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Optimizing prices for small-scale distributed generation resources: A review of principles and design elements

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ABSTRACT

Regulators worldwide are considering many proposals to improve pricing schemes for low-carbon distributed electricity resources in order to achieve compensation that is fairer and better aligned with the incremental benefits to the utility and society. The key concern is that under the current practice of net metering, the expansion of renewables-based, small-scale distributed generation is at odds with the utility's efforts to provide service on a reliable, efficient (least-cost) and equitable basis.

1. Introduction

The U.S. has moved a long way towards the restructuring of its energy sector. Today, the push for a cleaner environment and the subsequent expansion of renewable energy generation resources is changing the dynamics of both wholesale and retail electricity markets, and is demonstrating the need for further regulatory reforms. The intermittent, rather unpredictable output of renewable-based generation presents short term reliability challenges and may dramatically affect long-term resource planning decisions. At the wholesale level, new mechanisms to incentivize "flexible" generation capacity resources are being developed to address the sudden and potentially large fluctuations of aggregate generation supply in order to ensure system stability.[1] At the retail level, regulators are developing new pricing measures for low-carbon distributed electricity generation resources such as solar Photovoltaics (PV) and wind, that allow for fair compensation, one that better aligns with the incremental benefits of these resources to the utility and society, so as to not unduly burdening other customers. The main concern is that under the current pricing systems, the growth of renewables-based distributed generation (DG)[2]is increasingly at odds with the utility's efforts to provide service on a reliable, efficient (least-cost), and equitable basis.

In the case of solar DG, the cost of integrating residential and small commercial customers' generation systems is often socialized among all customers. Among the integration challenges are the increased ancillary services often required to balance the excess output sent to the grid in real time, and the potential acceleration of upgrades to distribution facilities in certain areas to handle reverse flows, which raises the cost of delivery. More notably, there may be severe adverse equity impacts due to the implicit rate-funded subsidy mechanism employed in most states to compensate for the output of small-scale solar or wind generation systems. These facilities are subsidized by the practice of net metering, along with ratepayer-funded rebates and federal tax incentives. Currently, 44 states and the District of Columbia have adopted formal net metering policies which typically is available to residential and commercial solar systems of up to 1 MW of demand. Under this billing practice, the distribution utility has the obligation to buy any exported generation from the

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[1] This may include the need to acquiring ramping resources, and other dispatchable generation required to integrate high levels of variable generation reliably.

[2] Distributed generation (DG), also known as embedded generation, is located at or near the point of power consumption and typically meets a portion of the customers' daily electricity needs or provides backup service to customers that need highly reliable power.

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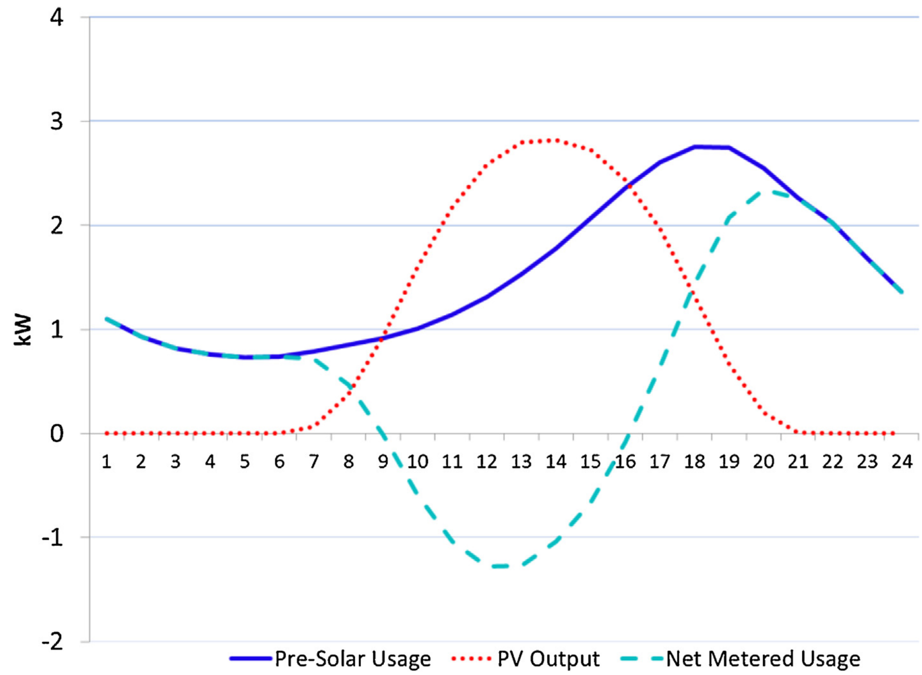

Fig. 1. Average residential load before and after PV, SMUD July 2014.

customer's generation facility at the prevailing retail per-kWh rate, regardless of the value of that energy to the grid.[3] The cumulative excess energy delivered to the distribution grid in one month is netted against the customer's energy purchases from the grid the same month, and any excess is carried over to offset consumption in the next billing cycle. In essence, the electric meter runs backwards when the customer system generation sends surplus generation to the utility grid. Because the standard rate applicable to residential and small commercial customers is generally structured as a two-part rate, with a low monthly fixed charge and a flat per-kWh charge that does not change by time of day, [4] the tariff revenues from customers under net metering decline faster than the cost savings realized by the utility or distribution owner. The subsequent net revenue gap must be collected from all customers in the rate class at the next general rate case to keep the utility financially whole, thus leading to cross-subsidies.[5]

From its onset, the practice of net metering was known to provide a subsidy to DG, funded by regular, full-service customers. Installation costs for utility-scale solar PV projects and for behind the meter residential and commercial rooftop solar have plummeted in recent years. As the costs of solar technologies fall and the net metering share of the utility's customer base expands, in some cases, exponentially, the validity of net metering as an appropriate tool to stimulate small-scale renewable DG has been called into question. Not only are there equity concerns about the intra-class cross-subsidies inherent in net metering, but also concerns that other clean energy resources, in particular utility-scale solar and wind turbines, do not receive comparable subsidies.[6] The fact that customers may not be acquiring the least-cost renewable energy available raises controversy as to how much renewable DG is desirable.

A number of states are now evaluating rate reforms that seek to reduce or eliminate the subsidies to renewable DG customers provided by net metering. However, regulators are finding it very challenging to agree on a "fix" that is considered fair to all grid users, and does not conflict with federal or state environmental policy or energy conservation goals. In order to facilitate consensus, first there needs to be a clear and widespread understanding of the goals of regulatory energy pricing. The goal behind a rate reform is not to hinder DG development, but to promote a more optimal expansion of DG that benefits all customers in the long term. Next, there needs to be a detailed evaluation of the distortions embedded in the utility's existing pricing scheme for both bundled service rates and network rates, and to what extent such distortions can be mitigated given the available metering technology. Ensuring a system of tariffs that do a better job at signaling the costs effectively imposed on the system by load growth, or equivalently, the direct financial benefit to the utility from load reductions, is critical to meet best practice rate making goals. Any subsidy aiming to foster a target amount of distributed solar generation on account of its clean attributes is more appropriately channeled outside of the retail tariff or unbundled distribution charges.

The right tariff revisions will not only promote efficient DG development, but will also support the development of more optimal amounts of other "distributed energy resources" (DER) such as residential and commercial demand response, electric vehicles (EV), behind-the-meter energy storage such as battery

[3] Under net metering, a single bi-directional meter registers the energy exported from the on-site system to the grid.

[4] Rates that have an inverted kWh block structure may be particularly suboptimal, providing a large credit to net metered usage. For example, SDG&E's residential and small solar commercial customers may receive for excess energy an average of over 22 cents/kWh under net metering.

[5] Cross-subsidies can be determined through comparing class revenue target with actual tariff revenues plus avoided costs from DG.

[6] A federal investment tax credit under the 2005 Energy Policy Act offers up to a 30% offset against all solar generator installation cost. Wind turbines receive a production tax credit. These credits are expected to be gradually phased out by 2022.