Net metering

Executive Summary

The "Net Metering and Easy Connection Act" (Section 386.890, RSMo) allows customers who own renewable energy generators (e.g., solar panels) to sell electricity that they generate to utility companies. When calculating utility costs, the customer is then charged for the difference in electricity that they provide to the utility company and the electricity that the utility company provides to the customer. The majority of customers who participate in net metering use solar panels due to relatively low costs, solar panel efficiency, and ease of installation. Several state-commissioned reports have found limited negative impacts for customers that do not participate in net metering as a result of utility companies attempting to recoup costs due to reduced revenue and fixed operational costs.

Science Highlights

- Net metering laws allow electrical utility customers to earn a return on investments in renewable energy systems such as solar panels.
    - Compensation policies for utility customers vary widely between states.
- Home solar panel usage has been rapidly growing during the last decade due to reduced panel and installation costs.
- Community solar is one possible way to minimize disruption to utility business models while promoting access to solar energy.

Limitations

- There is no scientific consensus on the ideal rate structure for energy customers.

Research Background

Net Metering

Net metering is a policy that allows electricity customers to sell electricity that they generate to their utility company. In contrast to localized electricity generation at large power plants by utility companies, this type of energy generation is termed "distributed generation". Common sources of distributed energy generation include solar panels, small wind power generators, natural gas micro-turbines, and methane digesters. In Missouri, net metering participants must generate electricity via a renewable energy source (Section 386.890, RSMo). State-level net metering policies have become more important as electricity generation at locations such as at houses, schools, or businesses has increased.[1] Across the United States solar panels accounted

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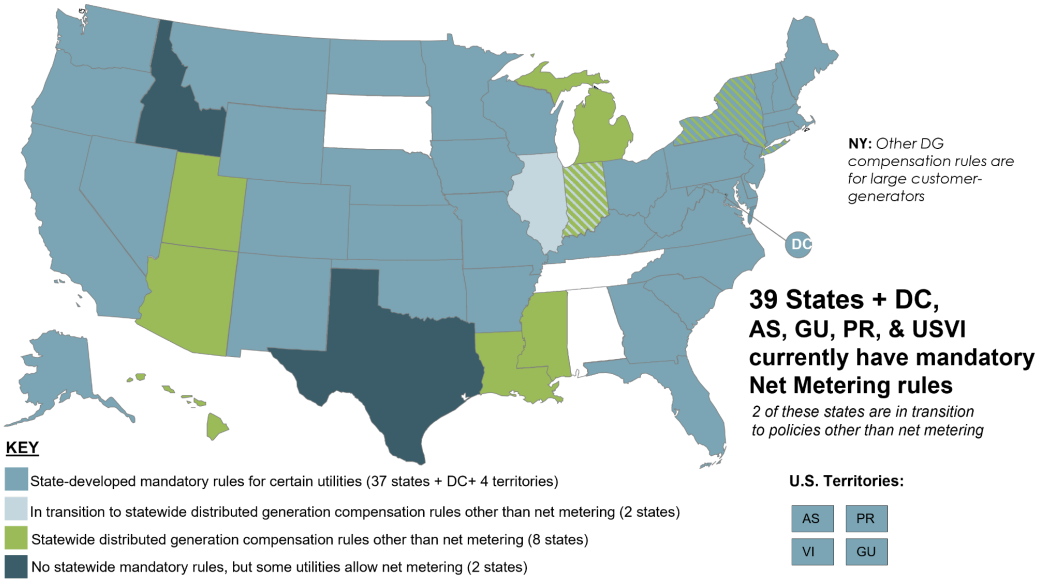

Figure 1. State map of net metering policies. Policies related to net metering vary between states, but 37 states (including Missouri) have mandatory rules allowing net metering. Figure from DSIRE NC Clean Energy Technology Center.

for 97% of the electricity generated as part of net metering in 2018, and therefore receive a large amount of the attention regarding net metering.[2]

Why People Choose Solar

With the increase in solar panel efficiency and rapid decrease in costs,[3] solar panels for home, business, and industry use have grown in popularity. Net metering policies enable those with solar panels to sell electricity, leading to a return on investment over the long term that can recoup initial upfront costs. Because of this, residential ownership of solar panels has increased more than 19-fold in the last decade.[4]

A review of 173 papers on the motivations of residential solar ownership found that education, income, and house ownership were the strongest predictors of solar panel ownership.[5] Solar often requires a substantial initial monetary investment which may explain why higher income homeowners are more likely to purchase solar panels. As for individual attitudes, "energy autonomy" and "financial motivations" ranked higher than "environmental concerns".

Types of Rate Models Energy Customers

Net metering laws are common in most states but not all states require net metering (**Figure 1**). There is no standard approach at the federal level to compensation for utility customers who sell electricity to their utility company, leading to a patchwork of laws and policies at the state and municipal levels.[6] In order to recover fixed costs associated with operating a grid, utility

companies are looking towards different rate structures.In 2020, 39 states and D.C. took some form of policy action related to net metering or solar-customer compensation.[7] Complex state laws and policies combined with the relatively recent implementation of distributed solar technology means that there is no broad-scale scientific consensus on the ideal rate structure for energy customers. However, several different rate models have been developed, and are outlined here:

1. **Minimum Service Fees:** This structure charges a service fee for using a utility's lines.[8] Such fees can be a fixed cost to all customers or a variable cost per amount of energy consumed. These fees or tariffs can be coupled with net metering and other rate designs (see peer-to-peer below).
2. **Disconnected Consumption/Production Fees:** As opposed to paying only for the net energy used each billing cycle, solar-customers and utilities in such a system pay different rates for energy consumed and energy produced. The compensation for energy produced is generally lower than the cost of energy consumed (e.g., Louisiana).
3. **Variable Pricing:** Variable pricing refers to rate pricing that can change throughout the day depending on demand. Variable rate pricing has begun to be offered in parts of Missouri.[9]
4. **Peer-to-Peer (P2P):** This model allows traditional customers and net metering customers to directly trade electricity with one another. The utility then acts as an intermediary and charges a fee to maintain the lines connecting customers, while providing additional energy if needed. This model is coupled with variable pricing of electricity where prices change with demand throughout the day. Such P2P systems have been implemented in Germany, the Netherlands, and the UK[10] and the technical requirements to run such a system are well understood.[11]

In Missouri, retail electric suppliers are required to offer net metering to customers who produce electricity using renewable energy sources. Net metering under current law is available on a first-come, first-serve basis until the total energy production capacity from renewable energy generators equals 5% of a utility's peak load. Less than 1% of Missouri utility customers participate in net metering.[12] Special meters are required in order to measure the amount of electricity sold to a utility company. Current Missouri law allows electric utilities to charge customers for the costs associated with installing meters capable of measuring net electrical usage.

Potential Impacts of Net Metering and Distributed Energy Generation

There are several possible impacts that come from distributed energy generation and net metering. The first is system efficiency: by shifting energy to local production, losses in energy that come from transmitting electricity across long distances can be minimized.[13] In addition, distributed generation maintains reliability during high peak loads by allowing grid operators to rely on some businesses to use their onsite electricity generators.[1] Power grid resilience is

another important concern. Disruptions caused by severe weather and other events could be reduced through distributed production and associated grid upgrades.[14]

Several states have commissioned reports on the effects of net metering with most finding a net benefit for both solar-customers and non-solar customers (Maine, Mississippi, Nevada, Vermont). In addition, a specific report on net metering in Missouri was completed in 2015 by the Missouri Energy Initiative.[12] In their analysis they find that the overall effect of net metering in Missouri would be positive, taking into account load reduction of utility operated grids, reduced greenhouse emissions, shifting of utility fixed operational costs to customers who do not participate in net metering, and increased administrative costs.

Impact of Different Rate Models

1. **Minimum Service Fees:** Adding a fixed charge to a net metering customer is intended to allow utilities to recover some of the fixed costs associated with operating a grid. Proponents of this model say that this model helps to prevent utility companies from having to increase rates for non net metering customers and has the added advantage of administrative simplicity. Opponents argue that this interferes with a competitive market, ignores the societal benefits of distributed generation, and that choosing a fixed rate that accurately reflects costs to the utility company is difficult.[2]
2. **Disconnected Consumption/Production Fees:** When determining the rate for net-metering customers who sell their electricity, some states refer to the avoided cost for utilities. This typically includes just the cost of generating electricity and is less than the retail rate, which includes costs associated with maintaining the grid, producing energy, and other utility expenses. An alternative takes into account other benefits of solar panels or distributed generation in general, such as reduced air emissions and greenhouse gases, and other benefits to the grid. Difficulties with this method include determining how to quantify benefits of distributed generation and the fact that costs and benefits may change depending on the season and time of day.[2]
3. **Variable Rates:** Variable rates pricing comes with the advantage of increasing system efficiency by encouraging users to use less electricity during times of high energy demand thus minimizing overhead associated with peak capacity. In a variable rate design, home batteries allow customers to store electricity during times of low demand when prices are low and then use stored power back when prices rise.[15]
4. **Peer-to-Peer:** Peer-to-peer models allow broad-scale involvement in renewable energy, even by those who do not own solar panels. In the United States, a case study of a potential peer-to-peer model has been conducted of the Brooklyn Microgrid (BMG) in Brooklyn, New York.[16] The BMG's grid is currently connected to the traditional grid in order to balance uneven supply and demand on the microgrid. The market platform is based on blockchain technology, the same technology underlying Bitcoin. However, direct peer-to-peer trading is not possible without utility involvement under current

regulation in the area. The case study finds that the BMG is operational and additional market and pricing testing is needed.

Jobs in Missouri

According to the U.S. Bureau of Labor Statistics,[17] Missouri had 12,000 jobs related to solar panel installation in 2019 with a median pay of $46,000 a year. This is a relatively high pay considering that the median earnings for someone with a high school diploma in 2019 was $38,792.[18] Furthermore, it is predicted that the number of solar energy-related jobs will increase by 52% in the next decade, which would be more than 6,000 new jobs in Missouri. In comparison, the average growth rate for other occupations is 7.7%.[19,20]

Missouri currently consumes almost eight times as much energy as it produces and is ranked 40th in total state energy production.[21] This implies that there may be room for growth within the energy production sector in Missouri.

Equity and Net Metering

One of the biggest concerns about net metering is that it may increase the cost burden for low-income populations, since property owners with higher incomes can afford the initial investment of solar panels and reduce their own energy costs, but renters and those with lower incomes (who disproportionately tends to be Black and Hispanic[22]) may have their energy rates increase as utilities seek to recoup lost revenue and pay for grid operation. One simulation of the Chicago energy market predicted higher rates for non-solar customers, but only at very high levels of solar adoption.[23]

One proposed way to avoid uneven distribution of the benefits and costs associated with net metering is **community solar generation**.[24] In these types of projects, solar generation systems are owned by, or provide benefit to, multiple community members. Such projects can be designed in partnership with utilities, where customers pay a set rate for energy, which is then offset by utility-owned solar panels. Projects can also be local cooperatives where community members contribute to solar panel ownership through an initial purchase or a set fee. Utility-partnered community solar projects are one way utilities could minimize disruptions caused by individual solar-customers.[25]

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