & Resource Economists, no. S1 (Sept. 2017).
[11] Galen Barbose, *Putting the Potential Rate Impacts of Distributed Solar into Context,* Lawrence Berkeley Nat'l Laboratory, at 10-11 (Jan. 2017).

produce as much electricity as possible, regardless of the time and location value of the electricity generated or the need of the electric grid for the electricity.[12]

The value of electricity varies over the course the day as demand varies and as different generation sources are used. As demand increases through the typical day, electricity generators bring more and more expensive generation online and meet higher amounts of demand. Generally speaking, peak electricity demand is the most expensive and valuable electricity during the day.

Volumetric rates do not provide price incentives to avoid electricity consumption when electricity is expensive to produce. Instead of providing price incentives to produce electricity when electricity is the most valuable, NEM provides the same rate throughout the day as incentive for rooftop solar generators. This means that no matter how cheap or how expensive the electricity, the NEM customer is paid the same amount. This does not create incentives for NEM customers to help meet system peaks or economize the electrical generation system. This results in sub-optimal location of solar panels and a lack of incentives for solar customers to purchase batteries.

4. *NEM-based PV programs can also have significant operational impacts at the utility or grid level as its penetration increases.* Because NEM-based PV programs may do little to guide the timing, size, or location of the development of distributed PV capacity, they can lead to unstable electricity flows on affected distribution circuits and trigger the need for new utility investments in distribution controls.[13] However, the implementation of new IEEE 1547-2018 standards may mitigate some of these impacts by standardizing grid-support services.[14] Proponents of NEM-based PV acknowledge that such impacts may occur but argue that its deployment results in total benefits to ratepayers and society that exceed its costs.[15]

   NEM-based PV programs can also contribute to area-wide grid management challenges, such as the steep "ramps" in net electricity demand that occur late

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[12] This raises the possibility that a NEM-based generation array could be sized much larger than required to serve the owner's electricity requirements. FERC has sought to prevent such outcomes, however, by ruling that it would assert jurisdiction over the rate for such sales "if the end-use customer participating in the net metering program produces more energy than it needs over the applicable billing period, and thus is considered to have made a net sale of energy to a utility." *Sun Edison LLC*, FERC Docket No. EL09-31-000, 129 FERC ¶ 61,146 at P 18 (2009).

[13] Nat'l Ass'n of Regulatory Util. Comm'rs, *Distributed Energy Resources Rate Design and Compensation Manual*, at 131.

[14] Re IEEE 1547-2018, s*ee* IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (IEEE Standard 1547-2018), available at https://standards.ieee.org/standard/1547-2018.html.

[15] *See, e.g.*, *Sunrun Comments in Response to US Department of Energy Request for Information on Net Metering Cost-Benefit Studies* and *Comments of Joint Solar Parties in Response to DOE Request for Information*, Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), both available at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

afternoons on many days in California, when solar output tapers off while peak demand is still increasing due to warm temperatures and customers coming home at the end of their work day. These ramps require the California Independent System Operator (CAISO) and utilities to bring very large amounts of conventional generation capacity into operation very quickly and may lead to thermal stress that shortens the operating life of the affected generation units.

5. *Distributed solar generation can provide a number of important benefits.* Figure 1 below shows 18 different value categories identified in recent cost-benefit studies. Some of the value categories are an attribute of distributed energy resources, while others such as avoided environmental costs are true of distributed solar as well as utility-scale solar.

   One of the most important points about these different value categories is that the magnitudes of the values are very location specific. As the Joint Solar Parties note in their comment on the RFI, "[i]t is important to emphasize that the results of benefit-cost studies are highly dependent on the specific facts, including the utility's rate and rate design, [Distributed Energy Resource (DER)] penetration levels, and existing and planned grid conditions."[16]

   For example, distributed solar in a highly constrained urban center may delay the need for infrastructure investment. Alternatively, if a feeder is near capacity, increased distributed solar on the feeder may necessitate infrastructure investments.[17] The location and context is critical in considering various costs and benefits of NEM and distributed solar generation.

   Figure 1. Value categories included in 15 recent studies.[18]

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[16] *Comments of Joint Solar Parties in Response to DOE Request for Information,* Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0062.

[17] *See, e.g.*, Am. Pub. Power Ass'n, *RE: Costs and Benefits of Net Energy Metering: Request for Information* (Oct. (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0033.

[18] Source of this table is ICF Review, *supra* n.3, at ii. In the left-most column, G = Generation, T = Transmission, D = Distribution, C = Costs, and S = Societal.

		Arkansas - Crossborder Energy 2017	Nevada - E3 2016	Louisiana - Acadian Consulting Group 2015	South Carolina - E3 2015	Mississippi - Synapse 2014	Vermont - VT Public Service Dept 2014	Washington DC - Synapse 2017	Georgia - Southern Company 2017	Hawaii - Clean Power Research 2015	Maine - Clean Power Research 2015	Oregon - Clean Power Research 2015	Minnesota - Clean Power Research 2014	Utah - Clean Power Research 2014	New York - NYBCA Framework 2016 + VDER	California - UNBA Framework 2016	Total
Utility System Impacts																	
G	Avoided Energy Generation	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Generation Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Environmental Compliance	•	•			•	•	•	o		•	o		•		o	10
	Fuel Hedging	•			•	•		•		o	•	o	•	•			9
	Market Price Response	•					•	•		o	•				o		6
	Ancillary Services		•		•	o		o	o	o					o	o	8
T	Avoided Transmission Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Line Losses	•	•		•	•	•	•	o			o		•	o	o	11
D	Avoided Distribution Capacity	•	•	•	•	•	•	•		o	o	o	o	•	o	o	14
	Avoided Resiliency & Reliability	o				o		o							o	o	5
	Distribution O&M			•					o						o	o	4
	Distribution Voltage and Power Quality									o	o	o	o		o	o	6
C	Integration Costs	•	•	•	•	o		•	o	o	•	o	o		o	o	13
	Lost Utility Revenues	•	•	•	•	•	•								o		7
	Program and Administrative Costs		•	•	•	•	•	o							o		7
Societal Impacts																	
S	Avoided Cost of Carbon	•					•	•		o	•		o		o	o	8
	Other Avoided Environmental Costs	•	•			o		o		o	•		o		o	o	9
	Local Economic Benefit	•				o		o									3

Included	•
Included/represented in another category	•
Discussed but not monetized/quantified	o
For NY, included in VDER Phase One	o

6. *As a result of the impacts noted above as well as other impacts, many states have either phased out "NEM 1.0" in favor of one or another NEM-successor regulatory approach or framework, or are considering such actions.* There are many alternatives. Some states are exploring the use of valuation methodologies based on a calculation of system costs and benefits, which can be used to inform ratemaking processes aimed at moving beyond NEM. Such calculations are examined in the *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar* (enclosed), which includes examples from 15 states. Other states have taken or are considering regulatory actions to modify NEM-based compensation schemes using a range of approaches. Examples of such approaches by nine states are discussed below to illustrate their diversity and the range of challenges they address. These examples, however, are not intended to be either representative or exhaustive. The states are listed below in alphabetical order.[19]

   Arizona. In 2014, the Arizona Corporation Commission (ACC) became concerned that under its existing NEM rule, customer-generators could obtain multi-year contracts for the sale of electricity to the utility, and that given the prospects for

[19] The legislative language to which this report responds can be understood to cover NEM plans adopted by local, tribal, and territorial governmental entities, as well as those adopted by states. The examples discussed above pertain only to states. However, it is unlikely that broadening the scope to include local, tribal, and territorial governmental entities would appreciably change the conclusions.

continuing reductions in the cost of PV technology and other possible changes in electricity markets (*e.g.*, fuel price changes), such contracts could easily become well above-market years before their expiration – at the expense of other customers.

In December 2016, the ACC voted to replace net metering with a net billing approach that would compensate customers for excess energy exported to the grid at an adjustable avoided cost rate.[20] The ACC decided that relying on an easily-updated historical proxy to set the rate would yield more realistic results than basing the rate on long-term projections of avoided costs. The new avoided cost rate is to be determined in each utility's rate case, using a proxy based on a weighted average of the price of electricity from utility-scale solar resources brought online by the utility during the preceding five years.

California. In 2016, California's total PV penetration (including utility-scale systems) reached an estimated 9 percent.[21] In 2014, the California Public Utilities Commission (CPUC) initiated a reconsideration of the then-existing NEM rule, with several objectives: It sought to align NEM customer costs more closely with non-NEM customer costs; support customers' transition to time-of-use rates for electricity purchased from state-regulated utilities; make programs for customer-owned PV systems available to disadvantaged communities and residents of multi-family buildings; and provide addition protection measures for customers participating in NEM-related programs.

On July 1, 2017, the CPUC adopted a net metering successor tariff that links the rates for customer-generators' electricity purchases from, and sales to, their local utility to the changing wholesale prices of electricity. Under the new tariff, new customer-PV generators will pay:

- A one-time interconnection fee, estimated at $75-$150;
- Several small non-bypassable per-kilowatt-hour (kWh) charges on electricity consumed from the grid (~$0.02-0.03/kWh), to cover utilities' public-purpose programs, nuclear decommissioning costs, transition-to-competition costs, and the costs of certain Department of Water Resources bonds; and
- A time-of-use rate for electricity consumed from the grid.[22]

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[20] Ariz. Corp. Comm'n, *Commission Passes Historic Decision to Protect Solar Interests and Provide Equity for all Customers* (Dec. 21, 2016), http://www.azcc.gov/Divisions/Administration/news/2016Releases/12-21-2016%20Value%20and%20Cost%20of%20Solar%20decision.pdf.

[21] ICF Review, *supra* n.3, at 34.

[22] Cal. Pub. Utils. Comm'n, *Net Energy Metering (NEM)*, http://www.cpuc.ca.gov/General.aspx?id=3800.

As before, customer-generators are paid for exports to the grid at the same price per kWh charged for retail sales – but now the price varies, depending on the time-of-use rate applicable at the time the export occurs.

This regime is likely to evolve further over the next few years. The CPUC plans to review the NEM successor tariff in 2019 and explore compensation structures other than NEM, and to consider an export compensation rate that takes into account locational and time-differentiated values.[23]

In a parallel effort, the CPUC is developing a framework for valuing the diverse costs and benefits associated with the deployment of multiple DERs (including distributed PV), taking into account potential synergies offered by some combinations of DERs, and that the impacts of a given DER asset can vary greatly depending on where it is located in a given distribution system.[24]

Hawaii. In 2014, the state's electricity regulators initiated a proceeding to investigate its NEM and DER policies, after finding that "high distributed PV penetration levels and remuneration rates [had] contributed to the increase in technical and financial issues for utilities."[25] (In 2016, Hawaii's estimated PV penetration was 22 percent.[26]) In October 2015, the Hawaii PUC voted to end net metering for PV in favor of two alternative options: a customer grid-supply (CGS) option and a self-supply option.[27] Under the grid-supply option, eligible customers receive credits on their electric bills for excess electricity sent to the grid or energy delivered by the utility to the customer-generator, whichever is less, at a fixed rate approved by the PUC through October 20, 2022.[28] The fixed rate ranges from $0.15/kWh - $0.28/kWh, depending on the island where the PV asset is located. The self-supply option is for PV customers that do not export power and provides expedited review and approval for interconnection.[29]

In October 2017, as the grid-supply program reached capacity, the PUC approved a successor program known as "CGS+," which compensates PV customers with required grid support equipment for export at fixed rates, and a similar "smart export" program for customers with PV and battery storage.[30] The Hawaiian Electric

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[23] Cal. Pub. Utils. Comm'n,, *Net Energy Metering Rulemaking (R.14-07-002).* Available at: http://www.cpuc.ca.gov/general.aspx?id=3934.
[24] *See* Juliet Homer *et al.*, *State Engagement in Electric Distribution System Planning* (Dec. 2017), http://eta-publications.lbl.gov/sites/default/files/state_engagement_in_dsp_final_rev2.pdf.
[25] *Id.* at 2.1.
[26] ICF Review, *supra* n.3, at 27.
[27] *In the Matter of Public Utilities Commission Instituting a Proceeding to Investigate Distributed Energy Resource Policies Docket No. 2014-0192, Decision Order No. 33258*. (Oct. 12, 2015), https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A15J13B15422F90464.
[28] *Hawaiian Electric, Customer Grid-Supply,* https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-renewable-programs/customer-grid-supply.
[29] *Id.*
[30] Hawaii Pub. Utils. Comm'n, *HPUC Expands Options for Customers to Install Rooftop Solar and Energy Storage* (Oct. 20, 2017),

Company said the Commission "approved these new rooftop PV programs to support the continued growth of rooftop PV and ensure safe, reliable service and fair treatment for all customers. The decision is the result of the PUC's effort to develop long-term technical and policy solutions that will support the continued growth of rooftop PV in Hawaii."[31]

Indiana. Indiana Senate Bill 309, enacted in May 2017, gradually reduces the rate paid to net metering customers and phases out retail rate net metering by July 1, 2022 (or when customer-owned PV reached 1.5 percent of an affected utility's peak summer load, whichever is earlier). New distributed generation compensation arrangements will be set through individual utility ratemaking proceedings. However, the new rate(s) must equal 1.25 x the average wholesale price paid by the utility for electricity.[32]

Maine. The state's estimated PV penetration in 2016 was 1 percent,[33] triggering a requirement to review the state's NEM rule. In March 2017, the Maine PUC issued an order replacing net metering with a "buy-all, sell-all" compensation structure, which treats customer-owned electricity production and consumption separately, and gradually reduces the rate utilities pay for electricity produced by customer-generators. Under this rate structure, instead of offsetting electric usage, customers sell to the utility all of the solar energy they generate at one rate and buy all the energy they consume from the utility at a higher rate. Existing customers with systems installed before 2018 may stay on the old structure for up to 15 years.[34]

Massachusetts. In 2016, the state legislature enacted bipartisan legislation to amend Massachusetts' net metering law. The objectives were to enable "the continued support of solar power generation and a transition to a stable and equitable solar market at a reasonable cost to ratepayers" and the new law directed utilities to calculate "market net metering credits" at approximately 60 percent of previous rates.[35] In January 2018, the Massachusetts Department of Public Utilities (DPU) approved "demand charges" for net metering customers of Eversource utilities operating in the state, and eliminated optional time-of-use rates for residential customers.[36] The DPU's adoption of demand charges for residential customer-generators is innovative. Utilities must maintain the physical capacity to deliver

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https://www.hawaiianelectric.com/Documents/clean_energy_hawaii/producing_clean_energy/20171020_hawaii_PUC_rooftop_solar_and_storage_press_release.pdf.

[31] https://www.mauielectric.com/customer-service/frequently-asked-questions?SortBy=&page=2.

[32] *Senate Enrolled Act No. 309: An Act to amend the Indiana Code concerning utilities*, https://iga.in.gov/static-documents/7/d/0/3/7d037e18/SB0309.05.ENRH.pdf.

[33] ICF, *op. cit.*, at 27.

[34] Nat'l Renewable Energy Lab, *Midmarket Solar Policies in the United States: Maine*, https://www.nrel.gov/solar/rps/me.html.

[35] Commonwealth of Mass., Session Laws, Acts (2016), Chapter 75, *An Act Relative to Solar Energy* (Apr. 11, 2016), https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter75.

[36] Commonwealth of Mass. Dep't of Pub. Utils., D.P.U. 17-05-B, Order Establishing Eversource's Rate Structure (Jan. 5, 2018), https://eeaonline.eea.state.ma.us/EEA/FileService/FileService.Api/file/FileRoom/9170110.

electricity to a given customer at the customer's maximum level of demand, even though the customer may require significantly less electricity during most of the hours in a given period. With the approval of state regulators, many utilities have long included demand charges as a component of the rates paid by commercial and industrial customers, but such charges have seldom been used for residential customers. In recent years, some utilities and states (such as Massachusetts) have considered or adopted demand charges for some residential customers, particularly customers with widely fluctuating electricity demand, such as customer-generators.[37]

Nevada. A state law, AB 405, reaffirmed net metering for PV systems up to 25 kilowatts (kW) in capacity.[38] Under the new rules, the first 80 MW of new net metered systems will have monthly generation and consumption netted, and any remaining excess generation will be credited at 95 percent of the retail rate. The latter rate will decline by 7 percent for every additional 80 MW, to a floor of 75 percent of the retail rate. For customer-owned non-PV systems up to 25 kW, exported generation is credited at the avoided cost rate.[39]

New Hampshire. The state's Office of Strategic Initiatives released a 10-year energy strategy on April 17, 2018. The New Hampshire Public Utilities Commission will work with stakeholders to collect data and other inputs concerning the impacts of net metering, implement pilot programs, and produce a DER valuation study. The Commission will also open a new proceeding in which it will revisit its existing NEM rule. The considerations of concern in the development of the new rule include the need "to provide predictability to stakeholders, protect investments made by all stakeholders, and avoid cost-shifting among ratepayers."[40] Additionally, "[a]ll existing net metered systems are grandfathered through 2040 at current rates."[41]

Vermont. In 2016, Vermont's PV penetration reached an estimated 6 percent.[42] Effective January 1, 2017, any electric customer in Vermont qualifies for net metering after obtaining a Certificate of Public Good from the Vermont Public Service Board (PSB). Solar systems 15 kW or less follow an expedited process;

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[37] For a detailed discussion of demand charges, *see* Nat'l Ass'n of Regulatory Util. Comm'rs, *NARUC* Manual *on Distributed Energy Resources Rate Design and Compensation*, at 98-116, https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0.

[38] *Assembly Bill No. 405 (SB 405)* (June 15, 2017), https://www.leg.state.nv.us/Session/79th2017/Bills/AB/AB405_EN.pdf.

[39] State of Nev. Pub. Utils. Comm'n, *Net Metering*, http://puc.nv.gov/Renewable_Energy/Net_Metering/.

[40] N.H. Office of Strategic Initiatives, *New Hampshire 10-Year State Energy Strategy* (Apr. 2018), at 8, https://www.nh.gov/osi/energy/programs/documents/energy-strategy.pdf.

[41] *Id.* at 37. *See also* State of New Hampshire Public Utilities Commission, DE 16-576, *Development of New Alternative Net Metering Tariffs and/or Other Regulatory Mechanisms and Tariffs for Customer-Generators, Order Accepting Settlement Provisions, Resolving Settlement Issues, and Adopting a New Alternative Net Metering Tariff*, Order No. 26,029 (June 23, 2017), https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/ORDERS/16-576_2017-06-23_ORDER_26029.PDF.

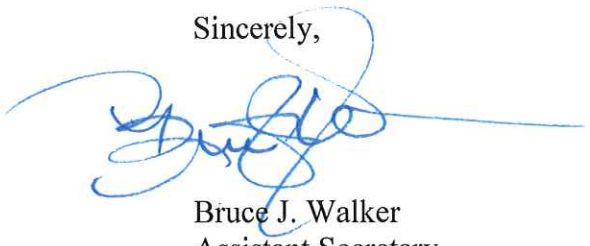
[42] ICF Review, *supra* n.3, at 27.

systems up to 150 kW may apply online; and systems greater than 150 kW must make a filing for the certificate.[43]

7. *DOE recognizes that the line between State and Federal jurisdiction over net metering transactions could shift*. Under the Federal Power Act (FPA), FERC has exclusive jurisdiction over wholesale sales of electric power, while states have jurisdiction over retail sales. Nevertheless, in two Commission opinions pertaining to particular parties, FERC determined that there is no wholesale sale within the meaning of the FPA unless the retail customer with on-premises generation is a *net* supplier of energy to the utility within the state retail billing period (usually one month). *See MidAmerican Energy Co.*, 94 FERC ¶ 61,340 (2001); *Sun Edison LLC*, 129 FERC ¶ 61,146 (2009). The Commission justified this determination on prior rulings involving the opposite situation: when a generator consumes energy from the grid from "station power" use in some hours, but has a net sale to grid over a monthly billing period. However, two D.C. Circuit Court of Appeals cases have since rejected FERC's station power netting theory. *See S. Cal. Edison Co. v. FERC*, 603 F.3d 996 (D.C. Cir. 2010); *Calpine Corp. v. FERC*, 702 F.3d 41 (D.C. Cir. 2012). In both cases, the court held that netting within a billing period cannot be the determining factor for whether a sale has taken place. FERC's attempts, therefore, in its net metering decisions to disclaim jurisdiction over net metering transactions on the theory that no sale has taken place, could be challenged and overturned.

   Regardless of whether states or FERC regulate net metering, DOE strongly urges that the appropriate regulatory bodies ensure that net metering rates are just and reasonable and do not discriminate by shifting costs from net metering customers to low-income and other non-net metering customers as mentioned in designated paragraph 2 above. Also, DOE strongly urges states to ensure that deployments will be designed and located so as to enhance the resilience and reliability of local and regional grids.

Sincerely,



Bruce J. Walker
Assistant Secretary
Office of Electricity

Enclosure

[43] *See* Vt. Pub. Util. Comm'n, Rule 5.100, https://puc.vermont.gov/sites/psbnew/files/doc_library/5100-PUC-nm-effective-07-01-2017_0.pdf.

Department of Energy
Washington, DC 20585

February 21, 2019

The Honorable Nita Lowey
Chairwoman
Committee on Appropriations
U.S. House of Representative
Washington, DC 20510

Dear Ms. Chairwoman:

This letter report provides findings in response to legislative language set forth in Senate Report No. 114-236, 114th Cong., 1st Sess. dated Apr. 14, 2016 which asked the Department of Energy (DOE) to conduct a study that would "determine the costs and benefits of net metering and distributed solar generation to the electrical grid, utilities, and ratepayers."

For the purposes of this report, net energy metering (NEM) is:

> "service to an electric consumer under which electric energy generated by that consumer from an eligible on-site generating facility [*e.g.*, a rooftop photovoltaic array] and delivered to the local [electric] distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period."[1]

After reviewing responses to DOE's public Request for Information (RFI) on NEM,[2] 15 recent NEM-related cost-benefit studies,[3] and other NEM-related literature, we have come to a number of conclusions:

1. *NEM was widely adopted by states[4] as a simple way to reimburse solar customer/generators who feed their excess electricity into the grid.* When most NEM

[1] 16 USC 2621(d)(11) This definition is drawn from the definition of "net metering service" at section 111(d)(11) of the Public Utility Regulatory Policies Act of 1978 (as amended by section 1251 of the Energy Policy Act of 2005), codified at 16 U.S.C. § 2621(d)(11).
[2] Comments received in response to the RFI can be accessed at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.
[3] *See* ICF, *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar*, May 2018 (ICF Review).
[4] As of November 2017, 38 states plus the District of Columbia had adopted some form of mandatory NEM rules for electric utilities. (*See* http://www.dsireusa.org/) However, many of these states have subsequently modified their rules substantially, and some have dropped NEM altogether in favor of an alternative approach. See Tom Stanton, "NEM 2.0 and Successor Tariffs: Which States are Doing What?" National Regulatory Research Institute webinar (Mar. 14, 2018). http://nrri.org/wp-content/uploads/2018/03/20180309-Stanton-and-Barber-NEM-and-Successor-Tariffs.pdf.

plans were first adopted, residential photovoltaic technology costs were high and its market penetration was minimal. Since then costs have fallen, and distributed market penetration is approaching 1% of retail sales. However, market penetration varies strongly by location. In 2016, only California and Hawaii had residential small-scale solar PV generation exceeding 3 percent of residential retail sales, and the majority of states were around 1 percent or less.[5] Nevertheless, NEM program caps are being approached or exceeded in several states, which often triggers requirements for program reviews.[6] Across the residential, commercial, and industrial sectors, the U.S. Energy Information Administration (EIA) estimates that growth will continue. By 2030, total market penetration could reach 2.6% of retail sales,[7] and could be significantly higher in certain locations.

2. *Multiple studies have found that basic NEM tariffs (paying solar customers at retail rate for electricity sent to the grid) results in cost-shifting between non-solar customers and solar customers.*[8] The vast majority of retail rate design has been based on volumetric rates that attempt to recover energy costs as well as fixed and demand costs (generation, transmission, and distribution) within the volumetric rate, rather than by disaggregating fixed and variable costs. With NEM tariffs, solar customers continue to receive fixed-cost services, but may avoid paying part of the costs of those services if fixed and volumetric energy costs are not disaggregated. When customers reduce volumetric payments and are not charged for fixed costs under standard rate design (either due to solar, storage, or efficiency measures), other customers that continue to pay full volumetric costs may bear a disproportionate share of costs for service. One study reviewed twelve available estimates and found that subsidies to net metering customers range from $444 to $1752 per year.[9] Less affluent customers who cannot afford rooftop solar or do not own residences frequently cross-subsidize more affluent customers.[10] It is, however, unclear at what point this cost shifting would result in significant impacts on retail rates. One study indicated for the majority of states and utilities, the effects of distributed solar on retail electricity prices will likely remain negligible for the foreseeable future.[11]

3. *Basic NEM tariffs do not provide effective incentives for solar customers to maximize the value of the electricity they generate.* NEM gives solar customers the incentive to

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[5] Energy Information Admin. (EIA), *Electric Power Annual 2016.*
[6] Stanton, *supra*, n.4, at 5.
[7] EIA, *Annual Energy Outlook 2018*, tables 8 & 16.
[8] *See, e.g.*, Energy Environment Economics, Inc., *California Net Energy Metering Ratepayer Impacts Evaluation* (Oct. 2013); California Public Utilities Commission Office of the Ratepayer Advocates *Proposal of the Office of Ratepayer Advocates for Net Energy Metering Successor Standard Contract or Tariff* (July 10, 2014).
[9] Barbara Alexander *et al.*, "Rethinking Rationale for Net Metering: Quantifying Subsidy from Non-Solar Customers," Pub. Util. Fortnightly (Oct. 2016.).
[10] See, *e.g.*, *California Net Energy Metering Ratepayer Impacts Evaluation, supra* n.8; Severin Borenstein, *Private Net Benefits of Residential Solar PV: The Role of Electricity Tariffs, Tax and Rebates,* 4 JJ. of the Ass'n. of Envtl. & Resource Economists, no. S1 (Sept. 2017).
[11] Galen Barbose, *Putting the Potential Rate Impacts of Distributed Solar into Context,* Lawrence Berkeley Nat'l Laboratory, at 10-11 (Jan. 2017).

produce as much electricity as possible, regardless of the time and location value of the electricity generated or the need of the electric grid for the electricity.[12]

The value of electricity varies over the course the day as demand varies and as different generation sources are used. As demand increases through the typical day, electricity generators bring more and more expensive generation online and meet higher amounts of demand. Generally speaking, peak electricity demand is the most expensive and valuable electricity during the day.

Volumetric rates do not provide price incentives to avoid electricity consumption when electricity is expensive to produce. Instead of providing price incentives to produce electricity when electricity is the most valuable, NEM provides the same rate throughout the day as incentive for rooftop solar generators. This means that no matter how cheap or how expensive the electricity, the NEM customer is paid the same amount. This does not create incentives for NEM customers to help meet system peaks or economize the electrical generation system. This results in sub-optimal location of solar panels and a lack of incentives for solar customers to purchase batteries.

4. *NEM-based PV programs can also have significant operational impacts at the utility or grid level as its penetration increases.* Because NEM-based PV programs may do little to guide the timing, size, or location of the development of distributed PV capacity, they can lead to unstable electricity flows on affected distribution circuits and trigger the need for new utility investments in distribution controls.[13] However, the implementation of new IEEE 1547-2018 standards may mitigate some of these impacts by standardizing grid-support services.[14] Proponents of NEM-based PV acknowledge that such impacts may occur but argue that its deployment results in total benefits to ratepayers and society that exceed its costs.[15]

   NEM-based PV programs can also contribute to area-wide grid management challenges, such as the steep "ramps" in net electricity demand that occur late

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[12] This raises the possibility that a NEM-based generation array could be sized much larger than required to serve the owner's electricity requirements. FERC has sought to prevent such outcomes, however, by ruling that it would assert jurisdiction over the rate for such sales "if the end-use customer participating in the net metering program produces more energy than it needs over the applicable billing period, and thus is considered to have made a net sale of energy to a utility." *Sun Edison LLC*, FERC Docket No. EL09-31-000, 129 FERC ¶ 61,146 at P 18 (2009).

[13] Nat'l Ass'n of Regulatory Util. Comm'rs, *Distributed Energy Resources Rate Design and Compensation Manual*, at 131.

[14] Re IEEE 1547-2018, *see* IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (IEEE Standard 1547-2018), available at https://standards.ieee.org/standard/1547-2018.html.

[15] *See, e.g.*, *Sunrun Comments in Response to US Department of Energy Request for Information on Net Metering Cost-Benefit Studies* and *Comments of Joint Solar Parties in Response to DOE Request for Information*, Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), both available at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

afternoons on many days in California, when solar output tapers off while peak demand is still increasing due to warm temperatures and customers coming home at the end of their work day. These ramps require the California Independent System Operator (CAISO) and utilities to bring very large amounts of conventional generation capacity into operation very quickly and may lead to thermal stress that shortens the operating life of the affected generation units.

5. *Distributed solar generation can provide a number of important benefits.* Figure 1 below shows 18 different value categories identified in recent cost-benefit studies. Some of the value categories are an attribute of distributed energy resources, while others such as avoided environmental costs are true of distributed solar as well as utility-scale solar.

   One of the most important points about these different value categories is that the magnitudes of the values are very location specific. As the Joint Solar Parties note in their comment on the RFI, "[i]t is important to emphasize that the results of benefit-cost studies are highly dependent on the specific facts, including the utility's rate and rate design, [Distributed Energy Resource (DER)] penetration levels, and existing and planned grid conditions."[16]

   For example, distributed solar in a highly constrained urban center may delay the need for infrastructure investment. Alternatively, if a feeder is near capacity, increased distributed solar on the feeder may necessitate infrastructure investments.[17] The location and context is critical in considering various costs and benefits of NEM and distributed solar generation.

   Figure 1. Value categories included in 15 recent studies.[18]

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[16] *Comments of Joint Solar Parties in Response to DOE Request for Information,* Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0062.

[17] *See, e.g.*, Am. Pub. Power Ass'n, *RE: Costs and Benefits of Net Energy Metering: Request for Information* (Oct. (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0033.

[18] Source of this table is ICF Review, *supra* n.3, at ii. In the left-most column, G = Generation, T = Transmission, D = Distribution, C = Costs, and S = Societal.

		Arkansas - Crossborder Energy 2017	Nevada - E3 2016	Louisiana - Acadian Consulting Group 2015	South Carolina - E3 2015	Mississippi - Synapse 2014	Vermont - VT Public Service Dept 2014	Washington DC - Synapse 2017	Georgia - Southern Company 2017	Hawaii - Clean Power Research 2015	Maine - Clean Power Research 2015	Oregon - Clean Power Research 2015	Minnesota - Clean Power Research 2014	Utah - Clean Power Research 2014	New York - NY BCA Framework 2016 + VDER	California - LNBA Framework 2016	Total
Utility System Impacts																	
G	Avoided Energy Generation	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Generation Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Environmental Compliance	•	•			•	•	•	o		•	o		•		o	10
	Fuel Hedging	•			•	•		•		o	•	o	•	•			9
	Market Price Response	•					•	•		o	•				o		6
	Ancillary Services		•		•	o		o	o	o					o	o	8
T	Avoided Transmission Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Line Losses	•	•		•	•	•	•	o			o		•	o	o	11
D	Avoided Distribution Capacity	•	•	•	•	•	•	•		o	o	o	o	•	o	o	14
	Avoided Resiliency & Reliability	o				o		o							o	o	5
	Distribution O&M			•					o						o	o	4
	Distribution Voltage and Power Quality									o	o	o	o		o	o	6
C	Integration Costs	•	•	•	•	o		•	o	o	•	o	o		o	o	13
	Lost Utility Revenues	•	•	•	•	•	•								o		7
	Program and Administrative Costs		•	•	•	•	•	o							o		7
Societal Impacts																	
S	Avoided Cost of Carbon	•					•	•		o	•		o		o	o	8
	Other Avoided Environmental Costs	•	•			o		o		o	•		o		o	o	9
	Local Economic Benefit	•				o		o									3

Included	•
Included/represented in another category	•
Discussed but not monetized/quantified	o
For NY, included in VDER Phase One	o

6. *As a result of the impacts noted above as well as other impacts, many states have either phased out "NEM 1.0" in favor of one or another NEM-successor regulatory approach or framework, or are considering such actions.* There are many alternatives. Some states are exploring the use of valuation methodologies based on a calculation of system costs and benefits, which can be used to inform ratemaking processes aimed at moving beyond NEM. Such calculations are examined in the *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar* (enclosed), which includes examples from 15 states. Other states have taken or are considering regulatory actions to modify NEM-based compensation schemes using a range of approaches. Examples of such approaches by nine states are discussed below to illustrate their diversity and the range of challenges they address. These examples, however, are not intended to be either representative or exhaustive. The states are listed below in alphabetical order.[19]

   Arizona. In 2014, the Arizona Corporation Commission (ACC) became concerned that under its existing NEM rule, customer-generators could obtain multi-year contracts for the sale of electricity to the utility, and that given the prospects for

[19] The legislative language to which this report responds can be understood to cover NEM plans adopted by local, tribal, and territorial governmental entities, as well as those adopted by states. The examples discussed above pertain only to states. However, it is unlikely that broadening the scope to include local, tribal, and territorial governmental entities would appreciably change the conclusions.

continuing reductions in the cost of PV technology and other possible changes in electricity markets (*e.g.*, fuel price changes), such contracts could easily become well above-market years before their expiration – at the expense of other customers.

In December 2016, the ACC voted to replace net metering with a net billing approach that would compensate customers for excess energy exported to the grid at an adjustable avoided cost rate.[20] The ACC decided that relying on an easily-updated historical proxy to set the rate would yield more realistic results than basing the rate on long-term projections of avoided costs. The new avoided cost rate is to be determined in each utility's rate case, using a proxy based on a weighted average of the price of electricity from utility-scale solar resources brought online by the utility during the preceding five years.

California. In 2016, California's total PV penetration (including utility-scale systems) reached an estimated 9 percent.[21] In 2014, the California Public Utilities Commission (CPUC) initiated a reconsideration of the then-existing NEM rule, with several objectives: It sought to align NEM customer costs more closely with non-NEM customer costs; support customers' transition to time-of-use rates for electricity purchased from state-regulated utilities; make programs for customer-owned PV systems available to disadvantaged communities and residents of multi-family buildings; and provide addition protection measures for customers participating in NEM-related programs.

On July 1, 2017, the CPUC adopted a net metering successor tariff that links the rates for customer-generators' electricity purchases from, and sales to, their local utility to the changing wholesale prices of electricity. Under the new tariff, new customer-PV generators will pay:

- A one-time interconnection fee, estimated at $75-$150;
- Several small non-bypassable per-kilowatt-hour (kWh) charges on electricity consumed from the grid (~$0.02-0.03/kWh), to cover utilities' public-purpose programs, nuclear decommissioning costs, transition-to-competition costs, and the costs of certain Department of Water Resources bonds; and
- A time-of-use rate for electricity consumed from the grid.[22]

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[20] Ariz. Corp. Comm'n, *Commission Passes Historic Decision to Protect Solar Interests and Provide Equity for all Customers* (Dec. 21, 2016), http://www.azcc.gov/Divisions/Administration/news/2016Releases/12-21-2016%20Value%20and%20Cost%20of%20Solar%20decision.pdf.

[21] ICF Review, *supra* n.3, at 34.

[22] Cal. Pub. Utils. Comm'n, *Net Energy Metering (NEM)*, http://www.cpuc.ca.gov/General.aspx?id=3800.

As before, customer-generators are paid for exports to the grid at the same price per kWh charged for retail sales – but now the price varies, depending on the time-of-use rate applicable at the time the export occurs.

This regime is likely to evolve further over the next few years. The CPUC plans to review the NEM successor tariff in 2019 and explore compensation structures other than NEM, and to consider an export compensation rate that takes into account locational and time-differentiated values.[23]

In a parallel effort, the CPUC is developing a framework for valuing the diverse costs and benefits associated with the deployment of multiple DERs (including distributed PV), taking into account potential synergies offered by some combinations of DERs, and that the impacts of a given DER asset can vary greatly depending on where it is located in a given distribution system.[24]

Hawaii. In 2014, the state's electricity regulators initiated a proceeding to investigate its NEM and DER policies, after finding that "high distributed PV penetration levels and remuneration rates [had] contributed to the increase in technical and financial issues for utilities."[25] (In 2016, Hawaii's estimated PV penetration was 22 percent.[26]) In October 2015, the Hawaii PUC voted to end net metering for PV in favor of two alternative options: a customer grid-supply (CGS) option and a self-supply option.[27] Under the grid-supply option, eligible customers receive credits on their electric bills for excess electricity sent to the grid or energy delivered by the utility to the customer-generator, whichever is less, at a fixed rate approved by the PUC through October 20, 2022.[28] The fixed rate ranges from $0.15/kWh - $0.28/kWh, depending on the island where the PV asset is located. The self-supply option is for PV customers that do not export power and provides expedited review and approval for interconnection.[29]

In October 2017, as the grid-supply program reached capacity, the PUC approved a successor program known as "CGS+," which compensates PV customers with required grid support equipment for export at fixed rates, and a similar "smart export" program for customers with PV and battery storage.[30] The Hawaiian Electric

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[23] Cal. Pub. Utils. Comm'n,, *Net Energy Metering Rulemaking (R.14-07-002).* Available at: http://www.cpuc.ca.gov/general.aspx?id=3934.

[24] *See* Juliet Homer *et al.*, *State Engagement in Electric Distribution System Planning* (Dec. 2017), http://eta-publications.lbl.gov/sites/default/files/state_engagement_in_dsp_final_rev2.pdf.

[25] *Id.* at 2.1.

[26] ICF Review, *supra* n.3, at 27.

[27] *In the Matter of Public Utilities Commission Instituting a Proceeding to Investigate Distributed Energy Resource Policies Docket No. 2014-0192, Decision Order No. 33258.* (Oct. 12, 2015), https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A15J13B15422F90464.

[28] *Hawaiian Electric, Customer Grid-Supply,* https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-renewable-programs/customer-grid-supply.

[29] *Id.*

[30] Hawaii Pub. Utils. Comm'n, *HPUC Expands Options for Customers to Install Rooftop Solar and Energy Storage* (Oct. 20, 2017),

Company said the Commission "approved these new rooftop PV programs to support the continued growth of rooftop PV and ensure safe, reliable service and fair treatment for all customers. The decision is the result of the PUC's effort to develop long-term technical and policy solutions that will support the continued growth of rooftop PV in Hawaii."[31]

Indiana. Indiana Senate Bill 309, enacted in May 2017, gradually reduces the rate paid to net metering customers and phases out retail rate net metering by July 1, 2022 (or when customer-owned PV reached 1.5 percent of an affected utility's peak summer load, whichever is earlier). New distributed generation compensation arrangements will be set through individual utility ratemaking proceedings. However, the new rate(s) must equal 1.25 x the average wholesale price paid by the utility for electricity.[32]

Maine. The state's estimated PV penetration in 2016 was 1 percent,[33] triggering a requirement to review the state's NEM rule. In March 2017, the Maine PUC issued an order replacing net metering with a "buy-all, sell-all" compensation structure, which treats customer-owned electricity production and consumption separately, and gradually reduces the rate utilities pay for electricity produced by customer-generators. Under this rate structure, instead of offsetting electric usage, customers sell to the utility all of the solar energy they generate at one rate and buy all the energy they consume from the utility at a higher rate. Existing customers with systems installed before 2018 may stay on the old structure for up to 15 years.[34]

Massachusetts. In 2016, the state legislature enacted bipartisan legislation to amend Massachusetts' net metering law. The objectives were to enable "the continued support of solar power generation and a transition to a stable and equitable solar market at a reasonable cost to ratepayers" and the new law directed utilities to calculate "market net metering credits" at approximately 60 percent of previous rates.[35] In January 2018, the Massachusetts Department of Public Utilities (DPU) approved "demand charges" for net metering customers of Eversource utilities operating in the state, and eliminated optional time-of-use rates for residential customers.[36] The DPU's adoption of demand charges for residential customer-generators is innovative. Utilities must maintain the physical capacity to deliver

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https://www.hawaiianelectric.com/Documents/clean_energy_hawaii/producing_clean_energy/20171020_hawaii_PUC_rooftop_solar_and_storage_press_release.pdf.

[31] https://www.mauielectric.com/customer-service/frequently-asked-questions?SortBy=&page=2.

[32] *Senate Enrolled Act No. 309: An Act to amend the Indiana Code concerning utilities*, https://iga.in.gov/static-documents/7/d/0/3/7d037e18/SB0309.05.ENRH.pdf.

[33] ICF, *op. cit.*, at 27.

[34] Nat'l Renewable Energy Lab, *Midmarket Solar Policies in the United States: Maine*, https://www.nrel.gov/solar/rps/me.html.

[35] Commonwealth of Mass., Session Laws, Acts (2016), Chapter 75, *An Act Relative to Solar Energy* (Apr. 11, 2016), https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter75.

[36] Commonwealth of Mass. Dep't of Pub. Utils., D.P.U. 17-05-B, Order Establishing Eversource's Rate Structure (Jan. 5, 2018), https://eeaonline.eea.state.ma.us/EEA/FileService/FileService.Api/file/FileRoom/9170110.

electricity to a given customer at the customer's maximum level of demand, even though the customer may require significantly less electricity during most of the hours in a given period. With the approval of state regulators, many utilities have long included demand charges as a component of the rates paid by commercial and industrial customers, but such charges have seldom been used for residential customers. In recent years, some utilities and states (such as Massachusetts) have considered or adopted demand charges for some residential customers, particularly customers with widely fluctuating electricity demand, such as customer-generators.[37]

Nevada. A state law, AB 405, reaffirmed net metering for PV systems up to 25 kilowatts (kW) in capacity.[38] Under the new rules, the first 80 MW of new net metered systems will have monthly generation and consumption netted, and any remaining excess generation will be credited at 95 percent of the retail rate. The latter rate will decline by 7 percent for every additional 80 MW, to a floor of 75 percent of the retail rate. For customer-owned non-PV systems up to 25 kW, exported generation is credited at the avoided cost rate.[39]

New Hampshire. The state's Office of Strategic Initiatives released a 10-year energy strategy on April 17, 2018. The New Hampshire Public Utilities Commission will work with stakeholders to collect data and other inputs concerning the impacts of net metering, implement pilot programs, and produce a DER valuation study. The Commission will also open a new proceeding in which it will revisit its existing NEM rule. The considerations of concern in the development of the new rule include the need "to provide predictability to stakeholders, protect investments made by all stakeholders, and avoid cost-shifting among ratepayers."[40] Additionally, "[a]ll existing net metered systems are grandfathered through 2040 at current rates."[41]

Vermont. In 2016, Vermont's PV penetration reached an estimated 6 percent.[42] Effective January 1, 2017, any electric customer in Vermont qualifies for net metering after obtaining a Certificate of Public Good from the Vermont Public Service Board (PSB). Solar systems 15 kW or less follow an expedited process;

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[37] For a detailed discussion of demand charges, *see* Nat'l Ass'n of Regulatory Util. Comm'rs, *NARUC* Manual *on Distributed Energy Resources Rate Design and Compensation*, at 98-116, https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0.

[38] *Assembly Bill No. 405 (SB 405)* (June 15, 2017), https://www.leg.state.nv.us/Session/79th2017/Bills/AB/AB405_EN.pdf.

[39] State of Nev. Pub. Utils. Comm'n, *Net Metering*, http://puc.nv.gov/Renewable_Energy/Net_Metering/.

[40] N.H. Office of Strategic Initiatives, *New Hampshire 10-Year State Energy Strategy* (Apr. 2018), at 8, https://www.nh.gov/osi/energy/programs/documents/energy-strategy.pdf.

[41] *Id.* at 37. *See also* State of New Hampshire Public Utilities Commission, DE 16-576, *Development of New Alternative Net Metering Tariffs and/or Other Regulatory Mechanisms and Tariffs for Customer-Generators, Order Accepting Settlement Provisions, Resolving Settlement Issues, and Adopting a New Alternative Net Metering Tariff*, Order No. 26,029 (June 23, 2017), https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/ORDERS/16-576_2017-06-23_ORDER_26029.PDF.

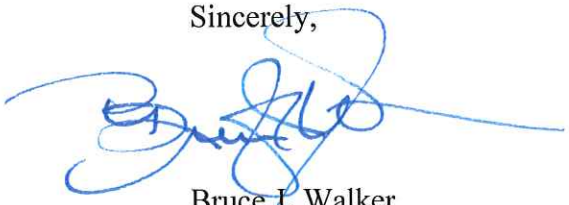
[42] ICF Review, *supra* n.3, at 27.

systems up to 150 kW may apply online; and systems greater than 150 kW must make a filing for the certificate.[43]

7. *DOE recognizes that the line between State and Federal jurisdiction over net metering transactions could shift*. Under the Federal Power Act (FPA), FERC has exclusive jurisdiction over wholesale sales of electric power, while states have jurisdiction over retail sales. Nevertheless, in two Commission opinions pertaining to particular parties, FERC determined that there is no wholesale sale within the meaning of the FPA unless the retail customer with on-premises generation is a *net* supplier of energy to the utility within the state retail billing period (usually one month). *See MidAmerican Energy Co.*, 94 FERC ¶ 61,340 (2001); *Sun Edison LLC*, 129 FERC ¶ 61,146 (2009). The Commission justified this determination on prior rulings involving the opposite situation: when a generator consumes energy from the grid from "station power" use in some hours, but has a net sale to grid over a monthly billing period. However, two D.C. Circuit Court of Appeals cases have since rejected FERC's station power netting theory. *See S. Cal. Edison Co. v. FERC*, 603 F.3d 996 (D.C. Cir. 2010); *Calpine Corp. v. FERC*, 702 F.3d 41 (D.C. Cir. 2012). In both cases, the court held that netting within a billing period cannot be the determining factor for whether a sale has taken place. FERC's attempts, therefore, in its net metering decisions to disclaim jurisdiction over net metering transactions on the theory that no sale has taken place, could be challenged and overturned.

   Regardless of whether states or FERC regulate net metering, DOE strongly urges that the appropriate regulatory bodies ensure that net metering rates are just and reasonable and do not discriminate by shifting costs from net metering customers to low-income and other non-net metering customers as mentioned in designated paragraph 2 above. Also, DOE strongly urges states to ensure that deployments will be designed and located so as to enhance the resilience and reliability of local and regional grids.

Sincerely,



Bruce J. Walker
Assistant Secretary
Office of Electricity

Enclosure

[43] *See* Vt. Pub. Util. Comm'n, Rule 5.100, https://puc.vermont.gov/sites/psbnew/files/doc_library/5100-PUC-nm-effective-07-01-2017_0.pdf.

Department of Energy
Washington, DC 20585

February 21, 2019

The Honorable Kay Granger
Ranking Member
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Congresswoman Granger:

This letter report provides findings in response to legislative language set forth in Senate Report No. 114-236, 114th Cong., 1st Sess. dated Apr. 14, 2016 which asked the Department of Energy (DOE) to conduct a study that would "determine the costs and benefits of net metering and distributed solar generation to the electrical grid, utilities, and ratepayers."

For the purposes of this report, net energy metering (NEM) is:

> "service to an electric consumer under which electric energy generated by that consumer from an eligible on-site generating facility [*e.g.*, a rooftop photovoltaic array] and delivered to the local [electric] distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period."[1]

After reviewing responses to DOE's public Request for Information (RFI) on NEM,[2] 15 recent NEM-related cost-benefit studies,[3] and other NEM-related literature, we have come to a number of conclusions:

1. *NEM was widely adopted by states[4] as a simple way to reimburse solar customer/generators who feed their excess electricity into the grid.* When most NEM

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[1] 16 USC 2621(d)(11) This definition is drawn from the definition of "net metering service" at section 111(d)(11) of the Public Utility Regulatory Policies Act of 1978 (as amended by section 1251 of the Energy Policy Act of 2005), codified at 16 U.S.C. § 2621(d)(11).

[2] Comments received in response to the RFI can be accessed at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

[3] *See* ICF, *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar*, May 2018 (ICF Review).

[4] As of November 2017, 38 states plus the District of Columbia had adopted some form of mandatory NEM rules for electric utilities. (*See* http://www.dsireusa.org/) However, many of these states have subsequently modified their rules substantially, and some have dropped NEM altogether in favor of an alternative approach. See Tom Stanton, "NEM 2.0 and Successor Tariffs: Which States are Doing What?" National Regulatory Research Institute webinar (Mar. 14, 2018). http://nrri.org/wp-content/uploads/2018/03/20180309-Stanton-and-Barber-NEM-and-Successor-Tariffs.pdf.

plans were first adopted, residential photovoltaic technology costs were high and its market penetration was minimal. Since then costs have fallen, and distributed market penetration is approaching 1% of retail sales. However, market penetration varies strongly by location. In 2016, only California and Hawaii had residential small-scale solar PV generation exceeding 3 percent of residential retail sales, and the majority of states were around 1 percent or less.[5] Nevertheless, NEM program caps are being approached or exceeded in several states, which often triggers requirements for program reviews.[6] Across the residential, commercial, and industrial sectors, the U.S. Energy Information Administration (EIA) estimates that growth will continue. By 2030, total market penetration could reach 2.6% of retail sales,[7] and could be significantly higher in certain locations.

2. *Multiple studies have found that basic NEM tariffs (paying solar customers at retail rate for electricity sent to the grid) results in cost-shifting between non-solar customers and solar customers.*[8] The vast majority of retail rate design has been based on volumetric rates that attempt to recover energy costs as well as fixed and demand costs (generation, transmission, and distribution) within the volumetric rate, rather than by disaggregating fixed and variable costs. With NEM tariffs, solar customers continue to receive fixed-cost services, but may avoid paying part of the costs of those services if fixed and volumetric energy costs are not disaggregated. When customers reduce volumetric payments and are not charged for fixed costs under standard rate design (either due to solar, storage, or efficiency measures), other customers that continue to pay full volumetric costs may bear a disproportionate share of costs for service. One study reviewed twelve available estimates and found that subsidies to net metering customers range from $444 to $1752 per year.[9] Less affluent customers who cannot afford rooftop solar or do not own residences frequently cross-subsidize more affluent customers.[10] It is, however, unclear at what point this cost shifting would result in significant impacts on retail rates. One study indicated for the majority of states and utilities, the effects of distributed solar on retail electricity prices will likely remain negligible for the foreseeable future.[11]

3. *Basic NEM tariffs do not provide effective incentives for solar customers to maximize the value of the electricity they generate.* NEM gives solar customers the incentive to

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[5] Energy Information Admin. (EIA), *Electric Power Annual 2016*.
[6] Stanton, *supra*, n.4, at 5.
[7] EIA, *Annual Energy Outlook 2018*, tables 8 & 16.
[8] *See, e.g.*, Energy Environment Economics, Inc., *California Net Energy Metering Ratepayer Impacts Evaluation* (Oct. 2013); California Public Utilities Commission Office of the Ratepayer Advocates *Proposal of the Office of Ratepayer Advocates for Net Energy Metering Successor Standard Contract or Tariff* (July 10, 2014).
[9] Barbara Alexander *et al.*, "Rethinking Rationale for Net Metering: Quantifying Subsidy from Non-Solar Customers," Pub. Util. Fortnightly (Oct. 2016.).
[10] See, *e.g.*, *California Net Energy Metering Ratepayer Impacts Evaluation*, *supra* n.8; Severin Borenstein, *Private Net Benefits of Residential Solar PV: The Role of Electricity Tariffs, Tax and Rebates,* 4 JJ. of the Ass'n. of Envtl. & Resource Economists, no. S1 (Sept. 2017).
[11] Galen Barbose, *Putting the Potential Rate Impacts of Distributed Solar into Context,* Lawrence Berkeley Nat'l Laboratory, at 10-11 (Jan. 2017).

produce as much electricity as possible, regardless of the time and location value of the electricity generated or the need of the electric grid for the electricity.[12]

The value of electricity varies over the course the day as demand varies and as different generation sources are used. As demand increases through the typical day, electricity generators bring more and more expensive generation online and meet higher amounts of demand. Generally speaking, peak electricity demand is the most expensive and valuable electricity during the day.

Volumetric rates do not provide price incentives to avoid electricity consumption when electricity is expensive to produce. Instead of providing price incentives to produce electricity when electricity is the most valuable, NEM provides the same rate throughout the day as incentive for rooftop solar generators. This means that no matter how cheap or how expensive the electricity, the NEM customer is paid the same amount. This does not create incentives for NEM customers to help meet system peaks or economize the electrical generation system. This results in sub-optimal location of solar panels and a lack of incentives for solar customers to purchase batteries.

4. *NEM-based PV programs can also have significant operational impacts at the utility or grid level as its penetration increases.* Because NEM-based PV programs may do little to guide the timing, size, or location of the development of distributed PV capacity, they can lead to unstable electricity flows on affected distribution circuits and trigger the need for new utility investments in distribution controls.[13] However, the implementation of new IEEE 1547-2018 standards may mitigate some of these impacts by standardizing grid-support services.[14] Proponents of NEM-based PV acknowledge that such impacts may occur but argue that its deployment results in total benefits to ratepayers and society that exceed its costs.[15]

   NEM-based PV programs can also contribute to area-wide grid management challenges, such as the steep "ramps" in net electricity demand that occur late

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[12] This raises the possibility that a NEM-based generation array could be sized much larger than required to serve the owner's electricity requirements. FERC has sought to prevent such outcomes, however, by ruling that it would assert jurisdiction over the rate for such sales "if the end-use customer participating in the net metering program produces more energy than it needs over the applicable billing period, and thus is considered to have made a net sale of energy to a utility." *Sun Edison LLC*, FERC Docket No. EL09-31-000, 129 FERC ¶ 61,146 at P 18 (2009).

[13] Nat'l Ass'n of Regulatory Util. Comm'rs, *Distributed Energy Resources Rate Design and Compensation Manual*, at 131.

[14] Re IEEE 1547-2018, s*ee* IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (IEEE Standard 1547-2018), available at https://standards.ieee.org/standard/1547-2018.html.

[15] *See, e.g.*, *Sunrun Comments in Response to US Department of Energy Request for Information on Net Metering Cost-Benefit Studies* and *Comments of Joint Solar Parties in Response to DOE Request for Information*, Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), both available at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

afternoons on many days in California, when solar output tapers off while peak demand is still increasing due to warm temperatures and customers coming home at the end of their work day. These ramps require the California Independent System Operator (CAISO) and utilities to bring very large amounts of conventional generation capacity into operation very quickly and may lead to thermal stress that shortens the operating life of the affected generation units.

5. *Distributed solar generation can provide a number of important benefits.* Figure 1 below shows 18 different value categories identified in recent cost-benefit studies. Some of the value categories are an attribute of distributed energy resources, while others such as avoided environmental costs are true of distributed solar as well as utility-scale solar.

   One of the most important points about these different value categories is that the magnitudes of the values are very location specific. As the Joint Solar Parties note in their comment on the RFI, "[i]t is important to emphasize that the results of benefit-cost studies are highly dependent on the specific facts, including the utility's rate and rate design, [Distributed Energy Resource (DER)] penetration levels, and existing and planned grid conditions."[16]

   For example, distributed solar in a highly constrained urban center may delay the need for infrastructure investment. Alternatively, if a feeder is near capacity, increased distributed solar on the feeder may necessitate infrastructure investments.[17] The location and context is critical in considering various costs and benefits of NEM and distributed solar generation.

   Figure 1. Value categories included in 15 recent studies.[18]

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[16] *Comments of Joint Solar Parties in Response to DOE Request for Information,* Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0062.

[17] *See, e.g.*, Am. Pub. Power Ass'n, *RE: Costs and Benefits of Net Energy Metering: Request for Information* (Oct. (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0033.

[18] Source of this table is ICF Review, *supra* n.3, at ii. In the left-most column, G = Generation, T = Transmission, D = Distribution, C = Costs, and S = Societal.

		Arkansas - Crossborder Energy 2017	Nevada - E3 2016	Louisiana - Acadian Consulting Group 2015	South Carolina - E3 2015	Mississippi - Synapse 2014	Vermont - VT Public Service Dept 2014	Washington DC - Synapse 2017	Georgia - Southern Company 2017	Hawaii - Clean Power Research 2015	Maine - Clean Power Research 2015	Oregon - Clean Power Research 2015	Minnesota - Clean Power Research 2014	Utah - Clean Power Research 2014	New York - NY BCA Framework 2016 + VDER	California - LNBA Framework 2016	Total
Utility System Impacts																	
G	Avoided Energy Generation	•	•	•	•	•	•	o	o	•	o	o	•	o	o		15
	Avoided Generation Capacity	•	•	•	•	•	•	o	o	•	o	o	•	o	o		15
	Avoided Environmental Compliance	•	•			•	•	o		•	o		•		o		10
	Fuel Hedging	•			•	•		•		o	•	o	•	•			9
	Market Price Response	•					•	•		o	•				o		6
	Ancillary Services		•		•	o		o	o	o					o	o	8
T	Avoided Transmission Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Line Losses	•	•		•	•	•	•	o			o		•	o	o	11
D	Avoided Distribution Capacity	•	•	•	•	•	•	•		o	o	o	o	•	o	o	14
	Avoided Resiliency & Reliability	o				o		o							o	o	5
	Distribution O&M			•					o						o	o	4
	Distribution Voltage and Power Quality									o	o	o	o		o	o	6
C	Integration Costs	•	•	•	•	o		•	o	o	•	o	o		o	o	13
	Lost Utility Revenues	•	•	•	•	•	•								o		7
	Program and Administrative Costs		•	•	•	•	•	o							o		7
Societal Impacts																	
S	Avoided Cost of Carbon	•					•	•		o	•		o		o	o	8
	Other Avoided Environmental Costs	•	•			o		o		o	•		o		o	o	9
	Local Economic Benefit	•				o		o									3

Included	•
Included/represented in another category	•
Discussed but not monetized/quantified	o
For NY, included in VDER Phase One	o

6. *As a result of the impacts noted above as well as other impacts, many states have either phased out "NEM 1.0" in favor of one or another NEM-successor regulatory approach or framework, or are considering such actions.* There are many alternatives. Some states are exploring the use of valuation methodologies based on a calculation of system costs and benefits, which can be used to inform ratemaking processes aimed at moving beyond NEM. Such calculations are examined in the *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar* (enclosed), which includes examples from 15 states. Other states have taken or are considering regulatory actions to modify NEM-based compensation schemes using a range of approaches. Examples of such approaches by nine states are discussed below to illustrate their diversity and the range of challenges they address. These examples, however, are not intended to be either representative or exhaustive. The states are listed below in alphabetical order.[19]

   Arizona. In 2014, the Arizona Corporation Commission (ACC) became concerned that under its existing NEM rule, customer-generators could obtain multi-year contracts for the sale of electricity to the utility, and that given the prospects for

[19] The legislative language to which this report responds can be understood to cover NEM plans adopted by local, tribal, and territorial governmental entities, as well as those adopted by states. The examples discussed above pertain only to states. However, it is unlikely that broadening the scope to include local, tribal, and territorial governmental entities would appreciably change the conclusions.

continuing reductions in the cost of PV technology and other possible changes in electricity markets (*e.g.*, fuel price changes), such contracts could easily become well above-market years before their expiration – at the expense of other customers.

In December 2016, the ACC voted to replace net metering with a net billing approach that would compensate customers for excess energy exported to the grid at an adjustable avoided cost rate.[20] The ACC decided that relying on an easily-updated historical proxy to set the rate would yield more realistic results than basing the rate on long-term projections of avoided costs. The new avoided cost rate is to be determined in each utility's rate case, using a proxy based on a weighted average of the price of electricity from utility-scale solar resources brought online by the utility during the preceding five years.

California. In 2016, California's total PV penetration (including utility-scale systems) reached an estimated 9 percent.[21] In 2014, the California Public Utilities Commission (CPUC) initiated a reconsideration of the then-existing NEM rule, with several objectives: It sought to align NEM customer costs more closely with non-NEM customer costs; support customers' transition to time-of-use rates for electricity purchased from state-regulated utilities; make programs for customer-owned PV systems available to disadvantaged communities and residents of multi-family buildings; and provide addition protection measures for customers participating in NEM-related programs.

On July 1, 2017, the CPUC adopted a net metering successor tariff that links the rates for customer-generators' electricity purchases from, and sales to, their local utility to the changing wholesale prices of electricity. Under the new tariff, new customer-PV generators will pay:

- A one-time interconnection fee, estimated at $75-$150;
- Several small non-bypassable per-kilowatt-hour (kWh) charges on electricity consumed from the grid (~$0.02-0.03/kWh), to cover utilities' public-purpose programs, nuclear decommissioning costs, transition-to-competition costs, and the costs of certain Department of Water Resources bonds; and
- A time-of-use rate for electricity consumed from the grid.[22]

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[20] Ariz. Corp. Comm'n, *Commission Passes Historic Decision to Protect Solar Interests and Provide Equity for all Customers* (Dec. 21, 2016), http://www.azcc.gov/Divisions/Administration/news/2016Releases/12-21-2016%20Value%20and%20Cost%20of%20Solar%20decision.pdf.

[21] ICF Review, *supra* n.3, at 34.

[22] Cal. Pub. Utils. Comm'n, *Net Energy Metering (NEM)*, http://www.cpuc.ca.gov/General.aspx?id=3800.

As before, customer-generators are paid for exports to the grid at the same price per kWh charged for retail sales – but now the price varies, depending on the time-of-use rate applicable at the time the export occurs.

This regime is likely to evolve further over the next few years. The CPUC plans to review the NEM successor tariff in 2019 and explore compensation structures other than NEM, and to consider an export compensation rate that takes into account locational and time-differentiated values.[23]

In a parallel effort, the CPUC is developing a framework for valuing the diverse costs and benefits associated with the deployment of multiple DERs (including distributed PV), taking into account potential synergies offered by some combinations of DERs, and that the impacts of a given DER asset can vary greatly depending on where it is located in a given distribution system.[24]

Hawaii. In 2014, the state's electricity regulators initiated a proceeding to investigate its NEM and DER policies, after finding that "high distributed PV penetration levels and remuneration rates [had] contributed to the increase in technical and financial issues for utilities."[25] (In 2016, Hawaii's estimated PV penetration was 22 percent.[26]) In October 2015, the Hawaii PUC voted to end net metering for PV in favor of two alternative options: a customer grid-supply (CGS) option and a self-supply option.[27] Under the grid-supply option, eligible customers receive credits on their electric bills for excess electricity sent to the grid or energy delivered by the utility to the customer-generator, whichever is less, at a fixed rate approved by the PUC through October 20, 2022.[28] The fixed rate ranges from $0.15/kWh - $0.28/kWh, depending on the island where the PV asset is located. The self-supply option is for PV customers that do not export power and provides expedited review and approval for interconnection.[29]

In October 2017, as the grid-supply program reached capacity, the PUC approved a successor program known as "CGS+," which compensates PV customers with required grid support equipment for export at fixed rates, and a similar "smart export" program for customers with PV and battery storage.[30] The Hawaiian Electric

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[23] Cal. Pub. Utils. Comm'n,, *Net Energy Metering Rulemaking (R.14-07-002).* Available at: http://www.cpuc.ca.gov/general.aspx?id=3934.

[24] *See* Juliet Homer *et al.*, *State Engagement in Electric Distribution System Planning* (Dec. 2017), http://eta-publications.lbl.gov/sites/default/files/state_engagement_in_dsp_final_rev2.pdf.

[25] *Id.* at 2.1.

[26] ICF Review, *supra* n.3, at 27.

[27] *In the Matter of Public Utilities Commission Instituting a Proceeding to Investigate Distributed Energy Resource Policies Docket No. 2014-0192, Decision Order No. 33258.* (Oct. 12, 2015), https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A15J13B15422F90464.

[28] *Hawaiian Electric, Customer Grid-Supply,* https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-renewable-programs/customer-grid-supply.

[29] *Id.*

[30] Hawaii Pub. Utils. Comm'n, *HPUC Expands Options for Customers to Install Rooftop Solar and Energy Storage* (Oct. 20, 2017),

Company said the Commission "approved these new rooftop PV programs to support the continued growth of rooftop PV and ensure safe, reliable service and fair treatment for all customers. The decision is the result of the PUC's effort to develop long-term technical and policy solutions that will support the continued growth of rooftop PV in Hawaii."[31]

Indiana. Indiana Senate Bill 309, enacted in May 2017, gradually reduces the rate paid to net metering customers and phases out retail rate net metering by July 1, 2022 (or when customer-owned PV reached 1.5 percent of an affected utility's peak summer load, whichever is earlier). New distributed generation compensation arrangements will be set through individual utility ratemaking proceedings. However, the new rate(s) must equal 1.25 x the average wholesale price paid by the utility for electricity.[32]

Maine. The state's estimated PV penetration in 2016 was 1 percent,[33] triggering a requirement to review the state's NEM rule. In March 2017, the Maine PUC issued an order replacing net metering with a "buy-all, sell-all" compensation structure, which treats customer-owned electricity production and consumption separately, and gradually reduces the rate utilities pay for electricity produced by customer-generators. Under this rate structure, instead of offsetting electric usage, customers sell to the utility all of the solar energy they generate at one rate and buy all the energy they consume from the utility at a higher rate. Existing customers with systems installed before 2018 may stay on the old structure for up to 15 years.[34]

Massachusetts. In 2016, the state legislature enacted bipartisan legislation to amend Massachusetts' net metering law. The objectives were to enable "the continued support of solar power generation and a transition to a stable and equitable solar market at a reasonable cost to ratepayers" and the new law directed utilities to calculate "market net metering credits" at approximately 60 percent of previous rates.[35] In January 2018, the Massachusetts Department of Public Utilities (DPU) approved "demand charges" for net metering customers of Eversource utilities operating in the state, and eliminated optional time-of-use rates for residential customers.[36] The DPU's adoption of demand charges for residential customer-generators is innovative. Utilities must maintain the physical capacity to deliver

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https://www.hawaiianelectric.com/Documents/clean_energy_hawaii/producing_clean_energy/20171020_hawaii_PUC_rooftop_solar_and_storage_press_release.pdf.

[31] https://www.mauielectric.com/customer-service/frequently-asked-questions?SortBy=&page=2.

[32] *Senate Enrolled Act No. 309: An Act to amend the Indiana Code concerning utilities*, https://iga.in.gov/static-documents/7/d/0/3/7d037e18/SB0309.05.ENRH.pdf.

[33] ICF, *op. cit.*, at 27.

[34] Nat'l Renewable Energy Lab, *Midmarket Solar Policies in the United States: Maine*, https://www.nrel.gov/solar/rps/me.html.

[35] Commonwealth of Mass., Session Laws, Acts (2016), Chapter 75, *An Act Relative to Solar Energy* (Apr. 11, 2016), https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter75.

[36] Commonwealth of Mass. Dep't of Pub. Utils., D.P.U. 17-05-B, Order Establishing Eversource's Rate Structure (Jan. 5, 2018), https://eeaonline.eea.state.ma.us/EEA/FileService/FileService.Api/file/FileRoom/9170110.

electricity to a given customer at the customer's maximum level of demand, even though the customer may require significantly less electricity during most of the hours in a given period. With the approval of state regulators, many utilities have long included demand charges as a component of the rates paid by commercial and industrial customers, but such charges have seldom been used for residential customers. In recent years, some utilities and states (such as Massachusetts) have considered or adopted demand charges for some residential customers, particularly customers with widely fluctuating electricity demand, such as customer-generators.[37]

Nevada. A state law, AB 405, reaffirmed net metering for PV systems up to 25 kilowatts (kW) in capacity.[38] Under the new rules, the first 80 MW of new net metered systems will have monthly generation and consumption netted, and any remaining excess generation will be credited at 95 percent of the retail rate. The latter rate will decline by 7 percent for every additional 80 MW, to a floor of 75 percent of the retail rate. For customer-owned non-PV systems up to 25 kW, exported generation is credited at the avoided cost rate.[39]

New Hampshire. The state's Office of Strategic Initiatives released a 10-year energy strategy on April 17, 2018. The New Hampshire Public Utilities Commission will work with stakeholders to collect data and other inputs concerning the impacts of net metering, implement pilot programs, and produce a DER valuation study. The Commission will also open a new proceeding in which it will revisit its existing NEM rule. The considerations of concern in the development of the new rule include the need "to provide predictability to stakeholders, protect investments made by all stakeholders, and avoid cost-shifting among ratepayers."[40] Additionally, "[a]ll existing net metered systems are grandfathered through 2040 at current rates."[41]

Vermont. In 2016, Vermont's PV penetration reached an estimated 6 percent.[42] Effective January 1, 2017, any electric customer in Vermont qualifies for net metering after obtaining a Certificate of Public Good from the Vermont Public Service Board (PSB). Solar systems 15 kW or less follow an expedited process;

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[37] For a detailed discussion of demand charges, *see* Nat'l Ass'n of Regulatory Util. Comm'rs, *NARUC* Manual *on Distributed Energy Resources Rate Design and Compensation*, at 98-116, https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0.

[38] *Assembly Bill No. 405 (SB 405)* (June 15, 2017), https://www.leg.state.nv.us/Session/79th2017/Bills/AB/AB405_EN.pdf.

[39] State of Nev. Pub. Utils. Comm'n, *Net Metering*, http://puc.nv.gov/Renewable_Energy/Net_Metering/.

[40] N.H. Office of Strategic Initiatives, *New Hampshire 10-Year State Energy Strategy* (Apr. 2018), at 8, https://www.nh.gov/osi/energy/programs/documents/energy-strategy.pdf.

[41] *Id.* at 37. *See also* State of New Hampshire Public Utilities Commission, DE 16-576, *Development of New Alternative Net Metering Tariffs and/or Other Regulatory Mechanisms and Tariffs for Customer-Generators, Order Accepting Settlement Provisions, Resolving Settlement Issues, and Adopting a New Alternative Net Metering Tariff*, Order No. 26,029 (June 23, 2017), https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/ORDERS/16-576_2017-06-23_ORDER_26029.PDF.

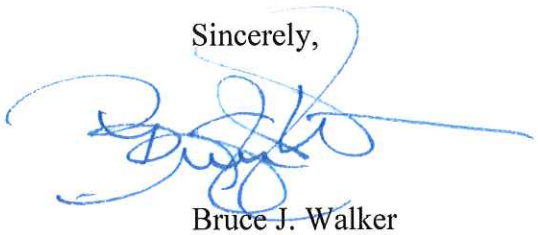
[42] ICF Review, *supra* n.3, at 27.

systems up to 150 kW may apply online; and systems greater than 150 kW must make a filing for the certificate.[43]

7. *DOE recognizes that the line between State and Federal jurisdiction over net metering transactions could shift.* Under the Federal Power Act (FPA), FERC has exclusive jurisdiction over wholesale sales of electric power, while states have jurisdiction over retail sales. Nevertheless, in two Commission opinions pertaining to particular parties, FERC determined that there is no wholesale sale within the meaning of the FPA unless the retail customer with on-premises generation is a *net* supplier of energy to the utility within the state retail billing period (usually one month). *See MidAmerican Energy Co.*, 94 FERC ¶ 61,340 (2001); *Sun Edison LLC*, 129 FERC ¶ 61,146 (2009). The Commission justified this determination on prior rulings involving the opposite situation: when a generator consumes energy from the grid from "station power" use in some hours, but has a net sale to grid over a monthly billing period. However, two D.C. Circuit Court of Appeals cases have since rejected FERC's station power netting theory. *See S. Cal. Edison Co. v. FERC*, 603 F.3d 996 (D.C. Cir. 2010); *Calpine Corp. v. FERC*, 702 F.3d 41 (D.C. Cir. 2012). In both cases, the court held that netting within a billing period cannot be the determining factor for whether a sale has taken place. FERC's attempts, therefore, in its net metering decisions to disclaim jurisdiction over net metering transactions on the theory that no sale has taken place, could be challenged and overturned.

   Regardless of whether states or FERC regulate net metering, DOE strongly urges that the appropriate regulatory bodies ensure that net metering rates are just and reasonable and do not discriminate by shifting costs from net metering customers to low-income and other non-net metering customers as mentioned in designated paragraph 2 above. Also, DOE strongly urges states to ensure that deployments will be designed and located so as to enhance the resilience and reliability of local and regional grids.

Sincerely,



Bruce J. Walker
Assistant Secretary
Office of Electricity

Enclosure

[43] *See* Vt. Pub. Util. Comm'n, Rule 5.100, https://puc.vermont.gov/sites/psbnew/files/doc_library/5100-PUC-nm-effective-07-01-2017_0.pdf.

Department of Energy
Washington, DC 20585

February 21, 2019

The Honorable Mike Simpson
Ranking Member
Subcommittee on Energy and Water Development
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Congressman Simpson:

This letter report provides findings in response to legislative language set forth in Senate Report No. 114-236, 114th Cong., 1st Sess. dated Apr. 14, 2016 which asked the Department of Energy (DOE) to conduct a study that would "determine the costs and benefits of net metering and distributed solar generation to the electrical grid, utilities, and ratepayers."

For the purposes of this report, net energy metering (NEM) is:

> "service to an electric consumer under which electric energy generated by that consumer from an eligible on-site generating facility [*e.g.*, a rooftop photovoltaic array] and delivered to the local [electric] distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period."[1]

After reviewing responses to DOE's public Request for Information (RFI) on NEM,[2] 15 recent NEM-related cost-benefit studies,[3] and other NEM-related literature, we have come to a number of conclusions:

1. *NEM was widely adopted by states[4] as a simple way to reimburse solar customer/generators who feed their excess electricity into the grid.* When most NEM

[1] 16 USC 2621(d)(11) This definition is drawn from the definition of "net metering service" at section 111(d)(11) of the Public Utility Regulatory Policies Act of 1978 (as amended by section 1251 of the Energy Policy Act of 2005), codified at 16 U.S.C. § 2621(d)(11).
[2] Comments received in response to the RFI can be accessed at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.
[3] *See* ICF, *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar*, May 2018 (ICF Review).
[4] As of November 2017, 38 states plus the District of Columbia had adopted some form of mandatory NEM rules for electric utilities. (*See* http://www.dsireusa.org/) However, many of these states have subsequently modified their rules substantially, and some have dropped NEM altogether in favor of an alternative approach. See Tom Stanton, "NEM 2.0 and Successor Tariffs: Which States are Doing What?" National

plans were first adopted, residential photovoltaic technology costs were high and its market penetration was minimal. Since then costs have fallen, and distributed market penetration is approaching 1% of retail sales. However, market penetration varies strongly by location. In 2016, only California and Hawaii had residential small-scale solar PV generation exceeding 3 percent of residential retail sales, and the majority of states were around 1 percent or less.[5] Nevertheless, NEM program caps are being approached or exceeded in several states, which often triggers requirements for program reviews.[6] Across the residential, commercial, and industrial sectors, the U.S. Energy Information Administration (EIA) estimates that growth will continue. By 2030, total market penetration could reach 2.6% of retail sales,[7] and could be significantly higher in certain locations.

2. *Multiple studies have found that basic NEM tariffs (paying solar customers at retail rate for electricity sent to the grid) results in cost-shifting between non-solar customers and solar customers.*[8] The vast majority of retail rate design has been based on volumetric rates that attempt to recover energy costs as well as fixed and demand costs (generation, transmission, and distribution) within the volumetric rate, rather than by disaggregating fixed and variable costs. With NEM tariffs, solar customers continue to receive fixed-cost services, but may avoid paying part of the costs of those services if fixed and volumetric energy costs are not disaggregated. When customers reduce volumetric payments and are not charged for fixed costs under standard rate design (either due to solar, storage, or efficiency measures), other customers that continue to pay full volumetric costs may bear a disproportionate share of costs for service. One study reviewed twelve available estimates and found that subsidies to net metering customers range from $444 to $1752 per year.[9] Less affluent customers who cannot afford rooftop solar or do not own residences frequently cross-subsidize more affluent customers.[10] It is, however, unclear at what point this cost shifting would result in significant impacts on retail rates. One study indicated for the majority of states and utilities, the effects of distributed solar on retail electricity prices will likely remain negligible for the foreseeable future.[11]

3. *Basic NEM tariffs do not provide effective incentives for solar customers to maximize the value of the electricity they generate.* NEM gives solar customers the incentive to

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[5] Energy Information Admin. (EIA), *Electric Power Annual 2016.*
[6] Stanton, *supra*, n.4, at 5.
[7] EIA, *Annual Energy Outlook 2018*, tables 8 & 16.
[8] *See, e.g.*, Energy Environment Economics, Inc., *California Net Energy Metering Ratepayer Impacts Evaluation* (Oct. 2013); California Public Utilities Commission Office of the Ratepayer Advocates *Proposal of the Office of Ratepayer Advocates for Net Energy Metering Successor Standard Contract or Tariff* (July 10, 2014).
[9] Barbara Alexander *et al.*, "Rethinking Rationale for Net Metering: Quantifying Subsidy from Non-Solar Customers," Pub. Util. Fortnightly (Oct. 2016.).
[10] See, *e.g.*, *California Net Energy Metering Ratepayer Impacts Evaluation, supra* n.8; Severin Borenstein, *Private Net Benefits of Residential Solar PV: The Role of Electricity Tariffs, Tax and Rebates,* 4 JJ. of the Ass'n. of Envtl. & Resource Economists, no. S1 (Sept. 2017).
[11] Galen Barbose, *Putting the Potential Rate Impacts of Distributed Solar into Context,* Lawrence Berkeley Nat'l Laboratory, at 10-11 (Jan. 2017).

produce as much electricity as possible, regardless of the time and location value of the electricity generated or the need of the electric grid for the electricity.[12]

The value of electricity varies over the course the day as demand varies and as different generation sources are used. As demand increases through the typical day, electricity generators bring more and more expensive generation online and meet higher amounts of demand. Generally speaking, peak electricity demand is the most expensive and valuable electricity during the day.

Volumetric rates do not provide price incentives to avoid electricity consumption when electricity is expensive to produce. Instead of providing price incentives to produce electricity when electricity is the most valuable, NEM provides the same rate throughout the day as incentive for rooftop solar generators. This means that no matter how cheap or how expensive the electricity, the NEM customer is paid the same amount. This does not create incentives for NEM customers to help meet system peaks or economize the electrical generation system. This results in sub-optimal location of solar panels and a lack of incentives for solar customers to purchase batteries.

4. *NEM-based PV programs can also have significant operational impacts at the utility or grid level as its penetration increases.* Because NEM-based PV programs may do little to guide the timing, size, or location of the development of distributed PV capacity, they can lead to unstable electricity flows on affected distribution circuits and trigger the need for new utility investments in distribution controls.[13] However, the implementation of new IEEE 1547-2018 standards may mitigate some of these impacts by standardizing grid-support services.[14] Proponents of NEM-based PV acknowledge that such impacts may occur but argue that its deployment results in total benefits to ratepayers and society that exceed its costs.[15]

   NEM-based PV programs can also contribute to area-wide grid management challenges, such as the steep "ramps" in net electricity demand that occur late

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[12] This raises the possibility that a NEM-based generation array could be sized much larger than required to serve the owner's electricity requirements. FERC has sought to prevent such outcomes, however, by ruling that it would assert jurisdiction over the rate for such sales "if the end-use customer participating in the net metering program produces more energy than it needs over the applicable billing period, and thus is considered to have made a net sale of energy to a utility." *Sun Edison LLC*, FERC Docket No. EL09-31-000, 129 FERC ¶ 61,146 at P 18 (2009).

[13] Nat'l Ass'n of Regulatory Util. Comm'rs, *Distributed Energy Resources Rate Design and Compensation Manual*, at 131.

[14] Re IEEE 1547-2018, s*ee* IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (IEEE Standard 1547-2018), available at https://standards.ieee.org/standard/1547-2018.html.

[15] *See, e.g.*, *Sunrun Comments in Response to US Department of Energy Request for Information on Net Metering Cost-Benefit Studies* and *Comments of Joint Solar Parties in Response to DOE Request for Information*, Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), both available at https://www.federalregister.gov/documents/2017/09/15/2017-19647/costs-and-benefits-of-net-energy-metering-request-for-information.

afternoons on many days in California, when solar output tapers off while peak demand is still increasing due to warm temperatures and customers coming home at the end of their work day. These ramps require the California Independent System Operator (CAISO) and utilities to bring very large amounts of conventional generation capacity into operation very quickly and may lead to thermal stress that shortens the operating life of the affected generation units.

5. *Distributed solar generation can provide a number of important benefits.* Figure 1 below shows 18 different value categories identified in recent cost-benefit studies. Some of the value categories are an attribute of distributed energy resources, while others such as avoided environmental costs are true of distributed solar as well as utility-scale solar.

   One of the most important points about these different value categories is that the magnitudes of the values are very location specific. As the Joint Solar Parties note in their comment on the RFI, "[i]t is important to emphasize that the results of benefit-cost studies are highly dependent on the specific facts, including the utility's rate and rate design, [Distributed Energy Resource (DER)] penetration levels, and existing and planned grid conditions."[16]

   For example, distributed solar in a highly constrained urban center may delay the need for infrastructure investment. Alternatively, if a feeder is near capacity, increased distributed solar on the feeder may necessitate infrastructure investments.[17] The location and context is critical in considering various costs and benefits of NEM and distributed solar generation.

   Figure 1. Value categories included in 15 recent studies.[18]

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[16] *Comments of Joint Solar Parties in Response to DOE Request for Information,* Docket No. EERE-2017-OT-0056 (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0062.

[17] *See, e.g.*, Am. Pub. Power Ass'n, *RE: Costs and Benefits of Net Energy Metering: Request for Information* (Oct. (Oct. 30, 2017), https://www.regulations.gov/document?D=EERE-2017-OT-0056-0033.

[18] Source of this table is ICF Review, *supra* n.3, at ii. In the left-most column, G = Generation, T = Transmission, D = Distribution, C = Costs, and S = Societal.

		Arkansas - Crossborder Energy 2017	Nevada - E3 2016	Louisiana - Acadian Consulting Group 2015	South Carolina - E3 2015	Mississippi - Synapse 2014	Vermont - VT Public Service Dept 2014	Washington DC - Synapse 2017	Georgia - Southern Company 2017	Hawaii - Clean Power Research 2015	Maine - Clean Power Research 2015	Oregon - Clean Power Research 2015	Minnesota - Clean Power Research 2015	Utah - Clean Power Research 2014	New York - NYBCA Framework 2016 + VDER	California - LNBA Framework 2016	Total
Utility System Impacts																	
G	Avoided Energy Generation	•	•	•	•	•	•	o	o	•	o	o	•	o	o		15
	Avoided Generation Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Environmental Compliance	•	•			•	•	•	o		•	o		•		o	10
	Fuel Hedging	•			•	•		•		o	•	o	•	•			9
	Market Price Response	•					•	•		o	•				o		6
	Ancillary Services		•		•	o		o	o	o					o	o	8
T	Avoided Transmission Capacity	•	•	•	•	•	•	•	o	o	•	o	o	•	o	o	15
	Avoided Line Losses	•	•		•	•	•	•	o			o		•	o	o	11
D	Avoided Distribution Capacity	•	•	•	•	•	•	•		o	o	o	o	•	o	o	14
	Avoided Resiliency & Reliability	o				o		o							o	o	5
	Distribution O&M			•					o						o	o	4
	Distribution Voltage and Power Quality									o	o	o	o		o	o	6
C	Integration Costs	•	•	•	•	o		•	o	o	•	o	o		o	o	13
	Lost Utility Revenues	•	•	•	•	•	•								o		7
	Program and Administrative Costs		•	•	•	•	•	o							o		7
Societal Impacts																	
S	Avoided Cost of Carbon	•					•	•		o	•		o		o	o	8
	Other Avoided Environmental Costs	•	•			o		o		o	•		o		o	o	9
	Local Economic Benefit	•				o		o									3

Included	•
Included/represented in another category	•
Discussed but not monetized/quantified	o
For NY, included in VDER Phase One	o

6. *As a result of the impacts noted above as well as other impacts, many states have either phased out "NEM 1.0" in favor of one or another NEM-successor regulatory approach or framework, or are considering such actions.* There are many alternatives. Some states are exploring the use of valuation methodologies based on a calculation of system costs and benefits, which can be used to inform ratemaking processes aimed at moving beyond NEM. Such calculations are examined in the *Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar* (enclosed), which includes examples from 15 states. Other states have taken or are considering regulatory actions to modify NEM-based compensation schemes using a range of approaches. Examples of such approaches by nine states are discussed below to illustrate their diversity and the range of challenges they address. These examples, however, are not intended to be either representative or exhaustive. The states are listed below in alphabetical order.[19]

Arizona. In 2014, the Arizona Corporation Commission (ACC) became concerned that under its existing NEM rule, customer-generators could obtain multi-year contracts for the sale of electricity to the utility, and that given the prospects for

[19] The legislative language to which this report responds can be understood to cover NEM plans adopted by local, tribal, and territorial governmental entities, as well as those adopted by states. The examples discussed above pertain only to states. However, it is unlikely that broadening the scope to include local, tribal, and territorial governmental entities would appreciably change the conclusions.

continuing reductions in the cost of PV technology and other possible changes in electricity markets (*e.g.*, fuel price changes), such contracts could easily become well above-market years before their expiration – at the expense of other customers.

In December 2016, the ACC voted to replace net metering with a net billing approach that would compensate customers for excess energy exported to the grid at an adjustable avoided cost rate.[20] The ACC decided that relying on an easily-updated historical proxy to set the rate would yield more realistic results than basing the rate on long-term projections of avoided costs. The new avoided cost rate is to be determined in each utility's rate case, using a proxy based on a weighted average of the price of electricity from utility-scale solar resources brought online by the utility during the preceding five years.

California. In 2016, California's total PV penetration (including utility-scale systems) reached an estimated 9 percent.[21] In 2014, the California Public Utilities Commission (CPUC) initiated a reconsideration of the then-existing NEM rule, with several objectives: It sought to align NEM customer costs more closely with non-NEM customer costs; support customers' transition to time-of-use rates for electricity purchased from state-regulated utilities; make programs for customer-owned PV systems available to disadvantaged communities and residents of multi-family buildings; and provide addition protection measures for customers participating in NEM-related programs.

On July 1, 2017, the CPUC adopted a net metering successor tariff that links the rates for customer-generators' electricity purchases from, and sales to, their local utility to the changing wholesale prices of electricity. Under the new tariff, new customer-PV generators will pay:

- A one-time interconnection fee, estimated at $75-$150;

- Several small non-bypassable per-kilowatt-hour (kWh) charges on electricity consumed from the grid (~$0.02-0.03/kWh), to cover utilities' public-purpose programs, nuclear decommissioning costs, transition-to-competition costs, and the costs of certain Department of Water Resources bonds; and

- A time-of-use rate for electricity consumed from the grid.[22]

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[20] Ariz. Corp. Comm'n, *Commission Passes Historic Decision to Protect Solar Interests and Provide Equity for all Customers* (Dec. 21, 2016), http://www.azcc.gov/Divisions/Administration/news/2016Releases/12-21-2016%20Value%20and%20Cost%20of%20Solar%20decision.pdf.

[21] ICF Review, *supra* n.3, at 34.

[22] Cal. Pub. Utils. Comm'n, *Net Energy Metering (NEM)*, http://www.cpuc.ca.gov/General.aspx?id=3800.

As before, customer-generators are paid for exports to the grid at the same price per kWh charged for retail sales – but now the price varies, depending on the time-of-use rate applicable at the time the export occurs.

This regime is likely to evolve further over the next few years. The CPUC plans to review the NEM successor tariff in 2019 and explore compensation structures other than NEM, and to consider an export compensation rate that takes into account locational and time-differentiated values.[23]

In a parallel effort, the CPUC is developing a framework for valuing the diverse costs and benefits associated with the deployment of multiple DERs (including distributed PV), taking into account potential synergies offered by some combinations of DERs, and that the impacts of a given DER asset can vary greatly depending on where it is located in a given distribution system.[24]

Hawaii. In 2014, the state's electricity regulators initiated a proceeding to investigate its NEM and DER policies, after finding that "high distributed PV penetration levels and remuneration rates [had] contributed to the increase in technical and financial issues for utilities."[25] (In 2016, Hawaii's estimated PV penetration was 22 percent.[26]) In October 2015, the Hawaii PUC voted to end net metering for PV in favor of two alternative options: a customer grid-supply (CGS) option and a self-supply option.[27] Under the grid-supply option, eligible customers receive credits on their electric bills for excess electricity sent to the grid or energy delivered by the utility to the customer-generator, whichever is less, at a fixed rate approved by the PUC through October 20, 2022.[28] The fixed rate ranges from $0.15/kWh - $0.28/kWh, depending on the island where the PV asset is located. The self-supply option is for PV customers that do not export power and provides expedited review and approval for interconnection.[29]

In October 2017, as the grid-supply program reached capacity, the PUC approved a successor program known as "CGS+," which compensates PV customers with required grid support equipment for export at fixed rates, and a similar "smart export" program for customers with PV and battery storage.[30] The Hawaiian Electric

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[23] Cal. Pub. Utils. Comm'n,, *Net Energy Metering Rulemaking (R.14-07-002).* Available at: http://www.cpuc.ca.gov/general.aspx?id=3934.

[24] *See* Juliet Homer *et al.*, *State Engagement in Electric Distribution System Planning* (Dec. 2017), http://eta-publications.lbl.gov/sites/default/files/state_engagement_in_dsp_final_rev2.pdf.

[25] *Id.* at 2.1.

[26] ICF Review, *supra* n.3, at 27.

[27] *In the Matter of Public Utilities Commission Instituting a Proceeding to Investigate Distributed Energy Resource Policies Docket No. 2014-0192, Decision Order No. 33258.* (Oct. 12, 2015), https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A15J13B15422F90464.

[28] *Hawaiian Electric, Customer Grid-Supply,* https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-renewable-programs/customer-grid-supply.

[29] *Id.*

[30] Hawaii Pub. Utils. Comm'n, *HPUC Expands Options for Customers to Install Rooftop Solar and Energy Storage* (Oct. 20, 2017),

Company said the Commission "approved these new rooftop PV programs to support the continued growth of rooftop PV and ensure safe, reliable service and fair treatment for all customers. The decision is the result of the PUC's effort to develop long-term technical and policy solutions that will support the continued growth of rooftop PV in Hawaii."[31]

Indiana. Indiana Senate Bill 309, enacted in May 2017, gradually reduces the rate paid to net metering customers and phases out retail rate net metering by July 1, 2022 (or when customer-owned PV reached 1.5 percent of an affected utility's peak summer load, whichever is earlier). New distributed generation compensation arrangements will be set through individual utility ratemaking proceedings. However, the new rate(s) must equal 1.25 x the average wholesale price paid by the utility for electricity.[32]

Maine. The state's estimated PV penetration in 2016 was 1 percent,[33] triggering a requirement to review the state's NEM rule. In March 2017, the Maine PUC issued an order replacing net metering with a "buy-all, sell-all" compensation structure, which treats customer-owned electricity production and consumption separately, and gradually reduces the rate utilities pay for electricity produced by customer-generators. Under this rate structure, instead of offsetting electric usage, customers sell to the utility all of the solar energy they generate at one rate and buy all the energy they consume from the utility at a higher rate. Existing customers with systems installed before 2018 may stay on the old structure for up to 15 years.[34]

Massachusetts. In 2016, the state legislature enacted bipartisan legislation to amend Massachusetts' net metering law. The objectives were to enable "the continued support of solar power generation and a transition to a stable and equitable solar market at a reasonable cost to ratepayers" and the new law directed utilities to calculate "market net metering credits" at approximately 60 percent of previous rates.[35] In January 2018, the Massachusetts Department of Public Utilities (DPU) approved "demand charges" for net metering customers of Eversource utilities operating in the state, and eliminated optional time-of-use rates for residential customers.[36] The DPU's adoption of demand charges for residential customer-generators is innovative. Utilities must maintain the physical capacity to deliver

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https://www.hawaiianelectric.com/Documents/clean_energy_hawaii/producing_clean_energy/20171020_hawaii_PUC_rooftop_solar_and_storage_press_release.pdf.

[31] https://www.mauielectric.com/customer-service/frequently-asked-questions?SortBy=&page=2.

[32] *Senate Enrolled Act No. 309: An Act to amend the Indiana Code concerning utilities*, https://iga.in.gov/static-documents/7/d/0/3/7d037e18/SB0309.05.ENRH.pdf.

[33] ICF, *op. cit.*, at 27.

[34] Nat'l Renewable Energy Lab, *Midmarket Solar Policies in the United States: Maine*, https://www.nrel.gov/solar/rps/me.html.

[35] Commonwealth of Mass., Session Laws, Acts (2016), Chapter 75, *An Act Relative to Solar Energy* (Apr. 11, 2016), https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter75.

[36] Commonwealth of Mass. Dep't of Pub. Utils., D.P.U. 17-05-B, Order Establishing Eversource's Rate Structure (Jan. 5, 2018), https://eeaonline.eea.state.ma.us/EEA/FileService/FileService.Api/file/FileRoom/9170110.

electricity to a given customer at the customer's maximum level of demand, even though the customer may require significantly less electricity during most of the hours in a given period. With the approval of state regulators, many utilities have long included demand charges as a component of the rates paid by commercial and industrial customers, but such charges have seldom been used for residential customers. In recent years, some utilities and states (such as Massachusetts) have considered or adopted demand charges for some residential customers, particularly customers with widely fluctuating electricity demand, such as customer-generators.[37]

Nevada. A state law, AB 405, reaffirmed net metering for PV systems up to 25 kilowatts (kW) in capacity.[38] Under the new rules, the first 80 MW of new net metered systems will have monthly generation and consumption netted, and any remaining excess generation will be credited at 95 percent of the retail rate. The latter rate will decline by 7 percent for every additional 80 MW, to a floor of 75 percent of the retail rate. For customer-owned non-PV systems up to 25 kW, exported generation is credited at the avoided cost rate.[39]

New Hampshire. The state's Office of Strategic Initiatives released a 10-year energy strategy on April 17, 2018. The New Hampshire Public Utilities Commission will work with stakeholders to collect data and other inputs concerning the impacts of net metering, implement pilot programs, and produce a DER valuation study. The Commission will also open a new proceeding in which it will revisit its existing NEM rule. The considerations of concern in the development of the new rule include the need "to provide predictability to stakeholders, protect investments made by all stakeholders, and avoid cost-shifting among ratepayers."[40] Additionally, "[a]ll existing net metered systems are grandfathered through 2040 at current rates."[41]

Vermont. In 2016, Vermont's PV penetration reached an estimated 6 percent.[42] Effective January 1, 2017, any electric customer in Vermont qualifies for net metering after obtaining a Certificate of Public Good from the Vermont Public Service Board (PSB). Solar systems 15 kW or less follow an expedited process;

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[37] For a detailed discussion of demand charges, *see* Nat'l Ass'n of Regulatory Util. Comm'rs, *NARUC* Manual *on Distributed Energy Resources Rate Design and Compensation*, at 98-116, https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0.

[38] *Assembly Bill No. 405 (SB 405)* (June 15, 2017), https://www.leg.state.nv.us/Session/79th2017/Bills/AB/AB405_EN.pdf.

[39] State of Nev. Pub. Utils. Comm'n, *Net Metering*, http://puc.nv.gov/Renewable_Energy/Net_Metering/.

[40] N.H. Office of Strategic Initiatives, *New Hampshire 10-Year State Energy Strategy* (Apr. 2018), at 8, https://www.nh.gov/osi/energy/programs/documents/energy-strategy.pdf.

[41] *Id.* at 37. *See also* State of New Hampshire Public Utilities Commission, DE 16-576, *Development of New Alternative Net Metering Tariffs and/or Other Regulatory Mechanisms and Tariffs for Customer-Generators, Order Accepting Settlement Provisions, Resolving Settlement Issues, and Adopting a New Alternative Net Metering Tariff*, Order No. 26,029 (June 23, 2017), https://www.puc.nh.gov/Regulatory/Docketbk/2016/16-576/ORDERS/16-576_2017-06-23_ORDER_26029.PDF.

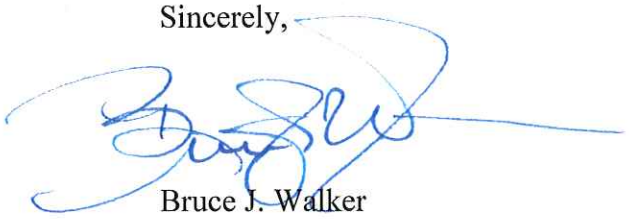
[42] ICF Review, *supra* n.3, at 27.

systems up to 150 kW may apply online; and systems greater than 150 kW must make a filing for the certificate.[43]

7. *DOE recognizes that the line between State and Federal jurisdiction over net metering transactions could shift.* Under the Federal Power Act (FPA), FERC has exclusive jurisdiction over wholesale sales of electric power, while states have jurisdiction over retail sales. Nevertheless, in two Commission opinions pertaining to particular parties, FERC determined that there is no wholesale sale within the meaning of the FPA unless the retail customer with on-premises generation is a *net* supplier of energy to the utility within the state retail billing period (usually one month). *See MidAmerican Energy Co.*, 94 FERC ¶ 61,340 (2001); *Sun Edison LLC*, 129 FERC ¶ 61,146 (2009). The Commission justified this determination on prior rulings involving the opposite situation: when a generator consumes energy from the grid from "station power" use in some hours, but has a net sale to grid over a monthly billing period. However, two D.C. Circuit Court of Appeals cases have since rejected FERC's station power netting theory. *See S. Cal. Edison Co. v. FERC*, 603 F.3d 996 (D.C. Cir. 2010); *Calpine Corp. v. FERC*, 702 F.3d 41 (D.C. Cir. 2012). In both cases, the court held that netting within a billing period cannot be the determining factor for whether a sale has taken place. FERC's attempts, therefore, in its net metering decisions to disclaim jurisdiction over net metering transactions on the theory that no sale has taken place, could be challenged and overturned.

   Regardless of whether states or FERC regulate net metering, DOE strongly urges that the appropriate regulatory bodies ensure that net metering rates are just and reasonable and do not discriminate by shifting costs from net metering customers to low-income and other non-net metering customers as mentioned in designated paragraph 2 above. Also, DOE strongly urges states to ensure that deployments will be designed and located so as to enhance the resilience and reliability of local and regional grids.

Sincerely,



Bruce J. Walker
Assistant Secretary
Office of Electricity

Enclosure

[43] *See* Vt. Pub. Util. Comm'n, Rule 5.100, https://puc.vermont.gov/sites/psbnew/files/doc_library/5100-PUC-nm-effective-07-01-2017_0.pdf.