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7.4 Customer Rates and Data Access

Policy Description and Objectives

Summary

Customers benefit economically from utility bill savings or direct payments for their electricity output when they improve their energy efficiency or install distributed renewable energy and combined heat and power (CHP). Consequently, the specifics of a customer's rates and other utility charges can drive the economic attractiveness of energy efficiency, distributed renewable energy, CHP, and other technologies, such as storage and electric vehicles. States have found that access to utility data on energy usage is key to helping customers understand and manage their utility bills and consider potential energy efficiency and clean energy investments.

Objective

The policies described in this section involve setting rates and giving customers access to information that will encourage them to use energy more efficiently or invest in distributed renewable energy and CHP. States have found that rate design and data access policies can help encourage additional customer investment in these technologies and practices while complementing the energy efficiency, renewable energy, and CHP policies discussed elsewhere in the *Guide to Action*, such as energy efficiency resource standard and renewable portfolio standard (RPS) policies.

In most cases, utility rates are not designed with energy efficiency and clean energy technology in mind. Utility rates are the outcome of a complex process that must take into account multiple objectives. There are usually three main priorities: 1) meeting utility revenue requirements, 2) fair apportionment of costs among customers, and 3) economic efficiency (Bonbright 1961; Phillips 1993). Other regulatory and legislative goals may include providing stable revenues for the utility and stable rates for customers, simplifying understanding and ease of implementation, encouraging effective load management, promoting social equity in the form of lifeline rates for people with low incomes, and promoting environmental sustainability in the form of rates that encourage reduced energy use and lower emissions.

Because states consider multiple priorities when designing rates, rate design may be more or less compatible with the adoption of energy efficiency, distributed renewable energy, and CHP. This section describes common rate forms and how they can affect the benefits and risks of these technologies and practices. This section also discusses the role of electronic energy use data (and related privacy protections). Electronic access to energy use data can help customers manage their utility bills and make informed decisions about participating in energy efficiency programs and investing in distributed renewables.

Types of Utility Rates

Table 7.4.1 summarizes nine types of rate designs and highlights whether each design focuses on a customer's net usage or focuses on generator output. Each type of rate design is described in more detail below, followed by a discussion about providing customers with access to detailed energy use data.

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Table 7.4.1: Summary of Rate Designs

Rate Form	Effect or Goal of Design	Applies to Customer Usage or Generator Output
Energy Consumption Rates		
Flat Rates	Simplest rate form, often consisting of monthly demand/access charges and energy charges per kilowatt-hour consumed. Historically used to meet state policy objectives for rate design.	Customer usage
Inclining Block Rates	Promotes reduced monthly energy usage. Also provides bill reductions for consumers with smaller overall usage.	Customer usage
Time-Varying Rates (Time-of-Use and Real Time Pricing)	Promotes economically efficient consumer decisions by providing prices to customers that reflect the time-varying cost of energy.	Customer usage
Demand Charges	Incentivizes customers to reduce their demand during peak periods when electricity is more expensive for the utility to provide.	Customer usage
Technology Targeted Rates		
Standby Rates	Compensates the utility for having equipment ready and available to serve a customer when needed to provide backup for the customer's generator.	Generator output
Exit Fees	Allows the utility to charge customers for costs previously incurred by the utility even if the customer no longer requires grid service. Adds a disincentive for customers to depart from the grid.	Generator output
Net Energy Metering	Compensates customers for their generation output at rates that are equivalent to their retail rates.	Customer usage
Buyback Rates (Feed-in Tariffs)	Separates the value of customer-installed generation from the customer's rates. Compensates the customer for generation output.	Generator output
Electric Vehicle Rates	Provides time-of-use rates that incentivize off-peak charging.	Customer usage

Energy Consumption Rates

The first four types of rates relate to the way utilities charge customers for the amount of energy they use. While typically designed to meet the general ratemaking objectives described above, these rates can also incentivize energy efficiency and clean energy in a variety of ways.

Flat rates. The flat rate charges customers based on the total kilowatt-hours (kWh) of electricity or therms of natural gas they consume. In addition to these charges per unit of energy consumed, bills may also include a daily or monthly customer access charge to help cover the utility's fixed costs.[99] Flat rates are typically limited to residential and small commercial customers. Customers could realize cost savings if they adopt energy efficiency, distributed renewable energy, or CHP, but flat rates do not necessarily incentivize the customer to

[99] Access charges include items such as monthly customer charges or daily facility access fees. These charges and fees provide a stable revenue source for utilities that reduces the remaining costs that utilities must recover from customers via energy charges. For example, an all-energy rate might be 20 cents per kWh; whereas the addition of a $10 per month customer charge might allow a lower 18 cent per kWh rate.

adopt these technologies and practices in a manner that maximizes cost savings and environmental benefits across the electricity system as a whole.

***Inclining block rates*.** Under this rate form, the price per unit of electricity or natural gas increases with higher usage. Inclining block rates offer the advantages of being simple to understand and simple to meter and bill. Inclining block rates can also meet the policy goal of protecting small energy users. It was this desire to protect small users that prompted the adoption of inclining block rates in California. For larger users, inclining block rates offer a stronger price signal for energy efficiency and clean energy than a simple flat rate. In contrast, some utilities offer a declining block rate structure for their largest customers, in which the first block of usage is billed at a higher rate than subsequent usage.

Time-varying rates. Time-of-use (TOU) and real time pricing (RTP) rates refine the utility's pricing so that the cost of energy differs by season, month, time of day, or hour. Generally, natural gas rates will only vary by season or month, while electricity TOU prices will typically vary by season and consist of up to four pricing periods within each season that vary by time of day. RTP prices typically vary hourly. Other variations involve energy prices that are fixed for most of the year, but the utility can raise prices for a limited number of hours, or offer large credits for energy reductions in response to system needs or high market prices. Such hourly responses have existed for decades, but have historically been limited to large commercial and industrial customers. More recently, the implementation of advanced metering infrastructure (AMI) projects by utilities has enabled small commercial and residential customers to participate in RTP.[100]

TOU and RTP rates allow utilities to offer prices to customers that can better match the utility's supply costs. By reducing demand at peak times, these rates can decrease the need for utilities to build additional generation capacity or operate less efficient backup units. TOU and RTP prices can also provide larger economic incentives than flat rates for energy efficiency, distributed renewables, and CHP that provide relatively higher output during times of higher utility costs and prices—for example, solar power during hot, sunny summer days. Access to energy usage data and pricing information is important for customers who are on time-varying rates.

***Demand charges*.** With demand charges, customers pay for their energy usage and then pay an additional charge based on their peak demand during a particular period (a month, the year as a whole, or at a specific time of day). Demand charges reflect the fact that portions of the electricity system are sized to accommodate customers' peak loads. Demand charges have historically been limited to industrial and larger commercial customers because of the cost of advanced metering, but the spread of AMI to smaller customers presents additional opportunities—although the complexity of understanding and managing demand by smaller, less sophisticated customers remains an issue. (For more discussion about AMI and other modern grid technologies, see Section 7.5, "Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration.")

Like TOU and RTP structures, demand charges can lead to environmental benefits and overall cost savings by decreasing the need for utilities to build additional generation capacity or operate less efficient backup units during periods of peak usage. To the extent that energy efficiency, distributed renewable energy, and CHP can

[100] For example, PG&E, Portland General Electric, and Georgia Power are offering real-time pricing to customers. For more information, see http://www.pge.com/en/mybusiness/rates/tvp/peakdaypricing.page, https://www.portlandgeneral.com/our_company/corporate_info/regulatory_documents/pdfs/schedules/Sched_012.pdf, and http://www.georgiapower.com/pricing/files/rates-and-schedules/CPP-R-1.pdf.

reduce peak demand, they can greatly reduce customer demand charges. Some customers have also installed electricity storage to reduce their demand charges.[101]

Technology-Targeted Rates

In some cases, customers who install technologies could be subject to rates that are specific to their installation of distributed renewable energy, CHP (see Chapter 6, "Policy Considerations for Combined Heat and Power"), storage equipment (see Section 7.5), or a unique energy-intensive end-use (e.g., electric vehicles). This section discusses several common types of technology-targeted rates.

Standby rates. Facilities that use distributed renewable energy or CHP may still need backup power from the grid when the onsite system is unavailable due to equipment failure, maintenance periods, or other planned outages. Electric utilities often assess standby charges to cover the additional costs they incur as they continue to provide adequate generation, transmission, or distribution capacity (depending on the structure of the utility) to meet these customers' needs. The utility's concern is that the customer could require power at a time when electricity is scarce or at a premium cost, and the utility must be prepared to serve load during such extreme conditions, sometimes on short notice (see the introduction to Chapter 7, "Electric Utility Policies," for additional discussion on how the electric power grid must match supply with demand).

The probability that any one generator will require standby service at the exact peak demand period is low, and the probability that all interconnected small-scale distributed renewable energy or CHP will need it at the same time is even lower. Consequently, states are exploring standby rate alternatives that may more accurately reflect these conditions (DOE 2012a; NRRI 2012). States are also looking for ways to account for the diversity of customer types[102] when determining the probability that the demand for standby service will coincide with peak (high-cost) hours.

Exit fees. When facilities reduce or end their use of electricity from the grid, this affects the utility's ability to recover fixed operating costs for the investments it has made to serve all ratepayers. These fixed costs are usually recovered over time and are often tied to kWh consumption. The remaining customers may eventually bear these costs. This can be particularly problematic if a large customer leaves a small electric system. To minimize potential rate increases due to the load loss,[103] utilities sometimes assess exit fees on departing loads.

As many states began to restructure (i.e., deregulate) their electricity markets during the 1990s, utilities that previously generated power began to focus on delivery only, which meant that more of their costs tended to be fixed (e.g., investments in transmission and distribution infrastructure). Thus, exit fees gained favor as a means to allow these utilities to recover historical or "stranded" costs. Some states, however, exempted certain generation projects from exit fees because of the other benefits they provided, such as grid congestion relief and reliability enhancement. For example, Massachusetts and Illinois exempted some or all CHP projects from their stranded cost recovery fees.

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[101] See Section 7.5, "Maximizing Grid Investments to Achieve Energy Efficiency and Improve Renewable Energy Integration," for more information on electricity storage.

[102] For example, some industrial facilities run three shifts per day while others only run one shift per day. This would lead to a three-fold disparity between peak and minimum power demand in two otherwise identical facilities.

[103] Many factors affect utility rates and net revenues (e.g., customer growth, climate, fuel prices, and overall economic conditions). Therefore, a load reduction will not necessarily result in a net loss that would need to be recovered from the departing customer or other customers.

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Net energy metering. Net metering is designed for customers who own small distributed generation (DG) systems. The basic principle behind net metering is that the amount of electricity produced by the DG system is measured against the amount of electricity used by the customer (i.e., the customer's load). If the DG system produces more electricity in any given month than the customer needs to meet its own load, the surplus electricity is exported to the grid for other customers to use. The customer then receives a bill credit for the surplus kWh, which can be used to offset electricity use in future months when the customer's load exceeds the DG system's production. This crediting system means that the utility is effectively purchasing the surplus electricity generated by the DG system at the full retail rate. Net metering programs typically address interconnection in a simple way, which is appropriate for small renewable projects. (For more information on net metering, see Section 7.3, "Interconnection and Net Metering Standards.")

Several aspects of net metering vary by state, including roll-over of bill credits and the maximum size of a net metered system. Net metering is designed for customers who install a small DG system that will produce roughly the same amount as the customer's load, not for utility-scale power producers whose systems export large amounts of electricity to the grid and support many customers' loads. Most states also set a limit on the aggregate capacity of net metered systems in each utility's territory. See Section 7.3 for a map of state net metering policies.

Buyback rates. The payment received for surplus power generated by distributed renewable energy and CHP projects can be a critical component of project economics. The price at which the utility is willing to purchase this power can vary widely and is also affected by federal and state requirements.

The feed-in tariff (FIT) is a common type of buyback rate. A FIT consists of a contract between the utility and the renewable generator to purchase the output of the renewable generation capacity at a fixed rate for a fixed period of time (often 10 to 20 years). The FIT price is often higher than the utility's retail rate, and it remains fixed for the length of the contract period even if the retail rate fluctuates. This fixed price provides a degree of certainty that net metering cannot match with regard to the payback period of the customer's energy system.

FITs are a powerful tool for incentivizing renewable development, and they can jump-start a renewable industry faster and more effectively than many other policy instruments. However, it is precisely for this reason that they must be designed carefully and flexibly, allowing them to adjust to fluctuations in the industry and the markets they affect. This is a lesson learned from examples such as in Spain, where the government offered a highly attractive FIT rate in 2007 that incentivized installations far beyond the capacity targets (Voosen 2009). The government quickly reduced the tariff incentives a year after the start of the program, and they suspended the FIT altogether in 2012 to contain costs to the government and other utility customers (EIA 2013). To avoid such boom and bust cycles and to provide stability for both utilities and the clean energy technology industry, FITs can be designed with features such as capacity caps, incentives that decline with installed capacity levels, or incentives that are linked to market conditions.

Electric vehicle rates. As battery-powered electric vehicles (e.g., Tesla Model S, Nissan Leaf) and plug-in hybrid electric vehicles (e.g., Chevrolet Volt) become more common, some utilities have begun offering rate plans (tariffs) designed specifically for households that charge electric vehicles. These tariffs usually employ a TOU structure to encourage electric vehicle owners to charge their cars during off-peak hours and thus prevent peak load from increasing.

As of July 2014, 25 utilities scattered across 14 states have made electric vehicle-targeted rates available (Northeast Group 2014). These tariffs sometimes include "super off-peak" hours to encourage charging late at

night (e.g., Georgia Power, 11:00 p.m. to 7:00 a.m.) (Georgia Power 2014). Others, such as the electric vehicle tariffs offered by Pacific Gas and Electric (PG&E), include an option to meter the electric vehicle charger separately from the rest of the home (PG&E 2014d). This enables electric vehicle owners to put the charger on a different rate plan from the rest of the house, taking advantage of low off-peak prices without incurring higher costs for electricity used elsewhere in the house during peak hours.

In Texas, where night-peaking wind power is abundant, the utility TXU Energy's "Free Nights" plan offers free electricity from 9:00 p.m. to 6:00 a.m. every day, albeit with rates higher than those of many other plans during the rest of the day (TXU Energy 2014). This arrangement enables electric vehicle owners to save money and charge their vehicles with renewably generated electricity, and it helps the utility by minimizing surplus generation from renewables during off-peak hours.

Data Access

Providing customers, utilities, third parties and others access to energy use information can be an important part of incentivizing energy efficiency, distributed renewable energy, and CHP. Each group has different data access considerations.

Commercial customers. Access to energy use data is critical for benchmarking energy use in commercial, administrative, and multifamily residential buildings. Benchmarking allows building owners and managers to understand their buildings' energy use, identify the best opportunities for improvement, and measure the impact of efficiency efforts. Metering can present a challenge, as a single meter might register the combined energy use for multiple buildings, or a large building might have multiple meters that need to be summed to obtain total building energy use. This may require technical upgrades on the utility's part. Regulators can play a role by mandating that utilities provide such data access to commercial building owners, especially if the benchmarking process is itself being undertaken due to a regulatory mandate (SEE Action 2013). Seven states (California, Colorado, Illinois, Oklahoma, Pennsylvania, Texas, and Washington) have passed laws mandating that utilities provide consumers with access to their own data (SEE Action 2012).

Customers on time-varying rates. Rate schedules that seek to reduce peak demand by shifting some usage to off-peak hours are much more likely to be effective if ratepayers can see how specific choices and actions affect their energy use—and consequently, their bills—at different times. The standard total monthly energy use found on most ratepayers' bills will not provide sufficient detail for them to evaluate how much impact a particular action had. Many utilities are providing customers new online energy management tools, in-home energy use displays, and programmable thermostats to provide customers with better access to their energy usage information and to help them manage their energy bills. More detailed information on energy use also makes it easier for customers to track the savings afforded by distributed renewable energy such as solar panels.

Utilities. Though the utility itself has access to data—provided that its metering infrastructure is sufficiently advanced—the utility may employ an outside company to help implement its energy efficiency or clean energy programs. That company will likely need at least partial access to energy use data in order to fulfill its role. Utilities typically include provisions for data security and limitations on data usage in their contractual arrangements with outside companies. Customer consent is typically not required; however, the state public utility commissions (PUCs) in Oregon and Vermont have established rules for data sharing when all customer billing and energy use data is shared (SEE Action 2012).

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Third parties. From the perspective of third parties such as energy service companies, customer energy use data can be a valuable tool for identifying market opportunities and developing successful customer acquisition strategies. As discussed above, state regulators can exercise some control over the data that utilities can share with outside vendors. A key question is how much aggregate information the utility can share without obtaining consent from all the individual customers whose energy use is included in the total. This question is important to utilities due to the logistical expense of contacting customers to obtain consent, so several states have now passed standards governing when the need for consent is triggered. Vermont, for example, has established regulations that set minimum standards for size of the geographic area covered by the data, while Colorado has regulated the number of customers included in an aggregated data pool and their relative percent of the total energy use.

In situations where customers voluntarily provide their energy use data to third parties, there is again the potential for improper data usage and breach of privacy. In these situations, there are fewer direct actions regulators can take, but they can encourage third parties to provide privacy assurances and encourage customers to ask to see an official privacy policy (SEE Action 2012). For example, states could encourage third parties to voluntarily adopt the U.S. Department of Energy's (DOE's) Voluntary Code of Conduct, which includes concepts and principles regarding customer data privacy. [104]

Others. For researchers and policy-makers, energy use data aggregated by time period, geographic area, or demographic group can provide a valuable window into opportunities for energy efficiency or clean energy incentive programs on a larger scale (SEE Action 2012). However, requests for such data can raise customer privacy and utility cost concerns.

Designing Utility Rates and Providing Data Access to Support Energy Efficiency, CHP, and Clean Energy Goals

While there are a range of strategies available for encouraging customer investment in energy efficiency, distributed renewable energy, and CHP, states have found that having a supportive rate structure and complementary access to energy usage data can be critical to a customer making the business case and moving forward with investment. Similarly, ensuring that all customers benefit regardless of whether they directly participate in energy efficiency programming or invest in clean energy is important to maintaining long-term support for investments and policy goals. For this reason, it is important to understand the system-wide benefits of these investments and to address the unique perspectives and implications for each customer class. This section summarizes some key design issues, introduces the participants, and highlights how federal and state policies can interact with clean technology rates.

Key Design Issues

Utilities and regulators balance competing goals in designing rates. Achieving this balance is essential for obtaining regulatory and customer acceptance. Key design issues are described below.

Fairly Apportion Costs Among Customers

Utilities undergo formal processes to determine what share of their revenue will be received from each customer class. In regulatory proceedings, this process is often contentious, as each customer class seeks to

[104] DOE's Office of Electricity Delivery and Energy Reliability and the Federal Smart Grid Task Force facilitated a multi-stakeholder process to develop the Voluntary Code of Conduct. The Final Concepts and Principles, released on January 12, 2015, are available at http://www.energy.gov/sites/prod/files/2015/01/f19/VCC%20Concepts%20and%20Principles%202015_01_08%20FINAL.pdf.

pay less. This makes it difficult for utilities to propose rate designs that shift revenues between different customer classes. In redesigning rates to encourage energy efficiency, distributed renewable energy, and CHP, it is important to avoid unnecessary or inadvertent cost shifts between customer classes.

Maintain Rate Simplicity

The challenge for promoting energy efficiency is balancing the desire for rates that provide the right signals to customers with the need to have rates that customers can understand, and to which they can respond. Rate designs that are too complicated for customers to understand will not be effective at promoting efficient consumption decisions. Particularly in the residential sector, customers might pay more attention to the total bill than to the underlying rate design.

Mandatory vs. Voluntary Rates

A key design issue for utilities and policy-makers is whether the energy efficiency, distributed renewable energy, or CHP customer remains on a standard utility rate, can elect to move to a voluntary optional utility rate, or is required to take service under a special mandatory rate.

The use of voluntary rates provides more flexibility to incentivize clean energy, but it also introduces a potential free rider effect. For example, hot summer days are typically a peak usage period, so a utility might incentivize people to reduce their peak energy usage by offering a voluntary TOU rate with high summer midday prices and lower prices at other times of the year. These rates could encourage the installation of onsite solar, which would lower customers' net energy usage the most during sunny summer days. However, the same rate would also benefit a residential customer who commutes to work and is not home during the day, even if they do not install onsite solar. This is an example of the free rider effect. One partial solution would be to make the optional rate only available to customers who own onsite solar; however, in that case, a commuter customer with onsite solar could still see a large portion of their savings come from switching to the optional rate rather than from their onsite solar.

Mandatory special rates can be customized and targeted to energy efficiency, distributed renewable energy, and CHP customers. This design freedom can also lead to controversy, though, as targeting could be viewed as discriminatory *against* the technologies (i.e., high standby rates) or *for* clean technology (i.e., high FIT). Whereas standard utility rates are anchored by existing rate levels and utility rate increase percentages, special rates may be so unique that they have no clear benchmarks for deciding reasonableness.

Compensating Customers Who Generate Electricity

Another key design issue is how to compensate customers who generate their own electricity, such as through distributed renewables or CHP. These customers may be compensated through bill reductions due to their lower net energy usage, or they may be paid directly for their electricity output. As discussed above, the bill reduction method adds uncertainty into the customer's purchase decision because of unknown future changes in utility rates. Conversely, the use of set payment methods, such as FIT contracts with 20-year fixed prices, can burden utilities and other utility customers if the value of the distributed renewable generation drops.

Cost of Implementation

All of these designs will have implementation implications. For example, rates like RTP will have extensive data requirements, which raise the issue of how utilities will recover the costs incurred by information technology updates associated with making detailed energy data available to consumers. The range of recovery options includes spreading the costs to all customers via general operating expenses; adding a surcharge to customer

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bills; folding the costs into other project budgets, such as advance meter deployments and/or customer programs; or charging customers for data access.

Participants

Given the issues described above, changing rate design is often a contentious process involving lengthy workshops, settlement discussions, or litigated proceedings. This section introduces the major participants in the rate-setting process.

- *State PUCs.* Rates typically are approved by the state PUC during a utility rate filing or other related filing. The PUC staff are the focal point for evaluating costs and benefits to generators, utilities, consumers, and society as a whole. Many PUCs conduct active rate reviews in order to maintain consistency with changing policy priorities.
- *Utilities.* Utilities play a critical role in rate-setting. Their cost recovery and overall economic focus have historically revolved around volumetric rates that reward the sale of increased amounts of electricity. Anything that reduces electricity sales (including energy efficiency, distributed renewables, and CHP) also reduces utility income and may make it more difficult to cover fixed costs if the fixed components of existing tariffs are not calculated to match utility fixed costs. This creates a disincentive for utilities to support such projects. New ways of setting rates (e.g., decoupling or performance-based rates) can make utility incentives consistent with those of energy efficiency developers and policy-makers. (For more information on policies that can serve as utility incentives for clean energy, including decoupling utility profits from electric sales, see Section 7.2, "Policies That Sustain Utility Financial Health.")
- *Renewable energy and CHP project developers.* Project developers establish clean technology benefits and the policy reasons for developing rates that encourage their application. They participate in rulemakings and other proceedings, where appropriate.
- *Regional transmission organizations or independent system operators.* While not directly involved in utility rate-setting, these entities manage electricity infrastructure in some regions of the country. They interact with CHP and renewable generators and may also be involved in ratemaking discussions.
- *State energy offices, energy research and development agencies, and economic development authorities.* These state offices often have an interest in encouraging energy efficiency, distributed renewables, and CHP as a strategy to deliver a diverse, stable supply of reasonably priced electricity. They may be able to provide objective data on actual costs and help balance many of the issues that must be addressed.
- *Ratepayer advocates.* Many state governments have staff dedicated to representing ratepayer interests in rate case proceedings. These staff may be located within state PUCs (as in California), in the Office of the Attorney General (as in Kentucky, Arkansas, Alabama), or elsewhere within the state government (NASUCA 2014).

Interaction with Federal Policies

PURPA section 210 regulates interactions between electric utilities and renewable/CHP generators that are considered "qualifying facilities." PURPA played a role in structuring these relationships, most notably in conceptualizing rates based on avoided cost. In noncompetitive markets, qualifying facility status may be the only option for non-utility generators to participate in closed electricity markets. In those jurisdictions with open electricity wholesale markets, generators no longer need to attain qualifying facility status to participate in wholesale markets. Historically, PURPA has not spurred large growth in renewable generation because the

definition of "avoided cost" was taken to mean the cost of the cheapest marginal power source available. This was usually combined cycle natural gas, whose low cost was not enough to support renewable growth.

In October 2010, the Federal Energy Regulatory Commission (FERC) issued a ruling that changed the definition of avoided cost. Due to the fact that the original definition failed to stimulate much renewable energy growth, many states subsequently enacted RPSs. In its 2010 ruling, FERC recognized that an RPS changed the value of renewable generation because that value became dependent on more than just the cost of the cheapest marginal generation. FERC's ruling therefore authorized states to require higher payments to qualifying facilities, allowing for payments large enough to make renewables more economically feasible (NREL 2011).

More indirectly, the federal government plays a role in the evolution of electricity rate structures through the provision of analysis, funding, and research. The National Renewable Energy Laboratory (NREL) has produced numerous reports exploring the economics of various renewable energy technologies (NREL 2014). Some of these reports focus explicitly on the relationship between electricity rate structures, electricity prices, and economic feasibility of the technology in question—often solar PV.[105] NREL reports are freely available to the public, and may therefore be used by state officials and utilities during the ratemaking process.

The federal government also provides funding for projects that catalyze grid modernization, and this modernization process can profoundly affect data access and future rate structures. For example, the Smart Grid Investment Grants (SGIG) program, funded by the American Recovery and Reinvestment Act of 2009, distributed $3.4 billion in funds for grid modernization projects. Two of the eligible project categories were AMI and computer systems (DOE 2012b). Both of these technology classes enable a broader choice of rate structures by providing utilities and their customers with a more detailed, real-time picture of energy use. Lawrence Berkeley National Laboratory is also leading customer behavior research projects leveraging SGIG deployments. Similarly, the DOE's most recent loan guarantee solicitation for Renewable Energy and Efficient Energy Projects, released July 3, 2014, specifically names advanced grid integration and storage as a preferred project category (DOE 2014).

Interaction with State Policies

Designing utility rates to support energy efficiency, distributed renewable energy, and CHP can be coordinated with other state policies:

- Ratemaking issues are often closely tied to the structure of the state's electric regulatory authority. States regulate supply and delivery of vertically integrated IOUs. In restructured "retail choice" states, where the utility supply has been deregulated and is now separate from the delivery company, consumers can choose from whom they buy their energy. Utilities in restructured states often have exit fees, and they may also be sensitive to the need to facilitate clean technologies to prevent customers from looking to alternate electricity providers. Furthermore, customers in states with retail choice suppliers may have an opportunity to choose rate structures that are not subject to state regulatory approval. For example, Direct Energy in Texas offers a program called the "Meridian Plus" plan, which requires customers to lock in a fixed-rate electricity price for 24 months at a price that is currently above the variable and short-term pricing options. In exchange for the slightly higher price, customers gain price certainty in addition to devices and services that help them reduce their energy usage. Under the rate plan, Direct Energy offers smart thermostat installation and smartphone integration to improve customer heating and cooling

[105] E.g., "Impacts of Commercial Electric Utility Rate Structure Elements on the Economics of Photovoltaic Systems," http://energy.gov/sites/prod/files/2014/11/f19/46782.pdf; "Impacts of Regional Electricity Prices and Building Type on the Economics of Commercial Photovoltaic Systems," http://www.nrel.gov/docs/fy13osti/56461.pdf.

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decisions, as well as a seasonal heating, ventilating, and air conditioning maintenance checks to improve equipment performance (Direct Energy 2014).

- States have explored decoupling utility revenues from the volume of electricity sold. This issue addresses the inherent conflict when a utility has an incentive to maximize sales (the throughput incentive) instead of promoting demand-side options such as energy efficiency and onsite generation. Decoupling can be important when examining clean technology rates. States have also considered allowing utilities to recover more of their costs through monthly bill charges rather than through rate structures applied to the volume of electricity consumption. However, such approaches could lessen the incentive for energy efficiency and customer-sited clean energy. (For more information on decoupling and other mechanisms for adjusting utilities' incentives, see Section 7.2, "Policies That Sustain Financial Health.")
- If an RPS is in place, high standby rates, exit fees, and non-bypassable charges may unintentionally render clean energy projects uneconomical. (See Chapter 5, "Renewable Portfolio Standards.")
- As part of disaster preparedness planning, some states include grants or other incentives for DG installations that can support critical pieces of infrastructure during blackouts. CHP plants are typically included among the eligible technologies.[106]

Program Implementation and Evaluation

Administering Body

State PUCs are responsible for rate oversight and approval for IOUs and some cooperatively and municipally owned utilities. If not under PUC oversight, local boards oversee cooperatively and municipally owned utilities. In restructured (retail choice) states, competitive energy suppliers can set their own generation rates. However, PUCs in restructured states still have authority over the rates a regulated utility will charge for providing electricity to customers who do not receive their service from competitive suppliers. PUCs in restructured states also retain authority over other components of electricity rates, such as electricity delivery charges and collection of public benefits funds.

Evaluation and Oversight

States are attempting to ensure that rates are based on accurate cost and benefit measurements of energy efficiency, distributed renewable energy, and CHP; they are also attempting to ensure that such costs and benefits are distinct from those that are already captured in the otherwise applicable rate classification. Additionally, states are starting to explore ways to ensure that rates reflect the extent to which energy efficiency, distributed renewable energy, and CHP can benefit the rest of the electricity grid and under what conditions. These benefits include increased system capacity, potential deferral of transmission and distribution investment, reduced system losses, improved stability from reactive power, and voltage support. In restructured states, these benefits may be external to the regulated utility, but it is important that rates capture these elements to ensure optimal capital allocation by both regulated and unregulated parties.

Conducting evaluations of a state rate offering may require funding and other resources be made available at the utilities and state PUCs. Such resources will also allow for the monitoring of rate impacts on energy efficiency, distributed renewable energy, and CHP and across customers. Significant, unanticipated, or adverse impacts may be identified, which could then be addressed through modifications such as adjusting the rate

[106] For example, see Connecticut's Microgrid Grant and Loan Pilot Program at http://www.ct.gov/deep/cwp/view.asp?a=4120&Q=508780.

design or altering the rate qualification criteria. For example, several states have now initiated proceedings to move beyond net metering and develop new rate structures for energy efficiency, distributed renewable energy, and CHP that are more closely tied to DG's estimated value (CPUC 2014).

State Examples

Inclining Block Rates

California

Each of the California IOUs uses inclining block rates for their default residential customers. For example, PG&E has an inclining block rate with four tiers based on cumulative energy use in a given month. As customers use less energy due to installation of clean energy technologies, they see bill savings at their marginal tier energy rate. For example, in 2014, the Tier 4 residential rate is about 17 cents per kWh higher than the Tier 1 energy rate. This structure gives larger energy users larger incentives to adopt clean energy technologies than smaller users because the large users will have higher marginal tier energy rates.

Residential customers under net energy metering rates are also indirectly subject to the inclining block rates because the inclining block rates are the foundational "otherwise applicable schedule" upon which the residential net energy metering rates are based. An inclining block rate provides strong incentives for DG systems because these systems cancel out the most expensive kWh first.

New York

Consolidated Edison's (Con Edison's) default residential rate is a blend of flat and inclining block rates. The energy rate is flat for October through May. In the summer months, the rate switches to an inclining block rate with Tier 2 being about 1.3 cents per kWh higher than Tier 1. Tier 2 applies to all kWh in the summer months in excess of 250 kWh. As with PG&E, Con Edison's inclining block rate also provides the foundation for its net energy metering rate.

Time-Varying Rates

California

PG&E uses TOU energy rates for its business customers. The general TOU rate uses five TOU periods (two in the winter and three in the summer). While TOU rates have long been common for large commercial and industrial customers, the California Public Utilities Commission (CPUC) mandated the transition for all business customers to TOU rates. Small and medium business customers began transitioning in November 2012 (PG&E 2014e).

Inclining block is the default rate for residential customers, with inclining block TOU rates as a voluntary option. The inclining block TOU rate is the mandatory rate for all net energy metering customers starting service on or after January 1, 2007. The inclining block TOU rate has peak and off-peak rates and four tiers. The higher the tier usage, the higher the energy rate, and usage in the peak period receives a higher energy rate. Peak and off-peak usage is assigned to tiers on a pro-rata basis. For example, if 20 percent of a customer's usage is in the peak period, then 20 percent of the total usage in each tier will be treated as peak usage and 80 percent of the total usage will be treated as off-peak usage (PG&E 2014b).

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New York

Con Edison offers TOU rates as voluntary rate options. The voluntary TOU option is promoted for electric vehicle customers (see description under *Electric Vehicle Rates* below) but is also available to non-electric vehicle customers, albeit without the bill guarantee that is available to registered electric vehicle users. Con Edison customers can also choose to obtain supply from alternate providers that can offer different pricing options.

Standby Rates

California

California Senate Bill 1-28 (passed in April 2001) required utilities to provide DG customers with an exemption from standby reservation charges. The exemptions applied for the following time periods:

- Through June 2011 for customers installing CHP-related generation between May 2001 and June 2004.
- Through June 2006 for customers installing non-CHP applications between May 2001 and September 2002.
- Through June 2011 for "ultra-clean" and low-emission DG customers, 5 MW and less, installed between January 2003 and December 2005.

After Bill 1-28 expired, standby rates were left to be incorporated into utilities' general rate cases. However, CPUC still requires that utilities exempt DG systems from fixed standby charges as long as the DG systems provide physical assurance (EPA 2014).

New York

Under General Rule 20.3.1, Con Edison exempts customers from standby rates if 1) their onsite generation nameplate capacity is less than 15 percent of their maximum demand, 2) they take service on energy-only residential or small commercial rates, or 3) they have a contract demand less than 50 kW. In addition, General Rule 20.3.2 allows customers to opt out of the standby rate if they install a designated technology between July 29, 2003, and May 31, 2015. A customer with a designated technology must meet the following criteria (Con Edison 2012):

- Has an on-site generation facility that: 1) exclusively uses one or more of the following technologies and/or fuels: fuel cells, wind, solar thermal, PVs, sustainably managed biomass, tidal, geothermal, or methane waste, or 2) uses small, efficient types of CHP generation that do not exceed 1 MW of capacity in aggregate and meets eligibility criteria that were approved in the order of the New York State Public Service Commission, dated January 23, 2004, in Case 02-E-0781; and
- Has a contract demand of 50 kW or greater and has onsite generation equipment having a total nameplate rating equal to more than 15 percent of the maximum potential demand from all sources.

Exit Fees

California

There are several types of exit and transition fees in the California market, and they are handled differently depending on the specific utility. Fee exemptions exist for the following classes of renewable and CHP systems:

- Systems smaller than 1 MW that are net metered or are eligible for CPUC or California Energy Commission incentives for being clean and super-clean (PG&E 2014a).

- Ultra-clean and low-emission systems that are 1 MW or greater and comply with the California Air Resources Board's 2007 air emission standards (PG&E 2014a).
- Zero emitting, highly efficient (> 42.5 percent) systems built after May 1, 2001.

Illinois

Illinois ended exit fees for stranded costs on December 31, 2006. Prior to that end date the rule was fairly stringent and specific about the instances that triggered such a fee. The rule did, however, provide an exemption for DG and CHP. A departing customer's DG source had to be sized to meet its thermal and electrical needs with all production used on site (Illinois 2014).

Net Energy Metering

Georgia

In 2001, the state government of Georgia passed the Georgia Cogeneration and Distributed Generation Act, which requires all utilities to offer net metering to their customers. The Act contains the following provisions:

- Only solar PV, wind, and fuel cell systems are eligible.
- System size must not exceed 10 kW for residential systems or 100 kW for non-residential systems.
- The aggregate capacity of all the net metered systems in a utility's service territory must not exceed 0.2 percent of the utility's peak load from the previous year.
- If a customer's net metered system produces surplus electricity in any given month, the surplus is credited to the customer's bill for the following month. Surplus generation is credited at a value set by the Georgia Public Service Commission, as opposed to the full retail rate used by many states (DSIRE 2014a).

Connecticut

Connecticut provides net metering for a wide variety of technologies, including solar PV, solar thermal, wind, fuel cells, municipal solid waste, landfill gas, hydroelectric, wave and tidal energy, ocean thermal, and CHP. Connecticut's program has the following provisions:

- Systems must not exceed 2 MW in size, but there is no cap on the aggregate capacity of net metered systems.
- Excess generation is rolled over each month as kWh credits at full retail value.
- At the end of each year, customers are paid the wholesale value of any accumulated kWh credits.
- Net metered facilities are eligible to earn renewable energy certificates, which the system owner can sell to utilities to help the utilities meet their RPS commitments.

Connecticut also offers virtual net metering for certain types of facilities. Virtual net metering allows additional customers besides the owner to receive credits for the electricity generated by a net metered system. This can be extremely helpful for large institutions that have multiple meters (e.g., a large farm or state government complex), because the output from a net metered system can be shared among all the institution's electricity accounts while being wired to only one meter. This also allows multiple farms or government institutions to share both the costs and the benefits of a DG system. DG systems that will be using virtual net metering may be up to 3 MW in size (DSIRE 2013).

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New York

The state of New York offers net metering for distributed solar PV, wind, biomass, small hydroelectric, fuel cells, CHP, anaerobic digestion, and microturbine systems. New York's program has the following provisions:

- Maximum eligible system size varies by technology and sector, ranging from 10 kW for residential CHP systems to 2 MW for non-residential solar, wind, and small hydroelectric systems.
- Net excess generation is rolled over to the next month's bill at retail rate, with the exception of CHP and fuel-cell systems. For these two types of systems, excess generation is rolled over only at the avoided-cost rate.
- Long-term treatment of accumulated credits again varies, but depending on technology and customer sector, the credits are either rolled over from month to month indefinitely or paid to the customer at the avoided-cost rate at the end of each year.
- Aggregate capacity of net metered systems cannot exceed 3 percent of the demand for electricity generated from solar, fuel cells, micro-hydro, and agricultural biomass in a designated benchmark year (2005) (DSIRE 2014b).

California

California's net metering program dates back to 1996, and in the original form it was only available to wind and solar systems. The program has since been updated extensively, now covering landfill methane, biomass, geothermal, fuel cells, small hydroelectric, wave and tidal power, ocean thermal power, anaerobic digestion, and biogas. California's program has the following provisions:

- Systems may be up to 1 MW in size, with exceptions for up to 5 MW systems granted to municipal governments.
- Net excess generation rolls over monthly at the retail rate, and customers can choose whether to roll it over indefinitely or sell the accumulated credits at the 12-month average spot market price (hours of 7:00 a.m. to 5:00 p.m. only) at the end of each year.
- The aggregate capacity of net metered systems was originally set at 5 percent of peak demand, but differences in utility methodology for calculating peak demand led the state legislature to set absolute caps on the number of MW of net metered capacity for each of California's three largest electric IOUs. The caps are 607 MW for San Diego Gas and Electric, 2,240 MW for Southern California Edison, and 2,409 MW for PG&E. The net metering program expires when each utility reaches its cap or on July 1, 2017, whichever comes first.
- California is one of a few states that are actively developing alternatives to net metering in an attempt to avoid the cost shifts that net metering produces as the aggregate capacity of net metered systems increases. The CPUC is currently conducting a formal proceeding to gather stakeholder input on potential programs and rate structures that can replace net metering when the program expires.

Feed-in Tariff

Hawaii

In 2010, Hawaii instituted a FIT for a variety of renewable energy technologies. Owners of eligible DG installations can sign 20-year contracts with one of the three IOUs in Hawaii, wherein the utility agrees to purchase the output of the DG system at a fixed per kWh price. Eligible technologies include solar PV,

concentrating solar thermal, in-line hydroelectric, on-shore wind, and all other renewable technologies that qualify for Hawaii's RPS. The FIT price varies with the technology type and the system size. Concentrating solar plants command the highest FIT rates, followed by small (≤20 kW) solar PV and in-line hydroelectric systems (DSIRE 2014c).

Electric Vehicle Rates

Georgia

Rate schedules specifically for electric vehicles vary by utility rather than state. The plug-in electric vehicle tariff offered by Georgia Power is a good example of a residential electric vehicle rate. Each day is divided into three periods: on-peak, off-peak, and super off-peak. On-peak hours are from 2:00 p.m. to 7:00 p.m. on summer weekdays, June through September. These hours have the highest rates because this is when utilities have to deal with peak demand and thus wish to discourage the charging of electric vehicles. By contrast, the super off-peak hours of 11:00 p.m. to 7:00 a.m. have the lowest rates, because this is when aggregate demand is minimized and charging electric vehicles puts a minimal amount of stress on the grid. Regular off-peak hours fill the gap between on-peak and super off-peak hours, and their price correspondingly falls between the two (Georgia Power 2014). For customers who choose the plug-in electric vehicle rate, the charging load from their electric vehicle is aggregated with the rest of their household load in their total hourly meter reading. Though choosing this rate will save them money on the electric vehicle portion of their electricity load (assuming they charge during super off-peak hours), these customers may see their total bill increase from what it was under a flat rate if their household has high electricity demand for other uses during peak hours.

California

PG&E offers electric vehicle rates that incentivize charging between 11:00 p.m. and 7:00 a.m. (off-peak). Prices are lowest during these hours, and highest from 2:00 p.m. to 9:00 p.m. (peak). All other hours, designated "partial-peak" hours, have a price that falls between peak and off-peak prices. The partial-peak category applies only on weekdays; on weekends the partial-peak hours are absorbed into the off-peak category and use the off-peak rate (PG&E 2014c).

The most unique feature of PG&E's electric vehicle rate program is that it gives electric vehicle owners the option to meter their charging station separately from the rest of their home. This means that the vehicle charger and the rest of the home can be on different rate schedules, which is advantageous for electric vehicle owners who use large quantities of electricity elsewhere in their homes during peak hours. If they meter their charger separately and put only the charger on the electric vehicle rate, such vehicle owners can still subscribe to a flat rate schedule for the rest of their homes and avoid the high peak-hour charges they would receive if the whole house were on the electric vehicle schedule.

New York

Con Edison offers an off-peak rate of only 1.34 cents per kWh for usage between midnight and 8:00 a.m. under the voluntary TOU rate (Con Edison 2014). Unlike the PG&E rate, Con Edison's customer places their entire home on the TOU rate. Because the peak rate under TOU is higher than the standard rate, this introduces some risk that customers could pay more under the TOU rate than under the standard rate. To address this uncertainty, the voluntary TOU rate offers a price guarantee for customers who register a plug-in electric vehicle with Con Edison. Under the price guarantee, during the first year after registering their vehicle, plug-in electric vehicle customers are assured that they will not pay more over the course of the year than they would have paid under the standard rate.

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What States Can Do

Action Steps for States

States have chosen a wide variety of approaches and goals in developing their rates. Suggested action steps are described below for two groups of states: those that have already begun to address utility rates to incentivize energy efficiency, distributed renewable energy, and CHP, and those that have not.

States That Have Addressed Rates and Data Access

States that have established rate design and data access policies have found that it is important to identify and mitigate issues that might adversely affect the success of the rates. States can:

- Monitor utility implementation of rates. By doing so, a state may want to confirm that the rates are being properly communicated to customers and that the rates are not serving as unintentional barriers to energy efficiency, distributed renewable energy, and CHP adoption.
- Explore policies to give customers the data format and tools they may need to manage their energy bills.
- Monitor the impact of the rates on energy efficiency, distributed renewable energy, and CHP, as well as across customers. States have addressed significant, unanticipated, or adverse impacts through modifications such as adjusting the rate design or altering the rate qualification criteria. In considering the impact of clean energy technologies, a state may find it useful to consider the wide breadth of benefits of such technologies, and not focus solely on near-term economic impacts.
- Periodically review the evolving technologies to gauge whether rate or data access modification might be warranted. For example, in California, inclining block residential rates have long been lauded for promoting the adoption of energy efficiency. However, the recent surge in PV installations that produce more electricity than the homeowner can use at certain times of the year is raising questions about whether the inclining block rates are providing the correct incentives for PV installations under the net energy metering program.

States That Have Not Addressed Rates and Data Access

Experience from those states that have implemented rates to promote energy efficiency, distributed renewable energy, and CHP indicates that political support from PUC officials and staff is a key first step for establishing effective rates. Once support for these rates has been established, states have found that the next step is to facilitate discussion and negotiation among key stakeholders toward appropriate rate design. More specifically, states can:

- Ascertain the level of general interest and support for energy efficiency, CHP, and/or distributed renewable energy among public office holders and the public. If awareness is low, consider implementing an educational program about the environmental and economic benefits of accelerating development in order to gain policy and public support.
- Identify existing or pending policies that might be significant drivers for new energy efficiency, distributed renewable energy, and CHP. Rate revisions or new rate designs can then be presented and negotiated in the context of being consistent with and enabling these existing policy goals.
- Establish a working group of interested stakeholders to consider design issues and develop recommendations for favorable rates.
- Open a generic PUC docket to explore actual costs and system benefits of energy efficiency, distributed renewable energy, and CHP in order to inform rate reasonableness.

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Information Resources

Federal Resources

Title/Description	URL Address
The U.S. Environmental Protection Agency's (EPA's) CHP Partnership. A voluntary program that seeks to reduce the environmental impact of energy generation by promoting the use of CHP. The Partnership helps states with resources for policy development (energy, environmental, economic) to encourage energy efficiency through CHP and can provide additional assistance to states in assessing and implementing reasonable rates.	http://www.epa.gov/chp/
State and Local Energy Efficiency Action Network (SEE Action) Customer Information and Behavior Working Group. This Working Group has issued a report which discusses key state and local issues relating to customer access to energy usage data.	https://www4.eere.energy.gov/seeaction/working-group/customer-information-and-behavior
Guide to the Successful Implementation of State Combined Heat and Power Policies. The SEE Action Industrial Energy Efficiency and CHP Working Group has issued a report that informs state utility regulators and other state policy-makers with actionable information to assist them in implementing key state policies that impact CHP.	https://www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies
DOE's CHP Technical Assistance Partnerships (CHP TAPs). CHP TAPs promote and assist in transforming the market for CHP, waste heat to power, and district energy technologies/concepts throughout the United States.	http://www.energy.gov/eere/amo/chp-technical-assistance-partnerships-chp-taps
Consumer Behavior Studies. DOE is working with several SGIG award recipients who are conducting special studies to examine acceptance, retention, and response of consumers involved in time-based rate programs that include AMI and customer systems such as in-home displays and programmable communicating thermostats.	https://www.smartgrid.gov/recovery_act/consumer_behavior_studies
The National Action Plan for Energy Efficiency. A federally facilitated, private-public initiative that produced a number of resources on energy efficiency. In particular, the Customer Incentives for Energy Efficiency Through Electric and Natural Gas Rate Design briefing provides a foundation on the relationship between rates and energy efficiency.	www.epa.gov/eeactionplan http://www.epa.gov/cleanenergy/documents/suca/rate_design.pdf

Resources on Ratemaking

Title/Description	URL Address
The Regulatory Assistance Project (RAP). RAP has published several reports and presentations on utility rate design issues—for example, "Designing Distributed Generation Tariffs Well: Ensuring Fair Compensation in a Time of Transition." The RAP Library allows users to search by Rate Design within the Energy Efficiency/ Resource Planning Topic search.	http://www.raponline.org http://www.raponline.org/press-release/designing-distributed-generation-tariffs-well-ensuring-fair-compensation-in-a-time-of
Rate Design for the Distribution Edge. This report from the Rocky Mountain Institute's Electricity Innovation Lab discusses retail electricity pricing issues as use of distributed energy resources increases.	http://www.rmi.org/PDF_rate_design
Standby Rates for Customer-Sited Resources: Issues, Considerations, and the Elements of Model Tariffs. This EPA report provides background	http://www.epa.gov/chp/documents/standby_rates.pdf

Title/Description	URL Address
information on rate design and the economics of DG, then delves specifically into the topic of standby rates.	
California Net Energy Metering Ratepayer Impacts Evaluation. This study commissioned by the CPUC evaluates the net monetary impact that net metering has on DG owners, non-owner ratepayers, and society as a whole.	http://www.cpuc.ca.gov/NR/rdonlyres/C311FE8F-C262-45EE-9CD1-020556C41457/0/NEMReportWithAppendices.pdf

Other Resources

Title/Description	URL Address
Database of State Incentives for Renewables and Efficiency (DSIRE). Online database of information on incentives and policies that support renewables and energy efficiency in the United States. DSIRE is operated by the N.C. Solar Center at N.C. State University, with support from the Interstate Renewable Energy Council, Inc. DSIRE is funded by DOE.	http://www.dsireusa.org
Regulatory Requirements Database for Small Generators. Online database of regulatory information for small generators. Includes information on standby rates and exit fees, as well as environmental permitting and other regulatory information.	http://www.eea-inc.com/rrdb/DGRegProject/index.html
The Combined Heat and Power Association (CHPA). CHPA brings together diverse market interests to promote the growth of clean, efficient CHP in the United States.	http://chpassociation.org
Electricity Transmission: A Primer. This RAP publication was prepared for the National Council on Electric Policy in connection with the Transmission Siting Project. The primer is intended to help policy-makers understand the physics, economics, and policies that influence and govern the electric transmission system.	http://energy.gov/oe/downloads/electricity-transmission-primer

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