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ALIGNING UTILITY RATE DESIGN WITH GRID-EDGE TECHNOLOGY

The electric industry, including public power, is transitioning to a model where customers interact with the grid in new ways. Grid-edge technologies enable this new utility model and can provide value to the utility. Customer interest in an interactive grid will disrupt the standard rate model that utilities use to recover costs of services and will present challenges in ensuring an equitable allocation of power delivery costs. The American Public Power Association (APPA) wrote this report to educate members on ways to proactively address the changing landscape of grid-edge technology and its impacts on rate design.

A key challenge in aligning rate design with technology is the rapid, unpredictable insertion of new loads, such as electric vehicles (EVs), onto the distribution system. Residential and commercial EV charging may force many public power utilities accustomed to predictable loads to upgrade their infrastructure and change rate structures to manage a more dynamic load model.

Various grid-edge technologies that enable utilities to enhance grid efficiency and reliability include smart home technology, solar photovoltaic (PV), battery energy storage systems (BESS), and EV charging infrastructure. These technologies will transform energy consumption in homes and businesses and how utilities manage their distribution grid.

Standard and emerging rate designs play a role in customer adoption of technology, including distributed energy resources (DERs). The typical cost recovery options include fixed-variable rates, demand charges, time-of-use (TOU), dynamic rates, and subscription rates, as well as emerging rate structures designed for solar and EV charging.

Rate design not only affects technology adoption, but grid-edge technologies affect how utilities design and implement rate structures.

Key Findings

The deployment of advanced metering infrastructure (AMI) and its two-way communication capabilities allow utilities to offer pricing alternatives to residential and commercial customers that are not possible with traditional analog meters. With AMI, smart home technologies enable residential and commercial customers to leverage two-way communications to interact with their utility in new ways. Utility development of dynamic pricing programs to interact with these smart home technologies can bring more value to the utility and create a more informed and engaged customer.

Volunteers from APPA's Rate Design Interest Group participated in a facilitated workshop on which rate designs have worked for public power and what strategies and factors can help their communities to adopt new technologies. In the workshop, public power utilities identified EV charging as a priority issue regarding the future of utility rate design. EV charging, especially DC fast charging (DCFC), can strain distribution systems, motivating utilities to consider and implement new rates to help manage this load. TOU pricing, paired with critical peak pricing (CPP), is

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a promising rate design strategy to alter EV charging behavior effectively. Utilities can design commercial rates for fast charging stations using this strategy, incentivizing fast charging during off-peak hours to reduce or remove capacity constraints. Since fast charging stations may be inevitably utilized during peak hours, developers and site owners may respond to this rate strategy by installing onsite BESS to supply EVs during peak hours and recharge during off-peak hours. A blend of market adaptation, grid-edge technology, and new rate designs will help grow and manage EV demand.

Rooftop PV, BESS, and EV adoption are forcing utilities to make rate design decisions to allocate costs across customers equitably and incentivize or disincentivize customer behaviors for the benefit of all customers. For example, a utility may design a TOU rate that incentivizes BESS charging during peak solar output or disincentivizes EV charging during daytime peak load periods.

If not appropriately managed, grid-edge technology can reduce energy sales, increase peak demand, and strain the distribution system by introducing capacity constraints and bidirectional power flow, forcing large-scale infrastructure upgrades. These upgrades can lead to inequitable cost allocation amongst customers. However, rate design can be a tool to help manage the impact of new load and generation sources from grid-edge technologies and recover costs in a way that benefits both the utility and its customers.

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