PRICING RETAIL ELECTRICITY IN A DISTRIBUTED ENERGY RESOURCES WORLD

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The traditional integrated electric utility model in the U.S. (and elsewhere) is threatened by technological and institutional developments triggered by substantial public policy support for renewable energy. Partly as a result of this support, the costs of distributed renewable energy have been falling to a level at which these resources promise to become competitive with large power stations, even without continuing public subsidies. This cost-competitiveness will put downward pressure on the values of large power stations and on the transmission and distribution infrastructure that brings their power to consumers.

Part of the threat to the traditional model arises from antiquated retail pricing methods that fail to accurately match the prices and structures of retail power services with the costs and cost causation of those services. The inaccuracies of these old methods have always led to cross-subsidies among electricity consumers; but the cross-subsidies were sustainable only as long as consumers were dependent upon the power grid for virtually all of their power. As distributed energy resources (DER), including distributed generation and demand response, gain larger market shares, however, these cross-subsidies will shift larger and larger shares of costs toward those consumers who do not have their own DER and will incent new forms of uneconomic behavior by consumers, particularly including investment in DER that is expensive relative to other available resources.

Utilities are beginning to fight the most egregious mispricing of retail power services, particularly as manifested in the net metering rules of the large majority of states. Unfortunately, however, some utilities propose that DER be subject to special charges when the correct remedy is to instead reform the existing pricing structure.

The purpose of this paper is to describe the principles and elements of a retail pricing structure that can be applied to all electricity consumers regardless of whether they have their own DER and regardless of whether they have aggregated themselves with other consumers in a microgrid or independent distribution system operator arrangement. The basic principle is that the costs incurred by a utility depend solely upon the power flows that a consumer, or group of consumers, imposes or can reasonably be expected to impose upon the utility's power system. Aside from the effects of such power flows, what goes on behind the meter, including whatever DER technologies that the consumer may or may not have, is literally none of the utility's business.

1. DRIVERS OF CHANGE

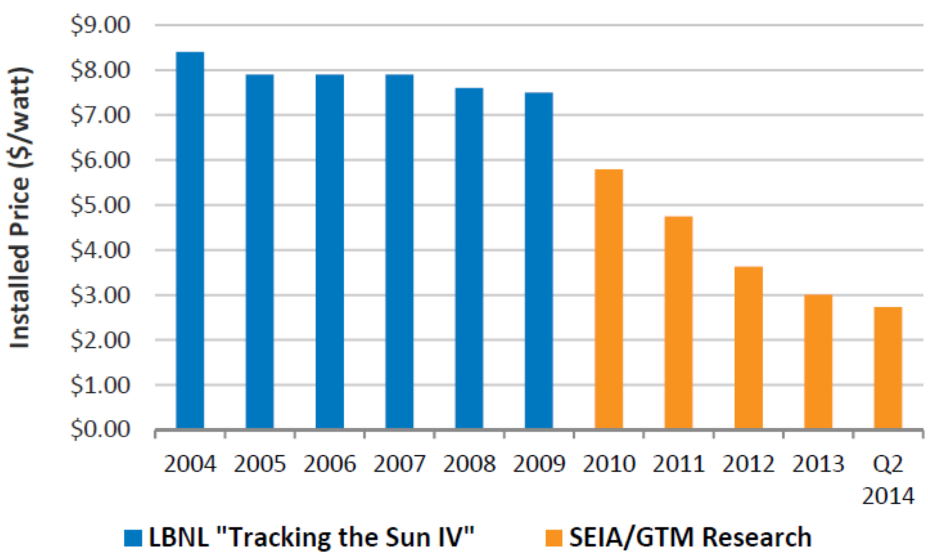
Change in the traditional regulated utility business model is being driven by the falling costs of DER and of the information technologies that promise to allow DER to be inexpensively integrated with the power system's other resources. This technological progress has been abetted by public policies in support of DER. Consequently, there has been growing worldwide use of on-site distributed generation, particularly solar photovoltaic (PV) systems. The prospect of further cost reductions promises continuation or acceleration of these trends in DER development.

1.1. Distributed Energy Resources

Investment in DER has historically been driven primarily by tax incentives and other public policies in support of renewable energy. Increasingly, however, such investment is being driven by the falling costs of DER relative to both conventional resources and retail electricity prices. In addition, DER investment is increasingly driven by some customers' needs for highly reliable electricity service and for exceptionally high power quality.

Solar power has enjoyed remarkable growth over the past decade, with capacity in the U.S. more than doubling every two years since 2006.[1] This rapid growth has been partly or largely driven by the dramatic downward trend in the cost of PV over the past decade, which is shown in Figure 1.

Figure 1
Average PV System Prices, 2004-2014 (nominal $)[2]



Demand response has grown substantially over the past few decades. As shown in Figure 2, reported potential peak load reductions have more than doubled during the 2006 to 2012 period.

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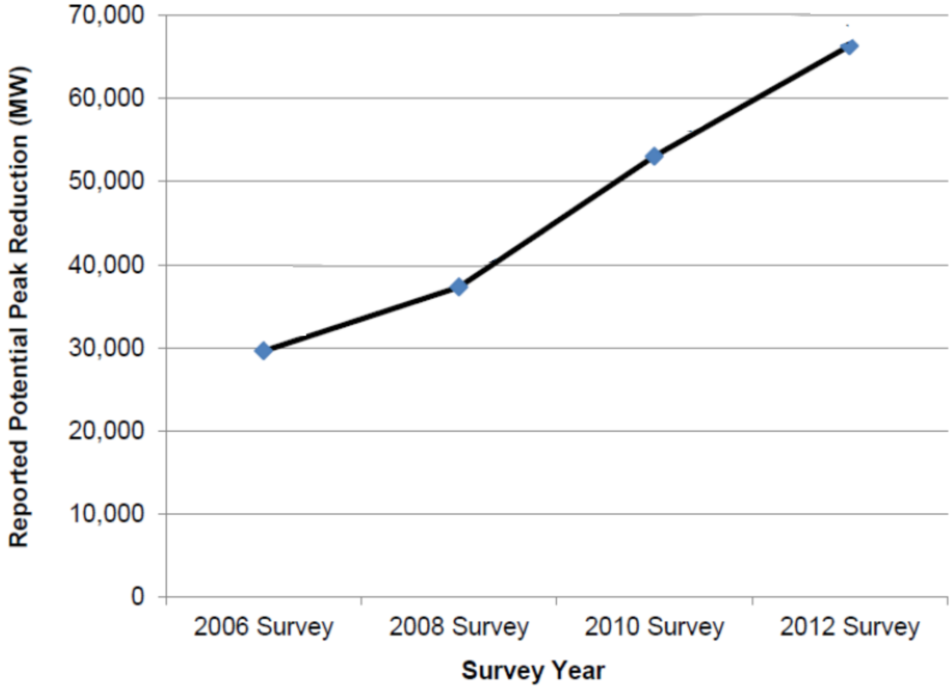
[1] Solar Energy Industry Association, *Solar Energy Facts: Q2 2014*, September 22, 2014, obtained at http://www.seia.org/research-resources/solar-industry-data.

[2] *Id*.

Figure 2
Total Reported Potential Peak Reduction due to Demand Response, 2006 through 2012[3]



Microturbines are small fossil fuel-fired electricity generators ranging in size from about 30 to 250 kW. They generally run on fossil fuels, but can also burn waste gases. Microturbines generally serve commercial customers, and can be incorporated into combined heat and power (CHP) systems for such customers.

Fuel cells generate electricity through chemical reactions that move electrons from a positive electrode to a negative electrode. Fuel cells generally run on hydrogen (or hydrogen-rich molecules) and oxygen gases, which provide environmentally benign energy. The efficiency and cost of this energy production depend upon the electrolytes and catalysts of the various fuel cell technologies. At the present time, these technologies are not yet cost-competitive with conventional generation.[4]

Electrical energy storage has historically been provided, on a fairly large scale, by hydroelectric facilities. Prospectively, it can also be provided, on a smaller scale, by batteries and innovative

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[3] Federal Energy Regulatory Commission, *Assessment of Demand Response & Advanced Metering*, Staff Report, December 2012, p. 23, http://www.ferc.gov/legal/staff-reports/12-20-12-demand-response.pdf.

[4] http://americanhistory.si.edu/fuelcells/basics.htm says "none [of the fuel cell technologies] is yet cheap and efficient enough to widely replace traditional ways of generating power." A more optimistic view is expressed by http://www.fuelcelltoday.com/about-fuel-cells/faq#9, which says "Technological developments are continually lowering the material and component cost of fuel cells and production is being ramped up and automated, allowing economies of scale to be realized."

technologies such as flywheels. Storage can be useful for facilitating integration into power systems of intermittent resources such as wind and solar, and for balancing electric supply and demand in small areas such as those served by microgrids. The gross value of the services provided by an energy storage facility primarily depends upon the differences in the values of electricity at those off-peak times when the facility is charged (that is, when it "buys" power) and those on-peak times when the facility is discharged (that is, when it "sells" power). It also depends upon the facility's capacity, which is the quantity of electrical energy that the facility can move from one time period to another. For a storage facility to provide a net profit to its owner and net benefits to the power system, its gross value based upon time differences in the value of electricity needs to exceed the facility's capital and operating costs. At the present time, these costs are high relative to peak-to-off-peak spreads in electrical energy prices.[5]

1.2. Microgrids

"A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid and that connects and disconnects from such grid to enable it to operate in both grid-connected or 'island' mode."[6] A microgrid is thus a small system of generators and loads operating within defined physical boundaries inside of a larger power grid. Although a microgrid should be able to operate either with or without the larger grid, it will generally operate in concert with the larger grid so that parties inside the microgrid can engage in cost-reducing power trades with parties in the larger grid. Power may thus flow into or out of a microgrid depending upon the net trades among parties. Nonetheless, microgrids' ability to operate without the larger grid may provide a higher level of reliability within microgrids than is available in the larger grid, as microgrids can separate from the larger grid when the latter faces emergency conditions.

Microgrid applications have included the following:

- rural electrification or grid support in areas with otherwise poor reliability;[7]
- federal government facilities;[8]

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[5] S. Cloete, "Seeking Consensus on the Internalized Costs of Energy Storage via Batteries," http://theenergycollective.com/schalk-cloete/421716/seeking-consensus-internalized-costs-energy-storage-batteries, July 10, 2014, says "battery storage is still about an order of magnitude from being economically viable given the price spreads available in wholesale electricity markets."

[6] DOE EERE, *Summary Report: 2012 DOE Microgrid Workshop*, Chicago, 2012; and T. Glenwright, *Introduction to Microgrids*, http://www.smartgrid-live.com/wp-content/uploads/2012/12/Introduction-to-Microgrids-by-Tristan-Glenwright.pdf, December 2012.

[7] For example, San Diego Gas & Electric has created a microgrid to manage the unusually high concentration of photovoltaic resources in relatively isolated Borrego Springs. See T. Bialek, *SDGE Borrego Springs Microgrid*, http://energy.gov/sites/prod/files/30_SDGE_Borrego_Springs_Microgrid.pdf, June 8, 2012.

[8] The microgrid installation at the new U.S. Food & Drug Administration headquarters site in Silver Spring, Maryland, includes several turbine generators capable of producing nearly 21 MW of power, which exceeds the site's electrical

- military installations;[9]
- universities;[10] and
- industries with needs for exceptionally reliable electricity service, such as hospitals and datacenters.[11]

Microgrids offer three sets of potential benefits to their participants. First, they may provide a greater level of reliability than is available on the larger power grid. Second, they may allow participants to substitute relatively inexpensive local resources for relatively expensive grid-supplied power. Third, they may be able to reduce participants' electricity expenditures by taking advantage of flaws in utilities' rate designs.

1.3. Independent Distribution System Operators

A *distribution system* is a distribution area bounded by specific interconnections to the transmission grid with no direct connections to any other distribution area. A *distribution system operator* (DSO) is an entity that has the responsibility to maintain safe, stable, reliable, and efficient operation of a distribution system and its interconnections with the transmission grid. Such operation must be consistent with engineering standards for voltages, phase balance, real and reactive power flows, and so forth.

Advances in technologies and changes in electricity institutions are driving a need for substantial changes in the operation of distribution systems. DER can cause power to flow from consumers toward the grid in addition to the traditional one-way flows from the grid to consumers, creating control problems that do not exist with traditional one-way flows. Intermittent DER adds to the operational problems of maintaining system stability, and increases the value of those ancillary services that help maintain stability and power balance. Computer technologies are increasing the feasibility of coordinating the actions of numerous DER owners and facilities. Markets for energy and ancillary services may allow price signals to help with such coordination.

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load. The facility was able to continue uninterrupted operations when Hurricane Irene hit in August 2011. See http://microgrid-news.com/projects.htm.

[9] See S.V. Broekhoven, N. Judson, S. Nguyen, and W. Ross, *Microgrid Study: Energy Security for DoD Installations*, Technical Report 1164, 2012; and S. Palley, "Hacker, Terrorist Threats Spur Bases to Build Power Grids: Military Worries About Facilities Being Linked to Vulnerable Utility Companies," *The Wall Street Journal*, October 21, 2014.

[10] Universities with microgrids include Cornell University, Illinois Institute of Technology in Chicago, IL, New York University at Washington Square Park, Santa Fe Community College in Santa Fe New Mexico, University of California at Riverside, University of California at Santa Cruz, Utica College, and Tohoku Fukushi University in Japan. According to C. Nelder, *Microgrids: A Utility's Best Friend or Worst Enemy*, http://www.greentechmedia.com/articles/read/microgrids-a-utilitys-best-friend-or-worst-enemy, Greentechgrid, May 23, 2013, there have been instances in which university microgrids have assisted utilities in restoring power systems after widespread blackouts.

[11] Z. Ye, R. Walling, N. Miller, P. Du, and K. Nelson, *Facility Microgrids*, National Renewable Energy Laboratory, 2005, http://www.nrel.gov/docs/fy05osti/38019.pdf.

Because of the federal-state jurisdictional divide between wholesale and retail electricity matters and because Regional Transmission Organizations (RTOs) have neither the data nor the authority to operate distribution systems, it is clear that RTOs will not serve as DSOs. Vertically integrated utilities *can* serve as DSOs, as they have for the past hundred years; but there has nonetheless been considerable discussion of non-utility entities serving as independent DSOs (IDSOs). If IDSOs have any consistent performance advantage over traditional utilities with respect to distribution system operations, that advantage would arise from market power considerations: utilities might have profit incentives to bias distribution system operations in favor of their own generation facilities, while IDSOs that have no generation ownership interests would lack such incentives. IDSOs could thus provide non-discriminatory distribution system access analogous to the non-discriminatory transmission system access provided by RTOs.

The IDSO concept has had some limited real-world applications. In Great Britain, there are seven IDSOs that "are mainly… serving new housing and commercial developments".[12] New York State is considering "the concept of the utility as a Distributed System Platform Provider (DSPP)",[13] which envisions "that DSPPs will balance demand and supply at the distribution system level, and also interface with the NYISO [New York Independent System Operator]."[14] Implementation of such a concept will require careful coordination of distribution- and transmission-level activities if balkanization of the grid is to be avoided.

2. PRICING ENERGY AND RESERVE SERVICES

In principle, the efficient prices of energy and reserve services (including regulating and operating reserves) equal the respective marginal costs of those services at each time and place. If all generators and all consumers received or paid these ideal prices, then the lowest-cost resources would provide electric power services at all times and consumers would use only that electricity that had value greater than marginal cost.

In the wholesale markets of the RTOs, the locational marginal prices (LMPs) of energy and the zonal prices of reserve services approximately achieve this ideal at the transmission level.[15] For regions not covered by RTOs, marginal costs of energy and reserve services can be derived from

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[12] https://www.ofgem.gov.uk/electricity/distribution-networks/connections-and-competition/independent-distribution-network-operators.

[13] State of New York Public Service Commission, Case 14-M-0101, *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, Order Instituting Proceeding, April 25, 2014, p. 11, http://www3.dps.ny.gov/W/PSCWeb.nsf/All/26BE8A93967E604785257CC40066B91A?OpenDocument.

[14] New York State Department of Public Service Staff, *Reforming The Energy Vision*, Case 14-M-0101, April 24, 2014, p. 44, http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/26be8a93967e604785257cc40066b91a/$FILE/ATTK0J3L.pdf/Reforming%20The%20Energy%20Vision%20%28REV%29%20REPORT%204.25.%2014.pdf.

[15] One reason this achievement is approximate (rather than exact) is because of discontinuities in the relationship between resource output levels and costs. Such discontinuities arise, for example, from resources' start-up and shut-down costs and from the minimum output levels of some resources. Another reason is that the zonal prices of reserve services may mask significant variations of marginal reserve costs within zones.

generation cost data available to system operators. While marginal costs are (or can be) available at the transmission level, they are not directly available at the distribution level at which most consumers and much DER is located. In the absence of congestion in distribution systems, distribution-level marginal costs can be derived from transmission-level marginal costs with adequate data on energy losses within distribution systems. The quantification of distribution congestion costs may be problematic, however, and is related to the problem, described below, of paying for distribution system infrastructure.

Computation difficulties aside, consumers and DER served by distribution systems should face energy and operating reserve prices that reasonably reflect the relevant transmission-level marginal costs. To the extent that parties served at the distribution level see such prices, they will have incentives to behave efficiently regardless of whether they are served by a utility, an IDSO, or a microgrid. If prices are closely aligned with marginal costs at the interface between a utility on the one hand and an IDSO or microgrid on the other, the utility will be financially indifferent to the efficiency of commitment and dispatch within the IDSO or microgrid: the benefits of efficient commitment and dispatch within the IDSO or microgrid will accrue to parties within those entities; and the utility need be concerned only with the cost and reliability impacts of the net flows into or out of the IDSO or microgrid.

3. PRICING DISTRIBUTION SERVICES

Distribution costs are related to the characteristics of the maximum power that the utility reasonably expects to flow over the distribution system. In traditional systems, power flowed one way, from the transmission system *toward* consumers. With DER, power can also flow *from* consumer locations within the distribution system. Thus, in a world with DER, the characteristics of the maximum power flows include the directions of those flows.

Distribution costs are mostly the capital costs of the facilities that provide distribution services. The costs of maintaining these facilities are generally unrelated to the flows through the facilities, but instead depend upon weather and upon the quantities, types, and ages of the facilities.

3.1. Recovering the Costs of Existing Facilities

Because distribution costs are related to the characteristics of maximum power flows, the costs of existing distribution facilities should be allocated among customers according to reasonable expectations of each of their maximum power flows. These may be determined by a number of methods:

- *Historical experience*. If the customer is demand-metered, the utility can reasonably expect that the customer will potentially use the distribution system in the future to the maximum extent that they have done so in the past. This implies that distribution charges may be based upon past and present (ratcheted) demand.
- *Customer facility power limits*. If a customer's facility is designed to allow the customer to consume a certain number of kW of power or to produce another number of kW of power, the utility may reasonably expect that the customer will potentially use the distribution system up to those design capabilities. This expectation needs to consider

the direction of flows and whether simultaneous consumption and production of power can dependably offset one another. The information used to implement this method needs to be updated over time to account for customers' occasional redesign of their facilities and for customers' changing use of their facilities.

- *Customer type*. For customers who are of a reasonably homogeneous type (e.g., apartment dwellers versus single-family homes, space-heating versus non-space heating), it may be reasonable to have standard expectations regarding the customer's use of the distribution system. The information used to implement this method needs to be updated over time to account for any significant changes in customers' uses of electricity.

For customers with self-generation or who are located within IDSOs or microgrids, what goes on behind-the-meter is none of the utility's business except to the extent that it affects (or can reasonably be expected to affect) flows through utility facilities. The utility may thus have an interest in the reliability of behind-the-meter generation because this reliability can affect the types and quantities of distribution infrastructure that the utility must provide to serve behind-the-meter loads when behind-the-meter generation fails.

Due to the diversity of loads and generation of the various parties within an IDSO or microgrid, the IDSO's or microgrid's payments for distribution service may be less than the sum of what the individual consumers within it might have otherwise paid the utility. In some cases, such as a microgrid high-rise apartment building, the diversity and the consequent savings may be small; while in other cases it may be significant. In all cases, the consumers within an IDSO or microgrid will bear some costs for the operation of the IDSO or microgrid, which will offset at least a part of the savings in utility distribution system charges.

3.2. Recovering the Costs of New Facilities

In a world with DER, the rules for determining the need for distribution system upgrades can be substantially the same as at present, with two main exceptions. First, additional upgrades will be required to deal with reverse flows from consumers toward the grid. The costs of distribution upgrades to deal with such reverse flows – and with potential generation overloads – are logically allocated to the owners of the generators who cause those reverse flows and potential overloads. Second, DER may create new low-cost dispatch options that can substitute for upgrades, in which event DER owners should earn compensation for their dispatch services, the costs of which will need to be recovered along with the costs of any upgrades.

The rules for distribution system access will depend upon the rules for determining the need for distribution system upgrades and for allocating upgrade costs. These rules, which will be developed through state regulatory proceedings, will generally guarantee access to consumers as at present and will provide access for DER according to DER owners' willingness to pay for necessary upgrades. It is likely that there will be some situations in which, as the distribution system reaches its load carrying capacity, queues will need to be established for DER seeking to interconnect with the power system.

In principle, customers should pay for their shares of the benefits of upgrades that are built on their behalf. Except for facilities that serve a single customer, these shares may be difficult to calculate and will surely differ from one situation to another. In particular, while it may be relatively easy to assign upgrade costs to customers who are near the locations of the upgraded facilities, customers at more distant locations may also benefit from the upgrades. To some extent, at least, engineering analysis can be used to identify the generators and loads that benefit from particular upgrades and to assign shares to those generators and loads. Nonetheless, the estimation process is subject to uncertainties and is complicated by the fact that the benefits of an upgrade will occur over its decades-long life, meaning that the beneficiaries will likely change over time and the benefits will depend upon uncertain future conditions.

In practice, regulators will be inclined to socialize the costs of the upgrades that serve small residential and commercial customers. The argument will be made that one group of such customers should not be forced to pay more for distribution service than is paid by similar groups of customers merely because one location requires upgrades while other locations do not.

To the extent that diversity of generation and loads within microgrids and IDSOs reduces the need for upgrades of a utility's distribution system, customers within microgrids and IDSOs may be spared some share of utility's upgrade costs.

4. NET METERING POLICIES

Net metering polices reward customers who have installed DER by implicitly or explicitly paying the full retail rate for energy provided by DER. Because full retail rates are designed to recover distribution costs as well as the costs of transmitting and generating energy, DER customers are in effect paid for providing distribution services that they do not, in fact, provide. In other words, DER customers escape a substantial share of their responsibility for the costs of the distribution infrastructure that is required to provide them with power and to receive their power. This is equivalent to DER customers receiving implicit payment for providing distribution infrastructure that they do not provide.

Net metering thus constitutes significant mispricing that creates serious efficiency and equity issues. As of late 2014, 43 states plus the District of Columbia have net metering policies. Of these, fourteen states plus the District of Columbia have policies that pay DER the full retail rate or higher without expiration; nineteen states pay DER at the retail rate for a limited period of time after which payments either expire or are reduced to avoided costs; and nine states have net metering prices set below retail rates (e.g., at utility avoided cost).[16]

Net metering polices will not be sustainable in the long term because their excessive payments to customers who have installed DER are financed through implicit taxes on retail customers who have not installed DER. Furthermore, evidence from California suggests that, because customers who install DER tend to be higher-income customers, the burden of paying net metering costs falls disproportionately on lower-income retail customers. Consequently, if this is generally the

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[16] North Carolina State University, North Carolina Clean Energy Technology Center, Database for State Incentives for Renewables & Efficiency, Summary Maps, Net Metering Policies, http://www.dsireusa.org/documents/summarymaps/net_metering_map.pdf.

case in other jurisdictions, net metering policies paying the full retail rate for DER energy are regressive, being generally available to and used by the well off, and placing additional cost burdens on customers less well off.[17]

4.1. Net Metering Reform – Legislative Initiatives

Utilities and state legislatures have begun to address the revenue and cost-shifting problems posed by net metering policies that credit DER at the full retail rate rather than at the avoided cost rate or wholesale market value of electricity.

Kansas legislation, for example, establishes a yearly expiration date for net metering credits for DER systems installed before July 1, 2014, and three tiers of net metering capacity limits for net metering systems installed after July 1, 2014. The legislation also allows utilities to develop new rate classes or tariffs for DER customers with systems installed after July 1, 2014.[18]

Oklahoma legislation (Senate Bill 1456) authorizes utilities to develop a new rate class for distributed generation customers to cover infrastructure costs, for DER installed after November 2014. The new rate class and any associated tariffs must be created by the end of 2015 and approved by the Oklahoma Corporation Commission. Oklahoma Governor Mary Fallin issued an executive order stating that the legislation provides utilities with an option, not a mandate, for implementing a tariff system for distributed generation.[19]

Utah legislation (Senate Bill 208)[20] requires the Public Service Commission and electric utilities to seek public comments on and to determine the costs and benefits of net metering programs. Following the outcome of the study, utilities may then be in a position to impose a charge, credit or ratemaking structure (including new or existing tariffs) for distributed generation.

4.2. Net Metering Reform – Regulatory Initiatives

Beginning in January 2014, the Arizona Corporation Commission has allowed Arizona Public Service Company (APS) to levy a charge for new rooftop solar panel installations connected to the electric grid through net metering. The charge amounts to $0.70/kW or about $4.90 per

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[17] These assertions are consistent with the findings of Energy+Environmental Economics, *California Net Energy Metering Ratepayer Impacts Evaluation*, prepared for California Public Utilities Commission, October 28, 2013, p. 11, which finds that DER customers have incomes averaging 34% higher than that of the average utility customer ($91,210 versus $67,821), http://www.cpuc.ca.gov/NR/rdonlyres/D74C5457-B6D9-40F4-8584-60D4AB756211/0/NEMReportwithAppendices.pdf.

[18] Legislature of the State of Kansas, Senate Substitute for House Bill 2101, July 1, 2014, http://kslegislature.org/li/b2013_14/measures/hb2101/ .

[19] Mary Fallin, Governor, Executive Department, *Executive Order 2014-07,* April 21, 2014, https://www.sos.ok.gov/documents/executive/938.pdf.

[20] State of Utah, S.B. 208, *Public Utility Modifications*, March 25, 2014, http://le.utah.gov/~2014/bills/static/SB0208.html

month for a typical residential solar roof top customer. The policy will be in effect until the next APS rate case, which will be in 2015.[21]

In March 2014, the Louisiana Public Service Commission agreed to an evaluation of the costs and benefits of distributed solar resources as part of its consideration of lifting the current implicit cap on net metering purchases of DER.[22] The cap was set at 0.5% of a utility's retail peak load. Currently, until that cap is reached, residential customers with DER producing less than 25 kW and commercial customers with DER systems that produce less than 300 kW can receive a retail rate credit for electricity produced but not consumed.[23] In light of the results of the cost-benefit study, due in November 2014, the Commission may initiate a proceeding to amend the current net metering policy.

In April 2014, the Minnesota Public Utilities Commission approved a Value of Solar (VOS) methodology for valuing electricity generated by distributed solar photovoltaic (PV) systems[24] This methodology is intended to accurately account for all relevant benefits and costs of PV electricity. Utilities have the option of replacing the net metering method of compensating PV owners with the VOS method. As of December 2014, no Minnesota utility had adopted the voluntary VOS tariff rate in lieu of net energy metering, choosing instead to continue compensating PV customers at the retail rate.

In December 2014, the Public Service Commission of Wisconsin approved a request from Wisconsin Electric Power Company (WEPCO) to restructure its distributed generation tariffs "for customers who own or operate electric generating facilities at their premises and that are used to offset some or all of their power requirements."[25] The revised tariffs credit DER customers for any energy sold to WEPCO based on LMPs in the markets operated by the Midcontinent Independent Transmission System Operator. DER customers would also be credited for any

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[21] Arizona Corporation Commission, *In the Matter of Arizona Public Service Company's Application for Approval of Net Metering Cost Shifting Solution*, Docket No. E-01345A-13-0248, Decision No. 74202, December 3, 2013, http://edocket.azcc.gov/Docket/DocketDetailSearch?docketId=18039#docket-detail-container2.

[22] Louisiana Public Service Commission, Order, Open Session Document Number F14-13629, Docket No. R-31417, March 12, 2014, http://lpscstar.louisiana.gov/star/portal/lpsc/PSC/PSCDocumentDetailsPage.aspx?DocumentId=ce0dbb3b-2804-4ee9-bf1b-50684ca43657&Class=Filing.

[23] According to the Alliance for Affordable Energy, several Louisiana utilities have claimed they have met their net metering cap and are no longer taking applications for net metering credits; http://all4energy.org/2014/04/latest-on-solar-net-metering-policy-at-the-la-psc/.

[24] Minnesota Public Utilities Commission, *In the Matter of Establishing a Distributed Solar Value Methodology under Minn. Stat.§ 216B.164, subd. 10 (e) and (f)*, April 1, 2014, Docket No. E-999/M-14-65, Order Approving Distributed Solar Value Methodology, April 1, 2014, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId=%7bFC0357B5-FBE2-4E99-9E3B-5CCFCF48F822%7d&documentTitle=20144-97879-01 .

[25] Public Service Commission of Wisconsin, *Final Decision*, in "Joint Application of Wisconsin Electric Power Company and Wisconsin Gas LLC, both d/b/a We Energies, for Authority to Adjust Electric, Natural Gas, and Steam Rates," Docket No. 5-UR-107, December 23, 2014, available at http://psc.wi.gov/apps40/dockets/content/detail.aspx?dockt_id=5-UR-107.

avoided transmission cost. The tariff restructuring included, for three of the new tariffs, facilities charges based on the customer's base consumption rate, and for two other tariffs, per-kW demand charges billed according to the nameplate capacity of the customer's generation system.

5. CONCLUSIONS

Getting retail prices right is a key element in assuring efficient and reliable power service in a world with DER. This means, among other things, that the power industry needs to finally get around to truly unbundling generation service cost recovery from distribution service cost recovery. Generation service is generally subject to competition while distribution service is not. Consequently, the retail prices for generation service can, over time, be reformed to better reflect wholesale marginal costs, which are measured by LMPs and ancillary services prices in the RTO markets. The retail prices for distribution service, by contrast, must more or less guarantee cost recovery by distribution service providers. Distribution service prices will therefore continue to be based upon cost of service; but the billing determinant for recovery of distribution costs needs to reflect some measure of customers' maximum power flows through distribution systems rather than customers' gross or net consumption of electrical energy.

Net metering applied to per-kWh distribution charges is not sustainable in a world with significant DER. As long as customers who rely upon DER also rely upon the distribution system to back up their generation and/or to take their excess generation, net metering combined with per-kWh distribution charges will force traditional customers to pay for the distribution facilities used by net metered customers. Efficient and equitable pricing would compensate DER for the value of the energy provided to the power system, and would charge DER owners for the utility distribution services upon which DER relies.