

Here Comes the Sun

A State Policy Handbook for Distributed Solar Energy



NASEO

*National Association of
State Energy Officials*



Acknowledgements

NCSL would like to thank the following entities for their contributions to this report. Sections in this report relied heavily on, “Standards and Requirements for Solar Equipment, Installation, and Licensing and Certification,” by Beren Argetsinger and Ben Inskeep for the Clean Energy States Alliance. The Database of State Incentives for Renewables and Efficiency (DSIRE) maintained by the North Carolina Clean Energy Technology Center also informed a significant amount of content. Finally, NCSL and NASEO would like to thank staff from the following organizations for providing comments on this handbook or its initial outline: the U.S. Department of Energy, the Clean Energy States Alliance, the Interstate Renewable Energy Council, the Lawrence Berkeley National Laboratory, the National Renewable Energy Laboratory, the North Carolina Clean Energy Technology Center, the Regulatory Assistance Project and the Solar Foundation, as well as Kansas Representative Tom Sloan.

Here Comes the Sun: A State Policy Handbook for Distributed Solar Energy

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About NCSL and NASEO

■ NATIONAL CONFERENCE OF STATE LEGISLATURES (NCSL)

The National Conference of State Legislatures is the bipartisan organization that serves the legislators and staff of the states, commonwealths and territories. NCSL works to build and maintain strong and independent states by providing them with the tools, information and resources needed to craft the best solutions to difficult problems. NCSL provides research across a wide variety of topics ranging from energy to education to health to fiscal policy to civil and criminal justice. NCSL is committed to the success of all legislators and staff and serves to:

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- Promote policy innovation and communication among state legislatures.
- Ensure state legislature have a strong, cohesive voice in the federal system.

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NCSL's Energy Program provides policymakers and staff with state-by-state analysis of energy issues, technical assistance, and works to help legislators in their efforts to maintain a reliable and cost-effective energy system that promotes economic development in their states. The topics covered by the Energy Program include climate and energy, energy efficiency, energy infrastructure and reliability, fossil fuels, nuclear energy, renewable energy, transportation energy and tribal energy.

Visit <http://www.ncsl.org/research/energy.aspx>, for Energy Program newsletters, publications and legislative updates, legislative tracking tools and meeting resources.

■ NATIONAL ASSOCIATION OF STATE ENERGY OFFICIALS (NASEO)

The National Association of State Energy Officials (NASEO) is the only national non-profit association for the governor-designated energy officials from each of the 56 states and territories. Formed by the states in 1986, NASEO facilitates peer learning among state energy officials, serves as a resource for and about their offices and communicates the states' views to Congress, federal agencies and the private sector.

State energy officials advise and inform governors and state legislators on energy issues and ensure that the needs and issues of industry, business and residential energy consumers are considered during energy policy, program and regulatory development. They are responsible for planning and responding to energy emergencies resulting from all hazards, including weather and cyber events and assisting in the recovery of energy systems with energy providers. State energy officials also provide education and information to the public and businesses on energy practices and technologies that aid in reducing energy waste, advance economic development, support environmental quality and enhance energy security.

Visit <http://naseo.org/> for energy planning guidelines, publications and meeting resources.

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Glossary

Aggregate Net Energy Metering: expands conventional net metering allowing a single customer to offset electrical use from multiple meters on his or her property, using a single renewable energy generating system also located on the owner's property.

Business Energy Investment Tax Credit (ITC): the 30 percent federal tax credit for solar systems on residential and commercial properties. Extended through 2019 at present value, with a gradual reduction in value over the following two years.

Database of State Incentives for Renewables and Efficiency (DSIRE): a database operated by the North Carolina Clean Energy Technology Center that provides federal, state, local and utility policy and program data.

Demand Response (DR): a coordinated process of reducing electricity consumption to relieve stress on the grid during peak hours or power outages. DR is also useful for integrating variable generation sources, such as wind and solar.

Distributed Energy Resources (DER): smaller power resources that are located close to where electricity is used. May be owned by customers and located on the customer side of the electric meter. Examples of DER include distributed generation and energy storage.

Generation (DG): power generation at the point of consumption, on the distribution grid. Rooftop solar is an example of DG.

Distribution Grid: the portion of the electric grid that is located between the transmission grid substations and individual houses or businesses.

Federal Energy Regulatory Commission (FERC): the federal entity responsible for monitoring interstate energy markets, regulating interstate transmission and wholesale electricity prices.

Gigawatt (GW): equal to 1,000 kilowatts. The average home consumes about 1.2 kilowatts of electricity on average.

Kilowatt-hour (kWh): one kWh of energy is 1,000 Watts (1 kW) of power delivered for one hour. A microwave or toaster consumes in the range of 1,000 Watts.

Net Energy Metering (NEM): a billing mechanism that credits DG owners at the retail rate for selling excess electricity to the grid.

Power Purchase Agreement (PPA): a financial agreement where a developer installs a renewable energy system on a customer's property at little or up-front no cost to the customer. The developer maintains ownership of the system and sells the power generated to the host customer at a fixed rate. PPAs also refer to long-term power purchase contracts between utilities and owners of power generation.

Public Utility Regulatory Policies Act (PURPA): a 1978 Congressional Act spawned by the energy crisis that was designed to encourage domestically produced energy from renewables and combined heat and power. PURPA requires utilities to purchase

energy from independent power producers if the cost is equal to or below the cost of the utility for producing the energy itself. The Federal Energy Regulatory Commission has jurisdiction over PURPA matters.

PV: solar photovoltaic technology, the fastest growing form of solar energy generation.

Renewable Energy Certificates (RECs): also known as renewable energy credits, represent the environmental attributes of electricity generated through a qualifying renewable energy resource. One REC is issued for every one megawatt-hour (MWh) of electricity produced by the qualifying source.

Renewable Portfolio Standard (RPS): also known as a Renewable Energy Standard (RES), requires utility companies and other electricity suppliers to source a certain amount of the energy they sell from designated renewable and clean energy sources.

Retail Energy Pricing: also known as the retail rate, a rate of compensation for electricity sold from electricity suppliers to utility customers.

Shared Renewable Energy (Shared Renewables): also known as or includes community renewables and community solar gardens. Shared renewable energy is a renewable energy system where the electricity generated directly benefits multiple customers.

Solar Renewable Energy Certificates (SRECs): also known as solar renewable energy credits, a representation of the environmental attributes of electricity generated through solar energy.

Third Party Ownership: refers to the financing mechanism for residential or commercial renewable energy installations where the entity that consumes the electricity generated is different than the system owner. With rooftop solar, for example, a homeowner can host a renewable energy system that is owned by another entity. Third party ownership agreements take the form of leases or power purchase agreements.

Time-of-Use Pricing (TOU): an approach to electricity ratemaking where prices vary based on the time of day.

Value of Solar Tariff (VoS/VOST): a payment offered to solar electricity generators based on the value of solar generation to the electric grid. Value components may include avoided fuel value, avoided generation capacity value, transmission and distribution costs, environmental costs, and others.

Virtual Net Energy Metering: a form of net energy metering that allows multiple customers to offset their energy use from a common distributed generation system. Virtual net metering can serve as a compensation mechanism for shared renewables systems.

Wholesale Pricing: also known as the wholesale rate, a rate of compensation for electricity sold from electric generators to suppliers.

Executive Summary

The rapidly transforming energy sector presents a host of opportunities, such as increased resilience, cleaner energy technologies, a more efficient and reliable energy system, as well as greater flexibility, choice and control for consumers. One of the newer sector technologies that is driving this transformation is distributed generation, with distributed solar energy leading the way.

States have played a significant role in this energy revolution by creating policies, incentives and regulations that have transformed the solar and power markets. These efforts have been motivated by a range of factors, including economic development, job creation, improved air quality, sustainability goals, economic development, energy diversification and resilience to name a few.

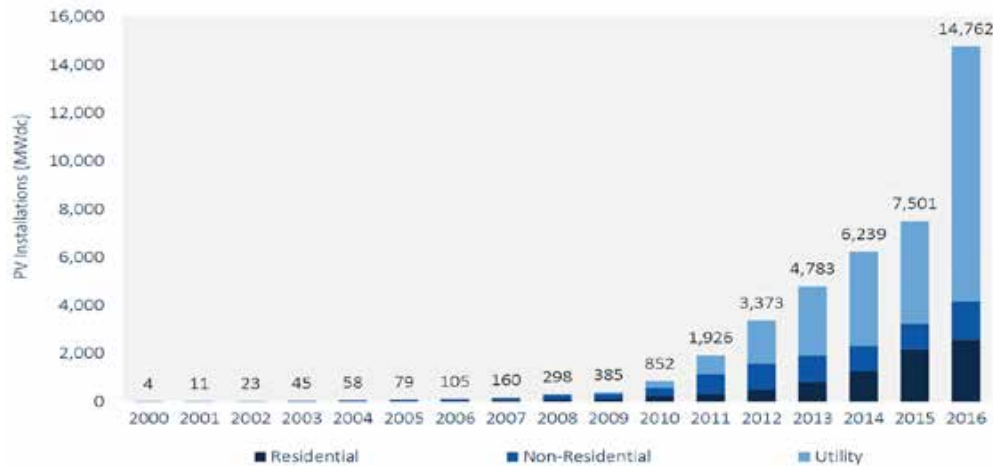
Generating power on-site and close to where it is consumed has evolved over the past 20 years, requiring states to explore new regulatory and policy approaches. Most states' electricity regulatory frameworks were designed with large centrally-owned and operated power stations in mind. Adapting the grid and its supporting policies to accommodate consumers' decisions to generate and use their own power, while sending some power onto the distribution grid, may require significant changes in regulatory and operational approaches. The technical challenges of integrating consumer-produced power are being overcome by most utilities, however, policy and operational approaches can lessen the challenge, lower costs and increase reliability as distributed power gains market share.

This handbook is designed for state legislators, legislative staff, energy officials and others who want to learn about and assess their state's distributed solar photovoltaic policies. It provides them with the tools to investigate options and practices to leverage the economic and reliability benefits of solar energy while addressing the challenges presented by this localized approach to energy generation. This document covers the many options and innovative approaches that states have implemented or considered when it comes to rate design, incentives, integration, financing, regulation and workforce development. While extensive, this report is by no means comprehensive, and provides readers with several references and resources for a deeper exploration of the topics covered.

This document will assist policymakers and planners that wish to tailor their state's energy policy to best leverage the opportunities offered by the burgeoning of distributed solar energy.



U.S. PV Installations, 2000-2016



Source: SEIA/GTM Research U.S. Solar Market Insight

Introduction

Solar electricity production is on the rise. Installations are soaring, costs are declining and the industry is growing. This rapid growth has generated greater interest in the solar energy sector, as well as questions about how to craft solar policy in the face of these changes. State legislators and energy officials are actively working to address the rapid rise of solar in a way that reflects their state's goals and markets.

This report provides state legislators, energy offices, governors and commissioners, as well as other interested parties the tools to understand the distributed solar market in their states, assess their state's policies and regulations, and determine a path forward.

THE GROWTH OF SOLAR ENERGY

Solar energy has experienced explosive growth in recent years. In the 2016 year alone, the U.S. solar market nearly doubled its annual record for installations—with 14,800 MW of new solar PV installed, a 97 percent increase over 2015, which itself had broken the previous year's record.¹

In another milestone, solar energy represented 39 percent of new capacity additions for all fuel types in 2016, outpacing natural gas for the second consecutive year.² In total, 42.4 GW of solar capacity has been installed in the U.S. as of the end of 2016, producing enough energy to power 8.3 million homes. The Solar Energy Industries Association (SEIA) predicts this amount will triple in the next five years as growth continues.³

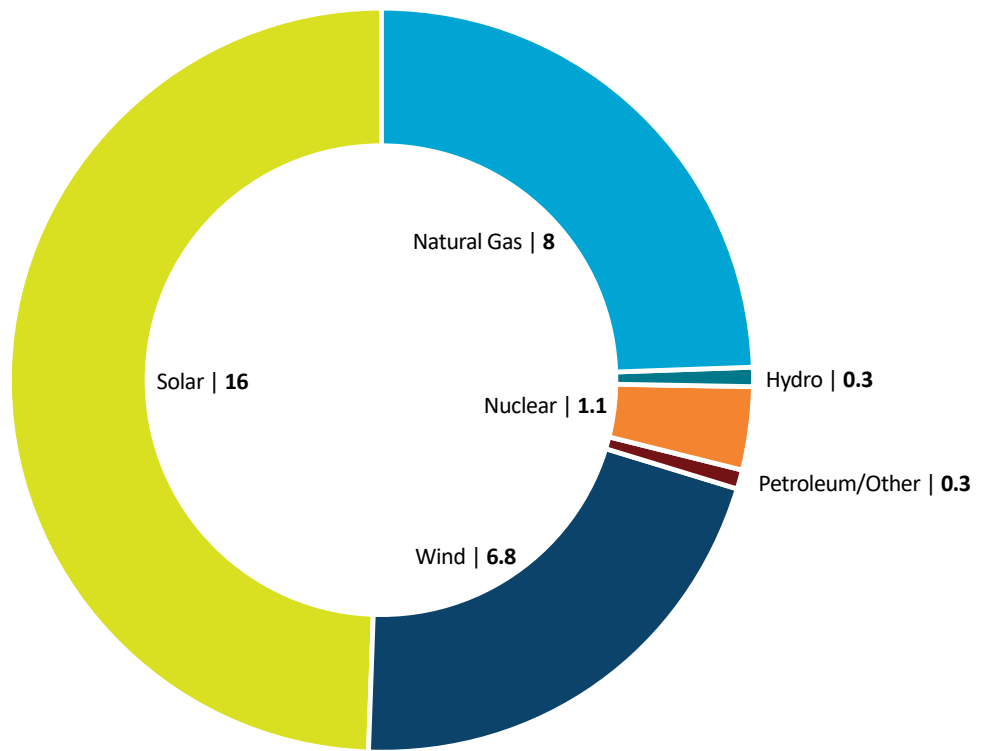
Solar energy comprises just over 1 percent of total generation in the U.S., however, and is likely to be below 3 percent for the next five years.⁴ Some states will see stronger growth in that timeframe however, with California, Hawaii, Nevada and Vermont each projected to surpass 20 percent of generation from solar.⁵

Recent innovations in solar PV technology have dramatically lowered the cost of solar energy while increasing the value proposition. The levelized cost (defined as lifetime costs divided by energy production, allowing for the comparison of various technologies across different lifespans⁶) of utility-scale solar PV has decreased 74 percent, while the levelized cost of residential solar PV has decreased 57 percent between 2010 and 2016.⁷ Additionally, the efficiency ratings on PV modules continue to improve.⁸

During the first quarter of 2017, the average total cost for a typical 6-kilowatt residential rooftop PV system was roughly \$17,000, before applying the 30 percent federal tax credit.⁹ The installed costs vary widely, however, driven mostly by differences in "soft" costs. Soft costs include: installation, permitting and interconnection fees, labor, taxes, transaction costs and indirect expenses (see "PV System Soft

U.S. Capacity Additions, 2016

In gigawatts (1 gigawatt = 1 billion watts)



Note: Solar capacity additions include both utility scale and distributed solar.

Source: Solar Electric Power Monthly, GTM Research

Costs” in State Policy Options, page 50). One Department of Energy (DOE) analysis found that non-hardware costs account for as much as 64 percent of the cost of new solar systems.¹⁰ Soft costs vary dramatically across localities and states, in part due to a patchwork of regulations across 18,000 localities and 3,000 utilities.¹¹ Some states are developing policies to decrease these costs to make it easier and cheaper for ratepayers to access solar energy. For example, California passed Assembly Bill 2188 in 2014 that required all city and county governments to adopt an expedited, streamlined permitting process for small residential rooftop solar energy systems.

SOLAR TECHNOLOGY

Solar energy technology can be divided into several categories: photovoltaic (PV), heating and cooling, and concentrating solar power (CSP). This handbook largely focuses on solar PV technology and policies.

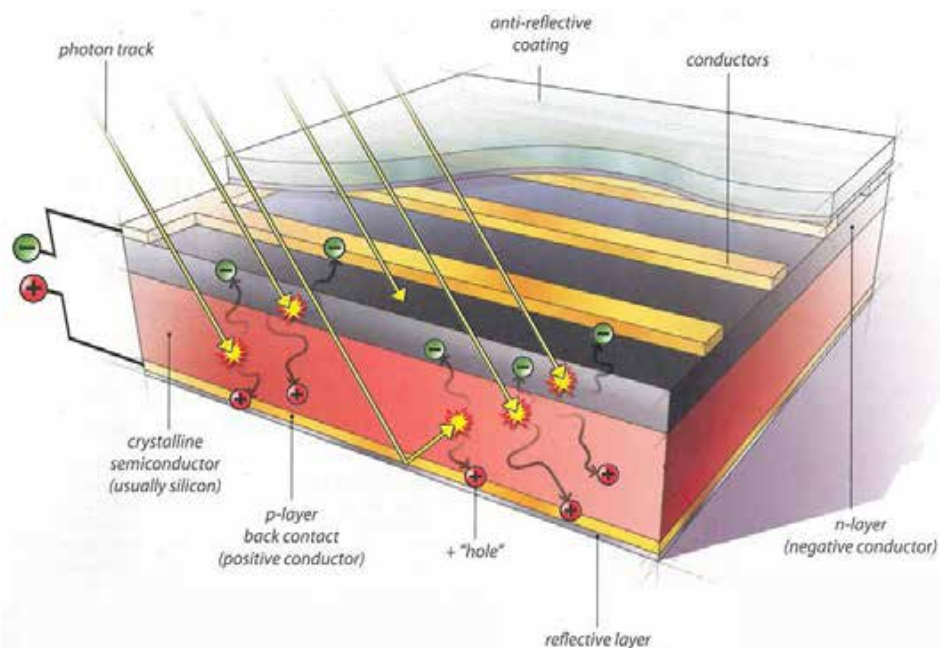
Solar PV is scalable and can be installed on roofs or other surfaces, or be mounted on the ground. This technology uses the photoelectric effect, with photons from the sun hitting the semiconductor in a PV panel, dislodging electrons, which then flow in a single direction and generate a direct current. PV systems need an inverter to change the direct current (DC) produced by the solar panels into the alternating current (AC) used by the grid.

Concentrating solar power is a large-scale solar application where mirrors concentrate thermal (light) energy to drive traditional steam turbines or engines, generating electricity. Thermal energy in a CSP plant can be stored or used directly, allowing for continuous power generation. Arizona, California and Nevada have CSP plants.¹² The falling price of PV has made CSP a less competitive option.

How Does PV Technology Work?

Photons strike and ionize semiconductor material on the solar panel, causing outer electrons to break free of their atomic bonds. Due to the semiconductor structure, the electrons are forced in one direction creating a flow of electrical current.

Source: Solar Energy Industries Association (SEIA); Illustration by Kurt Stuve



Types of Technology



Photovoltaic (PV)

This directly produces electricity which can be used, stored, or converted for long-distance transmission.



Concentrating Solar Power (CSP)

Using reflective materials like mirrors and lenses, these systems concentrate sunlight to generate thermal energy, which is in turn used to generate electricity.



Solar Heating & Cooling (SHC)

SHC generates thermal (heat) energy for water and pool heating and space heating/cooling.

Solar heating and cooling, also known as solar thermal, uses the sun's thermal energy to heat water or air. Common applications are water heating, space heating and cooling, and pool heating in the residential, commercial or industrial sectors.

ECONOMIC DEVELOPMENT

Economic development is one major reason states are seeking to grow the solar market, with the aim of driving new job and industry growth. There are now more than 650 domestic manufacturing facilities in 28 states. These jobs serve local economies, generate local tax revenue and contribute to the national solar market.

Employment in the solar energy sector exceeded 260,000 positions in 2016—a threefold increase since 2010 and one of every 50 new jobs added in 2016 was in the solar industry.¹³ According to U.S. Department of Energy, solar industry employment jumped by over 73,000 jobs, or 25 percent, in 2016. Solar energy industry employment growth in 2016 outpaced the nation's overall economic growth by 17 times. Approximately half of these solar jobs were in installation with an average hourly salary of \$26, followed by manufacturing, sales and distribution, and project development.¹⁴ Nearly 70 percent of jobs identified do not require a Bachelor's degree and veterans are employed in the industry at a rate higher than the national average.

STATE, LOCAL AND FEDERAL ROLES

Solar energy is governed by state, local and federal policies. States are the leaders in driving solar energy policy decisions, as there is no unified national energy strategy. Legislatures, governors and energy offices enact

policies that shape the viability of solar energy and its deployment. State legislatures have the authority to enable new policies, convene stakeholders, mandate certain approaches and study innovative strategies. As appropriators of the state budget, legislatures can fund new programs, initiatives or incentives. They are also the institutions that may address unintended policy consequences or market barriers. State legislatures decide whether to empower state agencies—including state energy offices or public utility commissions—to pursue specific policy approaches.

State energy offices serve as implementers of policies, fulfilling legislative directives and acting on the governor’s policy decisions. Many state energy offices oversee programs that provide financial incentives for solar deployment through grants, loans and tax credits. In many states, energy offices work with local governments and utilities to reduce soft costs of solar development through expedited permitting and interconnection. State energy offices have also advocated for broader solar access for low-income customers through community solar programs.

These state institutions are dependent on the policy environment. For example, if state legislation creates a solar carve-out in a Renewable Portfolio Standard, state public utility commissions must create regulations to ensure compliance. Additionally, if a legislature creates incentives—such as tax credits or grants—to support solar deployment, it frequently directs the state energy office to develop regulations or programs to administer these incentives.

At the federal level, Congress is responsible for authorizing incentives, including the Business Energy Investment Tax Credit (ITC). The ITC—which was reauthorized in 2015 for solar PV, solar water heating, solar space heating and cooling, and solar process heat—provides a 30 percent tax credit to systems that begin construction before 2020. The credit decreases to 10 percent beginning in 2022.¹⁵ Congress reauthorized the Residential Renewable Energy Tax Credit at the same time. This credit provides a 30 percent tax credit to solar PV and solar water heating systems placed in service by the end of 2019. The credit has two declining levels before expiring for systems installed after 2021.¹⁶

Another federal entity, the Federal Energy Regulatory Commission (FERC), regulates interstate transmission and wholesale electricity prices in addition to monitoring energy markets.¹⁷ FERC also has oversight of long-term contracts for third-party-operated renewable energy resources under the federal Public Utility Regulatory Policies Act (see “Ownership Models” in State Policy Options, page 28).

Localities can supplement state and federal policies, by adopting additional policies, incentives and regulations. For example, localities in many states have adopted policies for building energy codes and standards, grants and loans, tax credits and rebates, green power purchasing, siting and zoning, interconnection, and solar easements and access policies.

While this handbook explores how solar policies interact with all levels of government, state-level policies, programs and approaches are the focus. Each state has a unique generation portfolio, resource mix and perspective on the challenges and opportunities of solar energy. While a broad array of policy options is discussed, no single approach can be successfully applied to all states.

Questions for Consideration

To guide the reader, this handbook contains brief “Questions for Consideration” following each “State Policy Option” section. These questions will assist readers in evaluating existing solar programming in their states and options for revision or customization.

Incorporating Solar into State Energy Planning Guidelines

States conduct comprehensive energy planning to establish a strategy or framework to meet current and future energy needs in a cost-effective and sustainable manner, and to better inform state legislators and governors policy development and decision making. State energy offices, under the governor's direction and/or legislative requirements generally lead or co-lead this process. Plans are regularly revised or redeveloped, such as with an incoming Governor's new administration or when required based on legislative direction.

State energy offices engage in a process to determine the energy goals for a state and then align state departments and agencies with these goals, as well as a state's economic, societal and environmental objectives. In many states this will entail the use of stakeholders outside of government as well. State energy plans allow states to maximize use of domestic resources, improve infrastructure and kick start energy-related job creation and workforce development through targeted goals and directives that encourage economic development. A state energy plan is typically created through an extensive stakeholder engagement process to foster competitive energy markets, promote diverse energy supplies and ensure energy affordability and reliability.

The State Energy Planning Guidelines were created by NASEO to assist the 56 state and territory energy offices as they lead their respective energy-planning processes. These offices play a key role in developing and implementing energy policies and programs at the state level. As such, the guidelines recognize the leadership role of state energy offices in the development and review of state energy plans. While a state energy office may lead the planning process, collaboration with other state agencies throughout the development of a plan is encouraged to leverage the expertise and resources of those agencies and to ensure that state policy objectives are aligned across state government. Private sector engagement is also an essential part of the planning process to collect input reflecting various energy sector priorities and goals. State and local government agencies use state energy plans to support legislative and regulatory decisions and actions and the private sector can utilize these plans to inform investment decisions, so broad stakeholder engagement is critical.

State governments view renewable energy as both a solution to address environmental, energy security and resiliency challenges, as well as an economic development opportunity. The increase in renewable energy generation of the past 10 years is largely attributable to states' energy policies and incentive programs. Innovative policies and strategic programs designed by state energy officials and implemented through legislation have served as catalysts to increase installed renewable energy capacity in states across the country. Well-designed interconnection standards and permitting practices all serve to bring down the non-hardware "soft costs" of solar and other technologies. Decreasing the soft costs of distributed generation is important; in the case of solar photovoltaics, for example, soft costs can account for up to 64 percent of total costs. Renewable Portfolio Standards (RPS)—also called Renewable Energy Standards (RES)—and net metering have been primary policy drivers for creating markets for renewable energy within a state, particularly when an RPS is designed with a distributed generation carve-out (set aside). While the content of a state energy plan will be unique to each state's forecasted energy needs and constraints, as well as state-specific economic drivers, the competitive cost and increasing availability of solar has deemed this resource an integral element in state-set priorities, goals and planning processes.¹⁸

Innovative policies and strategic programs designed by state energy officials and implemented through legislation have served as catalysts to increase installed renewable energy capacity in states across the country.



State Policy Options

Compensating Solar Energy Producers

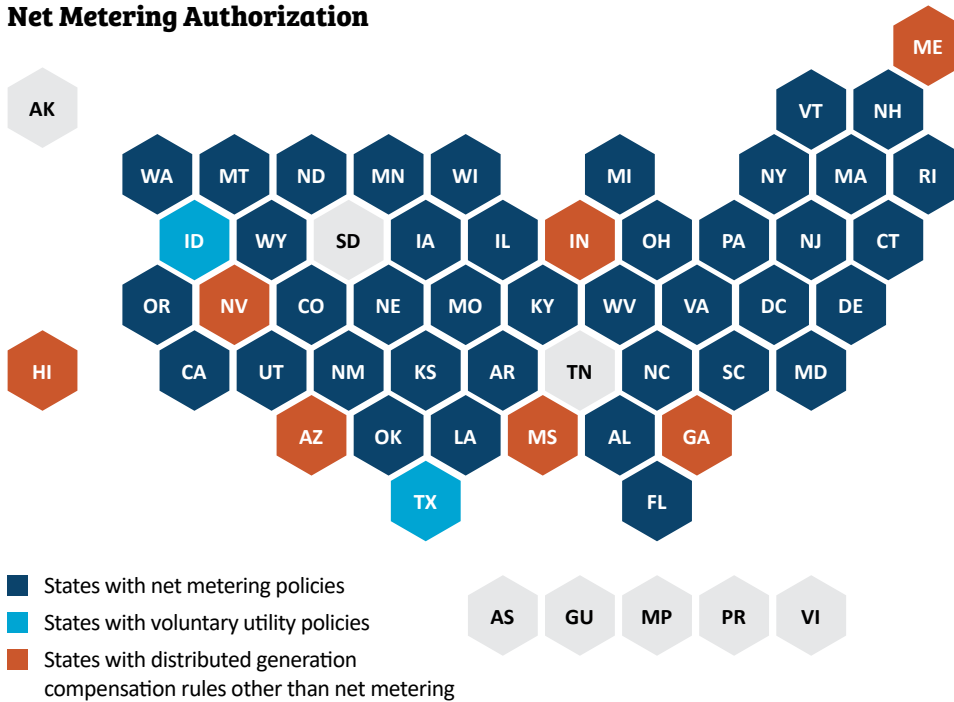
Paying customers who send electricity to the grid is a relatively new approach for utilities. The most broadly used practice to compensate consumer-producers, which spread rapidly during the past two decades, is net-metering. This approach of crediting customers at retail rate for the energy they produce arose when solar was a very small player in the energy market. The rapid increase in rooftop solar adoption has driven discussion on net metering and rates in nearly all states. Much of the conversation revolves around whether net metering, or other compensation methods, are best for creating a level playing field without shifting costs from one customer to another.

NET METERING

The most common policy, active in 37 states, for compensating distributed solar owners is net energy metering, also known as net metering. Net metering policies allow distributed generation customers to sell excess electricity to the utility at retail rate and receive credit on their utility bill. The credit offsets the customer’s electricity consumption during other times of the day, reducing the amount of electricity the customer needs to purchase.

Net metering is seeing significant growth. In 2016, approximately 2.6 gigawatts of net-metered solar capacity were added to the grid.¹⁹ Minnesota was the first state to adopt net metering compensation at the retail rate in 1983 and at the policy’s height, 44 states, Washington, D.C. and several territories had net metering policies.²⁰

Net Metering Authorization



Source: NCSL and Database of State Incentive for Renewables and Efficiency (DSIRE)

Thirty-seven states, Washington, D.C., and four territories provide net metering as of May 2017. Utilities in two additional states—Idaho and Texas—have voluntarily adopted net metering programs.²¹ Eight states—Arizona, Georgia, Hawaii, Indiana, Maine, Nevada, New Hampshire and Mississippi—have

statewide distributed generation compensation rules other than net metering. Georgia Power—Georgia’s largest electric power company—credits distributed generation customers at the avoided cost rate (the marginal cost for a producer to generate one more unit of power), which has attracted very few subscribers.²² Mississippi’s policy credits customers at the utility’s avoided cost plus a premium for electricity exports.

In 2015, regulators in Hawaii ended conventional net metering and replaced it with options for customers to utilize energy storage and not export solar to the grid or to export solar to the grid and be compensated at a reduced rate. Indiana passed Senate Bill 309 in 2017 to phase out net metering. Existing systems and those installed by the end of 2017 will be grandfathered for 30 years. Customers who install systems after 2017 will receive compensation at the utility’s marginal cost, plus 25 percent, beginning in 2022. Beginning Sept. 1, 2017, new distributed generation customers in New Hampshire will receive cash credits at 100 percent of retail energy and transmission charges and at 25 percent of distribution charges. Minnesota still offers net metering but has also created a value of solar tariff as an alternative to net metering. For more information regarding these policies see the “Next Generation Approaches” section.

Policy Variations

While a majority of states and territories have authorized net metering, they have taken differing approaches by varying capacity limits, eligible technology, net metering credit retention and renewable energy credit (REC) ownership.

■ CAPACITY LIMITS

States can set system capacity limits to regulate the size of net metered installations. They can also establish aggregate capacity limits—also called aggregate caps—to regulate the amount of net metered systems that are allowed to participate in a state’s or utility’s net metering program.

Individual system capacity limits are determined in a variety of ways and differ across states. For example, Wisconsin has authorized net metering for systems up to 20 kilowatts (kW), while Arizona caps systems at 125 percent of a customer’s total connected load. Nearly half of states with net metering policies have system capacity limits of two MW or less, while at least one state—Ohio—has authorized net metering with no specific capacity limit. System capacity limits can also vary based on utility type or provider (Oregon and Colorado), customer type (West Virginia), technology (New York) and system type (Pennsylvania and Connecticut).

While some state net metering policies specify an aggregate capacity limit, other states have not and a few states have discretionary caps. Most states with aggregate caps have percentage-based caps that are based on the peak demand, while a handful of states specify the number of megawatts covered by the cap. Aggregate caps can vary with regard to utility type or provider (Hawaii), customer type (Massachusetts) and technology (New York).

■ ELIGIBLE TECHNOLOGY

States include a variety of technologies in net metering policies. While all states with net metering include solar PV in their policies, they may also include: wind micro-turbines, combined heat and power or cogeneration, biomass, biogas, landfill gas, municipal solid waste, anaerobic digesters, geothermal electric, fuel cells, small hydroelectric, tidal energy, wave energy, ocean thermal and fuel cells powered by renewable sources.

■ COMPENSATION

State policies address how long customers can maintain or “roll over” bill credits for net metered electricity. Virtually all states credit excess generation to the next monthly billing period or allow distributed generation customers to select this option. Not all states, however roll over credit at the full retail rate.²³ An important distinction among policies is whether credits for excess generation can expire or can be carried over indefinitely; states have taken a range of approaches to address this. For example, Alaska credits excess generation to a customer’s next bill and credits may be carried over indefinitely. In Hawaii, excess generation is credited to a customer’s next bill at retail rate but excess credits are granted to the utility at the end of an annual billing cycle. These compensation policies may vary based on factors such as system size (Minnesota) or technology (New York).

Shared Renewable Energy

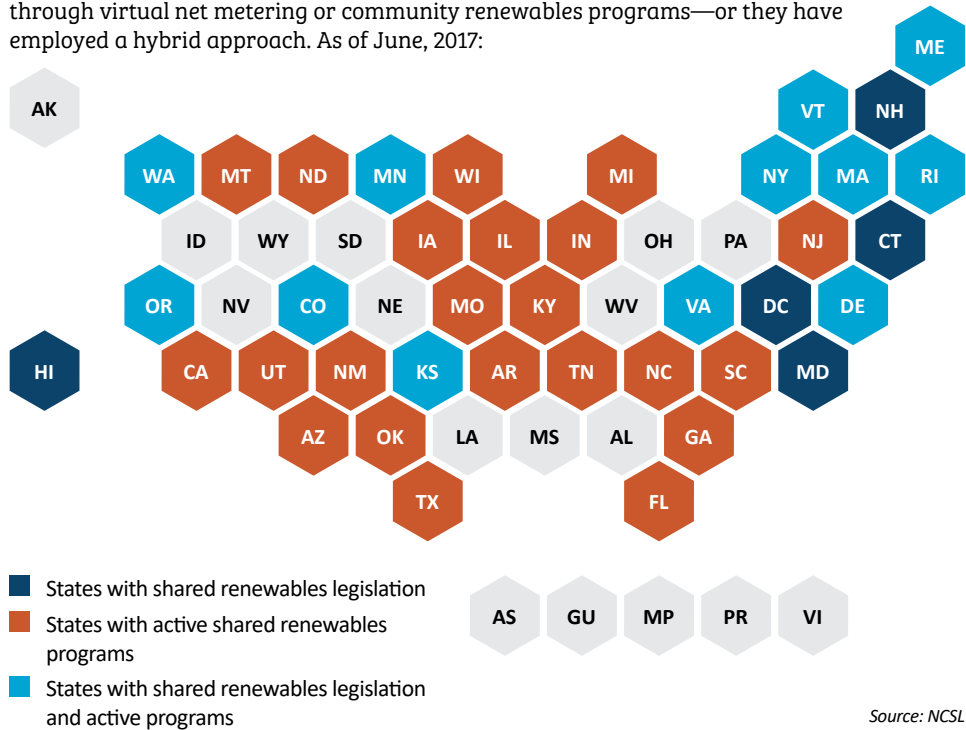
Virtual and community net metering, as well as initiating shared renewable programs or pilots, allow the creation of shared renewable energy programs, which offer customers who are unable or unwilling to install on-site distributed generation systems the opportunity to benefit from distributed renewable energy generation. Shared renewable programs can provide access to renewable energy to customers in multi-family residences, condominiums or those with roofs incompatible with solar arrays.

This emerging policy area quadrupled in the 2016 year, as more states enable shared renewable energy and developed installations.²⁴ At least 17 states and Washington, D.C., have legislation authorizing shared renewables. States can adopt different policies to arrive at the same outcome of developing shared renewable systems:

- Virtual net metering allows multiple customers, including tenants in a multi-family property or condominium owners, to offset their energy use from one or several shared distributed generation systems.
- Community net metering operates similarly to virtual net metering, but typically is offered to a wider array of customers—such as those in a particular geographic area or utility service territory.
- Community renewable projects—also known as shared or community solar, community solar gardens, shared clean energy or shared renewables—allows multiple customers to purchase interest in shared renewable energy systems located on-site or off-site. Participating customers receive benefits from the shared system through either virtual net metering, bill credits, community solar credits or another compensation mechanism. Utilities can also initiate or lead individual projects.

State Shared Renewables Action

States have taken one of two legislative paths to authorize shared renewables—through virtual net metering or community renewables programs—or they have employed a hybrid approach. As of June, 2017:



Source: NCSL

While the majority of shared renewables projects are solar projects, there is also a small number of shared wind projects operating in several states. At least 10 of the states with shared renewables legislation include provisions to allow for other renewable energy technologies than just solar, such as wind, biomass or geothermal.

Similar to individual net metering, appropriate valuation of shared renewables presents a challenge for regulators and remains an ongoing discussion. Determining a value for compensating generation from shared renewables facilities can be difficult, and although many stakeholders agree that credit for generation should be included, there are varying opinions on including transmission and distribution costs in compensation systems. In general, compensation rates and the perceived value of the renewable energy produced are specific to the communities in which shared renewables projects are located.

EMERGING COMPENSATION METHODS

While net metering policies have been responsible for expanding access to the benefits of distributed renewable energy, they have also generated questions of equity and cost-shifting. Originally designed to spur a nascent technology, net metering's success has led to debates on the policy's sustainability in virtually every state legislature or utility commission.

Critics argue that the compensation received by net metering customers unintentionally allows them to avoid paying for the cost of maintaining infrastructure and the electric grid, which may shift this cost burden to lower-income utility customers. Additionally, some feel distributed generation users should not be credited at the higher retail rate for excess electricity generation, but rather at the lower avoided cost or wholesale rates.

Net metering supporters contend that net metered resources, such as solar, provide utilities with economic benefits by supplying energy at peak times when producing and acquiring energy is most costly, reducing the need for transmission upgrades or the construction of new generation, while contributing to reliability and emissions goals.

Some utilities, especially investor owned utilities, are concerned about net metering in part due to the way they are regulated in most states, where they earn a return on the capital they own and recover most of their costs through electricity sales. Net-metered solar reduces utility sales and utilities' potential to earn income on new capital investments as well. Numerous discussions are taking place in states across the U.S. about how to regulate utilities in a way that better aligns customer and utility goals, particularly when it comes to distributed generation sources such as rooftop solar.

Two states with on-going net metering debates are Arizona and Nevada.

- In late 2016, Arizona and Nevada ended conventional net metering and voted to adopt alternative compensation methods for energy sent back to the grid. Net metering discussions in these states are continuing, however.
- In late 2016, the Arizona Corporation Commission (ACC) voted to end conventional net metering and created a separate rate class for rooftop solar customers. The ACC will determine the new solar export compensation rates through individual utility rate cases. In all future rate cases, regulators can choose to employ a "Resource Comparison Proxy" methodology—based on large-scale solar pricing in each utility territory—or an avoided-cost methodology to determine the export rate. Existing net metering customers will stay on their current rate plans for up to 20 years from their interconnection date. In March 2017, Arizona Public Service and other solar interests filed a settlement with the ACC on rate design and rooftop solar compensation. If approved by regulators, the settlement would allow rooftop solar customers to choose from four rate design options including a time-of-use rate with a grid access charge and a demand-based rate without a grid access charge. Existing solar customers and those who file for interconnection before a decision is issued in the rate case will be grandfathered for 20 years. For new rooftop solar customers, the settlement outlined rates for energy exported to the grid and for the energy offset by self-generated solar. The export rate would decline 10 percent annually, while the offset rate would depend on individual usage and system size, orientation and production.
- After Nevada reached its legislatively set net metering aggregate cap in August 2015, state regulators implemented a new solar tariff structure that reduced rooftop solar compensation from the retail rate to the avoided cost rate.²⁵ The new tariffs did not grandfather in existing net metering customers, and Nevada became the first state to make such a move. In September 2016, the Nevada Public Utilities Commission reversed this decision and restored conventional net metering to customers

who installed solar by Dec. 31, 2015, while new solar customers are to be compensated at the avoided cost rate.²⁶ Nevada also enacted Assembly Bill 405 in June 2017 reinstating net metering for rooftop solar customers in the state. New solar customers will be compensated for the energy they export to the grid at 95 percent of the retail electricity rate. The credit will reduce in 7 percent increments for every 80 MW of rooftop solar deployed, eventually decreasing to 75 percent of the retail rate. The bill also includes several consumer protection provisions (see the “Consumer Protection” section, page 40).

State legislatures and public utility commissions (PUCs) are debating the best way to balance customer demand for distributed generation with the impacts new technologies have on the electric power grid. The increase in net metered solar has launched a more comprehensive discussion about properly evaluating the effects and benefits of new technologies, such as energy storage, smart meters, distributed energy and energy management tools. Several of the alternative methodologies described below attempt to comprehensively value distributed energy resources (DER), not only solar energy.

It should also be noted that each of these methodologies can be addressed through one of two general approaches: net billing or “buy-all, sell-all.” A net billing approach allows customers to consume energy generated behind the meter with a retail rate credit, while exported energy is credited at a different rate. A buy-all, sell-all approach credits all exported energy at a non-retail rate and does not allow for behind-the-meter consumption.²⁷

California’s Successor Tariff

In 2013, California passed Assembly Bill 327 requiring the California Public Utilities Commission (CPUC) to create a successor tariff for net metering, also termed NEM 2.0. The legislation assigned program limits for the state’s three major utilities based on generating capacity. Once programs reach their caps or after July 1, 2017, utilities must offer distributed generation customers a standard contract or tariff determined by the California Public Utility Commission. The CPUC decided in January 2016 to preserve the retail rate credit through 2019 and guarantee net metering credits for existing customers for 20 years after they are connected. The decision also requires all new net metering customers to be subject to provisions under a new successor tariff, which includes interconnection fees, non-bypassable charges for all electricity consumed from the grid and participation in time-of-use rates.

Hawaii’s Grid-Supply and Self-Supply

In 2015, the Hawaii Public Utilities Commission issued a ruling that ended conventional net metering.²⁸ All new grid-connected customers with solar, after Oct. 12, 2015, are required to choose between a “Grid-Supply” and a “Self-Supply” option. The Grid-Supply option functions like conventional net metering, however customers are compensated at a location-based fixed rate for excess electricity sent to the grid. The cap on the grid-supply option was already reached in late 2016 and a docket is currently open on the matter. Customers under the self-supply option are not allowed to export excess electricity to the grid and would need to use energy storage to decrease their electricity consumption from the grid and reduce their electricity bill. Self-supply customers are also eligible for an expedited review and approval of their systems. Under the self-supply option, residential customers are required to pay a minimum bill of \$25 per month and small commercial customers are required to pay a minimum bill of \$50 per month.

Location-Based Valuation

As DG proliferation increases, states are exploring alternative valuation methods that incorporate the value of the benefits that distributed energy resources provide to the grid. One such method is location-based valuation, or locational valuation. Through this model, value is placed on the benefits that DER provide to the local distribution system. The value of DERs to the local distribution grid depends on their location on the distribution grid as well as the qualities of DER that contribute the necessary characteristics of availability, dependability and durability to the grid. Locational valuation provides incentives for DER that are sited in locations with optimal grid integration or those that are close to load centers. Distributed generation that is intentionally sited may also reduce grid congestion and the need to make costly upgrades.

Several states are exploring location-based valuation for distributed generation, particularly those with

Types of Net Metering



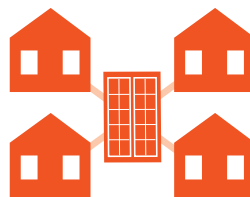
Conventional Net Metering

- Solar on a single property
- One meter on-site
- Example: House



Aggregate Net Metering

- Solar on same or adjacent property
- Multiple meters on-site
- Example: Farm



Virtual Net Metering

- Solar on-site or off-site, many properties
- Savings spread through subscribers
- Example: Shared renewables

Source: *Institute for Local Self-Reliance*

high solar and DG penetration, including California, Hawaii and New York. A small number of states are studying ways to value DERs based on their location and to deploy DERs at optimal locations and in ideal quantities to maximize their benefits to the grid and reduce utility customer costs.

California's PUC is currently undertaking two proceedings, the Integration Capacity Analysis (ICA) and the Locational Net Benefit Analysis. Together, these proceedings are designed to provide a better understanding of where distributed resources can be added to the grid without infrastructure upgrades and their value at each location. In the ICA proceeding, the state's three big investor-owned utilities—San Diego Gas & Electric (SDG&E), Pacific Gas & Electric (PG&E) and Southern California Edison (SCE)—are collaborating with DER providers to study the characteristics of local distribution systems to develop a better understanding of where customer-sited resources can be readily added to the grid. In its draft final report, the ICA working group identified the proceeding's two primary objectives: to improve the DER interconnection process through identifying how much DER can be added at any interconnection point on the distribution system and to integrate DER into utilities' distribution system annual planning through identifying optimal locations for future DER development.²⁹ Working with DER providers, the three utilities will meet these objectives by developing a methodology to identify optimal grid locations where DERs can connect and by creating publicly-accessible online system maps that include detailed, downloadable system data. Among the states currently studying location-based valuation of solar and other DER, California's investor-owned utilities are further along than any other U.S. distribution system operators in mapping granular distribution grid data.

Similarly, New York is also addressing locational valuation as part of the state's Reforming the Energy Vision (REV) initiative. This initiative is New York's foundational proceeding that aims to transform the state's energy economy into one that focuses on customers, embraces market and business model innovation, and is efficient, clean and reliable.³⁰ One of the primary purposes of the REV initiative is to "develop accurate pricing for DERs that reflect the actual value DERs create."³¹ To study the value of DER to the state's grid, the state Public Service Commission (PSC) is employing the LMP+D model. In this model, "LMP" is the locational marginal price of energy on the wholesale side, and "D" represents the value of the distributed energy resources to the distribution grid. According to this model, the full value of DER to the system will only be complete when the value of the DERs on the distribution grid are added to the location-based marginal wholesale price of the energy.

In April 2017, the New York PSC issued the Value of Distributed Energy Resources order as part of the REV initiative. The Value of DER Order establishes a new pricing methodology, which is based on the avoided utility cost combined with additional metrics that place values on qualities such as location and environmental benefits.³² The order requires utilities to file schedules and work plans within 45 days to develop new pricing values. Rooftop solar will continue to be eligible for full retail net metering until 2020, when compensation credits will gradually decrease.

TARIFFS

Tariffs are regulatory commission-approved frameworks and rules that dictate how DG customers are compensated for their contribution to the grid. In addition to fairly compensating DG customers, these frameworks must also preserve the financial integrity of the utility and ensure equity for non-DG customers. While net metering is the most widely-implemented method for compensating distributed generation, feed-in tariffs and value of solar tariffs have also been adopted for DG compensation.

Feed-in Tariffs

Feed-in tariffs (FITs) were originally designed to support nascent renewable energy technology, provide incentives for investing in new technologies and reward early adopters. This tariff structure functions similar to a power purchase agreement (PPA). Under a FIT, customers enter into a long-term contract with a utility and sell all the output from their renewable energy system to the utility at a pre-determined rate for a fixed amount of time. Customers then purchase all their electricity from the utility at the retail rate. Instead of designing the compensation rate around the utility's avoided costs or the value of the energy produced, FITs typically base the rate on the customer's cost for the



distributed generation investment.

While FITs have been adopted in several European countries, they have been less commonly used in the U.S. One reason for this low adoption is the conflict between this tariff structure and PURPA, which prevents state utility commissions from requiring utilities to pay more than their avoided costs for purchased energy. To sidestep PURPA, the compensation rate for many of the FITs adopted in the U.S. have been set through market forces, by state legislatures or by utilities on a voluntary basis.

Although there has been little activity on feed-in tariffs in the last couple years, more than half a dozen states and at least one U.S. territory have adopted feed-in tariffs at either the state, municipal or utility level. For example, in 2009, Vermont enacted House Bill 446 adopting a FIT and requiring all retail electricity providers to purchase electricity generated by solar, wind, biomass, landfill gas, farm methane and hydroelectric facilities. Contracts for solar under the FIT are between 10 and 25 years. In response to 2012 legislation, the Vermont Public Service Board (PSB) established a new market-based pricing mechanism that awards contracts through a Request for Proposals process.³³ In 2014, the Virgin Islands enacted Legislative Bill 4 requiring the Public Services Commission to create a FIT for solar PV systems. The resulting program offers solar PV customers a standard contract with terms between 10 and 30 years and compensates them at \$0.26 per kilowatt hour (kWh). The compensation rate will be periodically reviewed based on the avoided cost rate of the utility.

Value of Solar Methodology

A number of states have considered the value of solar (VOS, or VoST) tariff as a replacement for net metering. This compensation method is designed to capture the value that solar installations provide, along with costs they may create, for the electric system. Under existing VOS program designs, solar customers continue to purchase all their electricity from the grid at the utility's retail rate while receiving credit for the electricity produced by their panels at the approved VOS rate. Unlike net metering, customers are charged for all electricity they consume and credited for all electricity they produce, and are not credited for the net amount exported to the grid.

The VOS rate attempts to include the variety of costs and benefits that solar may create for the grid rather than simply crediting the fixed retail rate. The VOS rate is locked in for a specified period of time—more than 20 years in Minnesota for example—whereas net metering credits fluctuate with the retail price. By including both costs and benefits, the VOS rate addresses the concerns of cost-shifting to non-solar customers. VOS may allow utilities to better understand and manage electricity demand by allowing them to see how much solar electricity is being generated by the consumer along with how much they are consuming.

Only Minnesota and Austin, Texas, have adopted VOS policies to date. Austin's VOS program is active for residential customers of the city's municipal utility. However, as of January 2017, no eligible utility in Minnesota has chosen to implement a VOS rate. In 2013, Minnesota enacted House File 729 requiring the Minnesota Department of Commerce to develop a "value of solar" methodology for the Minnesota Public Utilities Commission (PUC).³⁴ The tariff will serve as a voluntary alternative to net metering. The Department of Commerce was required to submit a final methodology in January 2014 to the PUC and the PUC approved the tariff in April 2014. The legislation also authorized community solar gardens (see "Shared Renewables" section, page 12). If a utility elects to use the VOS, this tariff also applies to community solar garden customers.

Hawaii's Community-Based Renewable Energy Tariff

Another example of a tariff structure is Hawaii's community-based renewable energy program. In 2015, Hawaii enacted Senate Bill 1050 that required electric utilities to design a community-based renewable energy tariff to be filed with the Hawaii Public Utilities Commission (PUC) by October 2015. In response to utility filings, the Hawaii PUC filed an order in February 2017 creating a tariff framework for compensating community-based renewable energy projects that will be rolled out in two phases.³⁵ Compensation for participating projects will vary based on project location and the time of day the project provides power. The order established specific rates for midday, on-peak and

off-peak hours. The framework also breaks down participating projects into three categories—standard projects, peaker projects and utility projects—based on operating entity, output during peak hours and percent of capacity provided to low- and moderate-income customers. Rates will range from \$0.15 per kilowatt hour (kWh) to nearly \$0.33 per kWh, depending on the island and the time of day.

Questions for Consideration

- What is the status of your state’s net metering policy (if it has one)?
- What is the policy outcome for distributed solar compensation that your state is seeking to achieve? What mechanisms might best achieve these goals?
- Is your state Public Utility Commission (PUC) already acting in this area and would legislative involvement benefit stakeholders?
- Is the PUC considering specific approaches for individual utilities or a standard regulatory approach for all utilities?
- Which would be a more favorable approach in your state?
- Do municipal utilities and electric cooperatives fall within the jurisdiction of your state PUC? If so, these policy debates apply to those entities as well.

Rate Design and Solar

The growth of distributed generation, such as rooftop solar, has generated unique challenges for traditional rate design and utility business models. Under the traditional regulatory model, utilities build and operate centralized power generation and PUCs authorize them to recoup capital and operating expenses through charges in customers’ bills. In this model, both fixed costs (a new power plant or utility infrastructure) and variable costs (fuel and operating costs) are repaid through a combination of fixed and variable rates. How quickly a utility recoups costs is dependent on electricity sales. Under this model, actions that reduce sales, including energy efficiency and rooftop solar, may threaten utility profits. Since customer-owned solar power policies often allow customers to generate electricity and be credited for the amount they send back to the grid, utilities lose out on electric sales. Utilities may also experience increased uncertainty about cost recovery since several years may pass between PUC rate adjustments, depending on the state.

Utility commissions and policymakers with little experience in valuing the benefits and costs of newer technologies are now challenged with designing rates that appropriately value distributed generation while balancing the interests and concerns of utilities, solar customers and customers without solar.

In many states, policymakers, regulators and utilities are raising concerns about the potential for cost-shifting due to net metering, which compensates solar owners by crediting them at retail rate for energy they put back on the grid. Since these customers pay lower-than-average electricity bills, some feel that net metering customers don’t pay enough for the transmission and distribution infrastructure they are still using, shifting an unfair burden to non-distributed generation customers. Others contend that the value of solar electricity provides the utility with benefits that are equal to or greater than retail rates, since it reduces peak load and congestion, and can forestall costly infrastructure upgrades.

Very few states have seen enough net metering to create significant cost-shifting, according to a recent study. A report by the Lawrence Berkeley National Laboratory (LBNL) concluded that at the current penetration level of 0.4 percent of total U.S. retail electricity sales, the effects of distributed solar on retail electricity prices are negligible—less than a 0.03 cents per kilowatt-hour (kWh) increase.³⁶ The report found that at high penetration levels (such as 10 percent of electricity sales), distributed solar could increase or

decrease retail electricity prices five percent under full net metering. For a utility with electricity prices at the national average, this equates to a 0.5 cent per kWh increase or decrease in retail electricity prices.

Instances of cross-subsidization and cost-shifting are common in the electricity sector. While rate structures often subsidize low-income customers or those who live in rural areas, there is also precedent preventing utilities from passing costs to non-participating customers.³⁷

Small-scale solar and other distributed energy resources can provide benefits—such as reduced emissions, improved grid security and increased resiliency—that regulators may find difficult to quantify since they may not normally be monetized in traditional rate design. Distributed generation also reduces the need to construct new generation facilities and transmission lines, and may assist utilities in improving reliability and reducing grid congestion. These technologies, however create new operational challenges for entities managing distribution grids.

State legislatures have been active participants in this debate by authorizing net metering, commissioning studies on the costs and benefits of the policy and encouraging utility commissions to consider rate design alternatives. Legislators are balancing a number of considerations, including access, equity and other stakeholder concerns. While states have explored a range of policies, some legislation has created a framework for utility regulators to consider. Many components of rate design, however are left to the expertise of utility regulators.

POLICY CONSIDERATIONS

Government and industry leaders are considering alternatives to traditional regulatory approaches for a number of reasons, although the rapid growth of distributed generation is a significant factor. Additional factors include flat or declining electricity sales in many states, utility infrastructure replacement needs, increasing energy efficiency, grid modernization and environmental regulations.³⁸

Although utility commissions are responsible for approving investor-owned utility rates and determining what expenses those utilities can recoup, state legislatures set the framework and guiding policies within which utilities and commissions operate. Legislation can request commissions to explore specific rate designs options and commission studies. (Public power utilities and electric cooperatives are usually “self-regulated,” meaning that state policies exempt them from many of the requirements applicable to investor-owned utilities. The authority of utility commissions to regulate these consumer-owned utilities varies considerably from state to state.)

States across the U.S. are discussing distributed solar energy and rate design, with 47 states and Washington, D.C. taking action on these issues in 2016.³⁹ Among these actions, 71 entities proposed or enacted residential fixed charge increases in 35 states and Washington, D.C. and 73 entities in 28 states proposed or enacted changes related to net metering. This follows a trend that started in 2015, when regulators, policymakers and utilities in at least 46 states studied, proposed or enacted changes to rate design policies.⁴⁰ Already in the first quarter of 2017, 40 states and Washington, D.C. are considered action in this area.⁴¹

Beyond the specific rate designs explored in the following pages, states have enacted a number of other policies to address utility compensation challenges due to growing distributed generation, including decoupling sales from revenue, lost revenue adjustments, formula ratemaking and more frequent rate cases.⁴²

When engaging with utilities, commissions, consumer advocates, energy officials, economists, solar developers and environmental organizations, policymakers may wish to consider:

- What policy outcome is sought?
- How a particular model affects all stakeholders, including participants, nonparticipants and utilities.
- The message that rates may or should send to customers, and whether this can easily be achieved with the desired rate design.
- Does the attempt to address one issue create another elsewhere? For example, some are concerned that certain approaches to address distributed generation—such as increasing the fixed portion of the bill while lowering the volumetric portion—negatively impact energy efficiency choices.

- How knowledgeable are customers when it comes to reading utility rates and bills? Do they understand complex policies and will these policies achieve the desired customer behavior?

Below are the main approaches being proposed, discussed and implemented:

PERFORMANCE-BASED REGULATION

Performance-based regulation (PBR) rewards utilities for exhibiting a desired outcome or performance. While traditional cost of service regulation encourages capital intensive projects, the focus of PBR is on a series of intended outcomes (the method of achieving outcomes is not prescriptive and can be determined by the utility). Governments, such as Great Britain and New York, are redesigning incentives to reward utilities for new behaviors like increasing energy efficiency and demand response, improving resiliency or heightening customer satisfaction. In this model, utilities can test different approaches and, if successful, receive a share of the savings generated.

In 2014, New York created the Reforming the Energy Vision (REV) initiative, which serves as a statewide, comprehensive roadmap for building a clean, resilient and affordable energy system. It is the first state to begin a comprehensive reworking of its utility compensation model through performance-based incentives and a more accurate pricing schemes for distributed generation.

INCREASING FIXED CHARGES

Discussions around fixed charges have burgeoned in the past year, with 35 states considering adjustments (usually increases) to fixed charges in 2016.⁴³ As mentioned earlier, utility bills include variable and fixed portions, although the largest portion of most consumer bills are variable charges based on consumption. Utilities seeking increases in fixed charges state that most of their costs are fixed, not variable, and that the bill should better reflect this cost distribution. This approach also would mean that solar customers, who are currently offsetting most of their variable consumption charges through net metering, pay a larger share of the costs of building and maintaining infrastructure. The discussions have explored increasing fixed charges for all residential customers or focusing increases just on those with grid-connected solar.

Utilities tend to prefer higher fixed charges since they create a more stable revenue stream, removing the uncertainty of predicting changes in consumption. From a consumer viewpoint, however, higher fixed and lower variable charges weaken price signals. Economic theory indicates that higher fixed charges will provide less motivation for customers to engage in energy efficiency or conservation efforts, leading to increased consumption. Ultimately, increased consumption necessitates more generation and transmission infrastructure, leading to higher system costs, which are passed on to the consumer. A shift to higher fixed costs may increase the energy burden on low-income households since they often use less electricity than average residential consumers.⁴⁴ Higher fixed charges can also reduce the financial incentive for adopting distributed solar.

Fixed charges rely on the idea that fixed costs should be recovered through fixed charges, however, different stakeholders disagree on the definition of “fixed.” Economists believe all costs are variable in the long term. Utilities, which have definite fixed costs in the short term, may disagree. If consumers do not view a cost as fixed, they may not believe a fixed charge is the most appropriate mechanism for revenue recovery. Some may cite gasoline for instance, which is sold on a purely volumetric basis, despite there being fixed infrastructure costs in the short term for extraction and delivery.

The rapid growth of the fixed charge discussion is highlighted by a North Carolina Clean Energy Technology Center (NC CETC) study, which analyzed the large amount of fixed rate proposals that arose in 2015 and 2016. The organization found that utilities were granted 53 percent of their requested increases in the third quarter of 2016, indicating that utility commissions did not always agree with an increase or the degree of an increase.⁴⁵ The study identified 61 utilities in 30 states that proposed fixed charge increases greater than 10 percent for all residential customers in 2015, although few were approved at their initial level. Interest in fixed charges is expected to remain high in the coming years.

While a minimum bill is a separate component from a fixed charge, many principles are similar to the

policy discussed above. Minimum bills ensure that customers still contribute monthly, even if their energy use is zero. A minimum bill requirement would not affect most customers since their fixed and variable energy charges would be above the minimum. The demographics that may have bills low enough to trigger these charges would be distributed generation and net metering customers, customers with strong seasonal electricity use, or those with vacant or vacation properties.⁴⁶ According to the Lawrence Berkeley National Laboratory, minimum bills do not have widespread use and while they do not disincentivize efficiency as much as fixed charges, they also recoup less revenue.

DEMAND CHARGES

Demand charges are based on the highest usage, or peak demand, of a customer in a specific time frame (in 15 minute intervals or over an hour) during a billing period. This rate is typically based on a “non-coincident peak,” which means it is applied to the individual customer regardless of when the customer’s highest usage occurred. “Coincident peak” demand charges, which are based on each customer’s highest demand during the period of greatest total demand for the utility, are far less common. Demand charges may also include a “ratchet,” where the customer’s demand charge in any given billing period cannot be less than some specified fraction of their highest demand in the previous year. Historically, demand charges have been widely used for large commercial and industrial customers that have a more significant incremental impact on infrastructure, rather than used for individual residential customers.⁴⁷

If a residential customer’s demand charge peak is coincident with the utility’s peak, a customer’s usage may be adding to the infrastructure sizing needs and increasing overall costs. In this case, demand charges create an incentive for a customer to reduce or shift their usage, which can lower peak demand and utility costs. According to NC CETC, many existing or proposed residential demand charges are based on non-coincident peak demand, which may not align charges based on the highest costs to the system.⁴⁸

Some feel that demand charges aren’t the most effective or economically sound approach to capturing solar’s costs to the grid, however, stating that residential customers are not as sophisticated as industrial consumers that are accustomed to demand charges. If residential customers don’t know how to access or understand demand charges, individuals may be less able to change usage to decrease their electricity bills. There is also concern that demand charges may shift cost to certain customer groups who contribute minimally to system peaks—such as low-use and low- and moderate-income customers, and customers living in multifamily dwellings that have less control over their peak demand usage.⁴⁹

A limited number of mass-market demand charge rates are in place across the U.S. As of May 2016, utilities in more than a dozen states offer demand charge rates to residential customers. For example, two utilities in Arizona—Salt River Project (SRP) and Arizona Public Service (APS)—currently offer demand charges. Salt River Project (a public utility) introduced a tiered demand charge rate that increases with a customer’s peak consumption in 2015. Demand charges are mandatory for all SRP customers with distributed generation. Arizona Public Service first introduced demand charges in 1981 and now offers demand charges on an opt-in basis. This APS rate has the highest enrollment of any residential demand charge rate in the U.S.⁵⁰ Currently, no investor-owned utility in the U.S. has a mandatory or opt-out demand charge rate for residential customers.⁵¹

In recent years, utilities in a number of states have taken action on demand charges. According to NC CETC, there were 21 actions on demand and solar charges in 13 states in 2015, and in 2016 there were 16 actions in 10 states.⁵² With specific regard to residential demand charges, five utilities proposed these charges in 2016 however, all proposals were denied by regulators. Furthermore, over the past two years, no public utilities commission has approved a mandatory residential demand charge.

If demand charges are carefully implemented and fully understood by customers, they may help to reduce peak demand and produce cost savings to all customers. However, very little data exists on the impacts of demand charges on residential customers and their effectiveness to decrease peak demand.⁵³

TIME-BASED RATES AND DYNAMIC PRICING

Dynamic pricing is another type of rate design that includes time-based or time-of-use rates, critical peak pricing, peak time rebates and real time pricing. These approaches more accurately represent actual system costs, and signal customers to shift or reduce their energy use during periods of peak demand when the cost of providing electricity is highest. Dynamic pricing can decrease peak demand, allow flexibility in meeting demand and better reflect the time-variable cost of providing electricity. The various models of dynamic pricing typically require two-way smart meters to communicate pricing information between a consumer and the utility. While dynamic pricing has been used in the U.S. since the 1970s, the concept has gained popularity over recent years as an alternative rate design model.

When designing time-of-use rates (TOU), utilities divide the day into set periods of “on-peak” and “off-peak” hours. These rates help customers know ahead of time which periods of the day will be most costly, and allow customers to save money by shifting their usage to lower-cost periods. This model does shift responsibility to customers however, and some demographics may have difficulty adjusting their energy use. Furthermore, if too many hours are designated as on-peak, customers may be unable to avoid consuming during peak hours. Despite being the more economically transparent approach, a change to time-based rates is likely to create higher bills for some and lower bills for others, which can cause some pushback by those who see increases.

One example of a TOU program is TXU Energy’s Free Nights & Solar Days program, a 100 percent renewable time-of-use program.⁵⁴ To offset customers’ usage, the utility purchases solar power and renewable energy credits. Enrolled customers have access to free wind electricity all night from 9 p.m. to 6 a.m. and pay for solar electricity all day from 6 a.m. to 9 p.m. TXU Energy encourages customers to shift their use of large appliances to the free nighttime hours and adjust programmable thermostat settings to take full advantage of the program.

Critical peak pricing (CPP) and peak-time rebate are variations on the TOU concept that incentivize customers to reduce usage on critical peak days of the year. Under CPP, utilities set much higher prices for critical periods—during expected shortages or anticipated high-use, for example—and customers agree to pay the increased price for usage during that time. Utilities are limited on the number of days that can be designated as “critical,” typically between 3-12 days per year. Utilities may concentrate those days into a single on-peak season, for example summer or winter, depending on when the overall system peak occurs. Customers are given one-day advance notice of when critical peak periods will occur. Although these rates are generally opt-in, they have been largely successful in reducing critical peaks. In contrast to CPP, peak time rebates use a carrot rather than the stick, by providing a credit on the bills of customers who reduce usage during a peak-time event.

Utilities in most states offer time-of-use rates, however they are generally optional programs. A handful of states are transitioning or are considering transitioning to default TOU rates for residential customers. For example, California enacted Assembly Bill 327 in 2013 that gave the Public Utilities Commission the authority to direct investor-owned utilities to adopt TOU rates beginning Jan. 1, 2018. In 2015, the CPUC

Dynamic pricing is another type of rate design that includes time-based or time-of-use, critical peak pricing, peak time rebates and real time pricing ... Dynamic pricing can decrease peak demand, allow flexibility in meeting demand and better reflect the time-variable cost of providing electricity.

ordered the state's three largest investor-owned utilities—SDG&E, PG&E and SCE—to transition from voluntary to default TOU rates by 2019.⁵⁵ Some solar analysts have raised concerns that this transition could lower compensation for net-metered solar owners. Research by Greentech Media estimates the value of net-metered solar could be reduced by 15 to 20 percent for residential systems in SDG&E's service territory and by 20 to 40 percent for certain entities in PG&E's territory.⁵⁶

Under the real-time pricing model, customers are charged the actual prices for energy being set in wholesale markets or short-run marginal generation costs, with prices varying hour by hour. With increased adoption of smart technologies, customers are able to monitor energy prices, respond to price changes and realize the benefits. However, these programs may pose risks to customers who are unable to shift their use outside of high-price hours.

Questions for Consideration

- What is the policy outcome for distributed solar generation that your state is seeking to achieve? What compensation mechanisms might best achieve these goals?
- Has your state legislature set parameters of rate design that the PUC can or cannot consider?
- Is your state Public Utility Commission (PUC) already acting in this area and would legislative involvement benefit stakeholders?

Solar Incentives and Market Building Policies

While other sections of this publication have explored solar regulations, policies and programs, many states seek to encourage solar energy through financial incentives. Tax credits, direct cash incentives, RPS or RES policies and others, also can encourage solar deployment. Financing also serves as a market building policy, although it is discussed in a subsequent portion of the toolkit. These types of incentives reduce the cost of solar systems by either lowering the initial cost of a system or providing financial benefits after installation. The two most common types of state financial incentives are cash and tax incentives. While this section focuses on incentives for solar PV systems, other technologies such as solar thermal and passive solar may be included in these incentives.

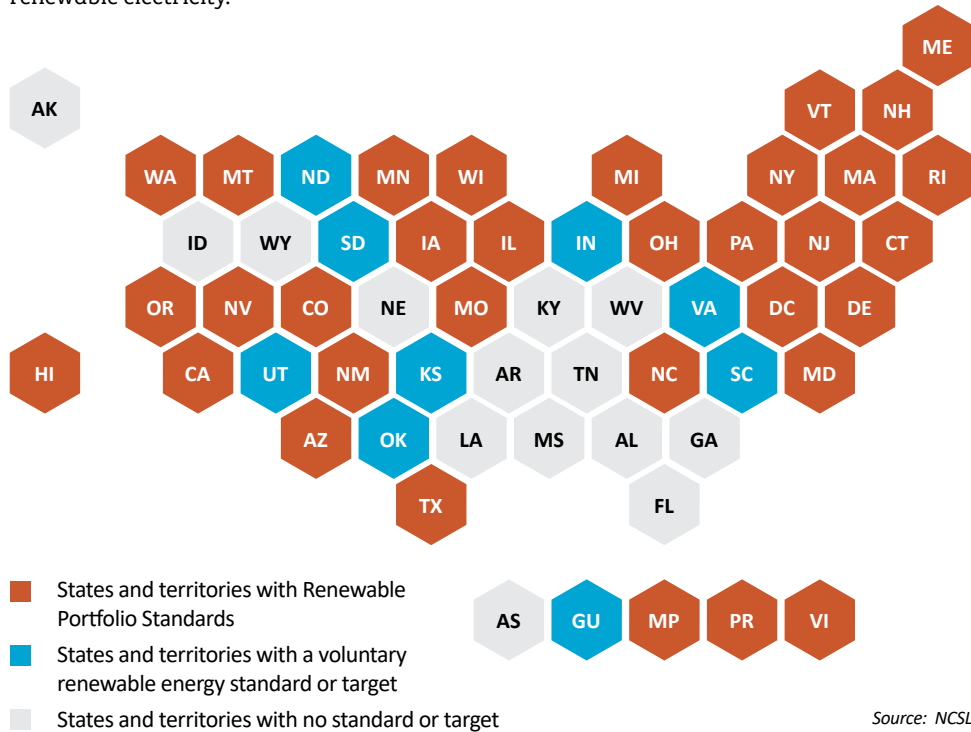
Much of the content referenced in this section is from the North Carolina Clean Energy Technology Center's Database of State Incentives for Renewables and Efficiency (DSIRE). Visit the DSIRE database for additional information.

Renewable Portfolio Standards/Renewable Energy Standards

The policy intent of Renewable Portfolio Standards is to drive the growth of renewable energy generation. These standards require utilities to sell a specified percentage or amount of renewable electricity. As of May 2017, 29 states, Washington, D.C., and three territories have adopted an RPS, while eight states and one territory have set non-binding renewable energy goals. Utilities can satisfy RPS requirements through building new generation or buying renewable energy certificates (RECs) and solar RECs (SRECs).

Renewable Portfolio Standards

29 states have standards that require utilities to sell a specified percentage or amount of renewable electricity.



Some states have established solar or distributed generation set-asides or carve-outs, requiring that a certain percentage of a state’s RPS be met with solar energy or DG. States have also established credit multipliers for solar and distributed generation. At least 22 states and Washington, D.C. have an RPS with solar or distributed generation provisions. For example, Illinois requires that 6 percent of the annual requirement under the state RPS be met with solar PV, while Delaware requires that 3.5 percent of the annual requirement is met with solar PV by 2025-2026. Oregon and Washington have established solar and distributed generation credit multipliers under their RPS policies. Oregon has a credit multiplier for solar PV installed before 2016, while Washington has a credit multiplier for distributed generation. Depending on state regulatory structures, utilities may meet RPS or carve-out requirements by building new generation or by purchasing RECs from third parties or customer-owned generation.

Several states—including Delaware, Massachusetts, Maryland, New Jersey and Ohio—have specific SREC programs. The New Jersey Board of Public Utilities requires investor-owned utilities in the state to enter into long-term contracts for SRECs as a means of increasing price certainty.⁵⁷ Massachusetts made significant changes to the state’s SREC program in early 2017, by replacing it with the Solar Massachusetts Renewable Target (SMART).⁵⁸ Under the new program, 1,600 MW of solar would be developed in 200 MW blocks, with declining incentives for each subsequent block. Incentives would be based on customer classes, with additional incentives for projects on preferred locations or serving low-income customers.

Tax Incentives

Tax incentives are one of the most common types of financial incentives for solar and other renewable energy sources. Relative to other forms of financial incentives, tax credits are fairly simple to administer and are generally more politically viable than direct cash incentives because they do not require states to appropriate funds. However, certain entities that do not have a tax liability, such as schools and government facilities or low-income customers may be unable to take advantage of these incentives. Several types of tax incentives exist, including personal and corporate investment tax incentives, property tax incentives and sales tax incentives.

Personal and corporate investment tax incentives provide a direct reduction in a taxpayer's tax liability for a portion of the cost of purchasing and installing a solar energy system. While these tax incentives are typically implemented at the state-level, municipal governments can also offer credits or exemptions for income, franchise or other similar taxes to encourage solar development. More than a dozen states offer personal and/or corporate investment tax credits.

As installing a solar energy system typically increases an entity's property tax burden, states have established property tax incentives. These incentives mitigate or eliminate the increase in assessed value of a property attributable to a solar energy system installation. Property tax incentives are particularly viable in states with high property tax rates.

More than half of states have established statewide property tax incentives. Several other states have established local option property tax exemptions, which authorize, but do not require, municipalities to pass ordinances to exempt residential renewable energy systems from taxation. In response to the recent growth in large-scale solar facilities, a handful of states have developed separate tax incentive policies for utility-scale solar generating facilities. For example, Nevada allows new and expanded businesses to apply for a property tax abatement of up to 55 percent for up to 20 years for real and personal property used to generate electricity from renewable energy resources including solar.⁵⁹ Eligible generation facilities must have a capacity of at least 10 megawatts and must plan to be in operation for at least 10 years. Furthermore, Colorado enacted House Bill 1101 in 2014 exempting a portion of community solar gardens from property tax. The percentage of electricity capacity of a community solar garden that is attributed to residential subscribers, governmental subscribers or certain organizations is exempted from property tax.

Finally, states have established sales tax incentives to reduce the costs of installing a solar energy system. These policies provide an exemption from or refund of sales tax for the purchase and installation of solar energy components and systems. Nearly half of states offer some form of sales tax incentive for solar installation, while a handful of states authorize, but do not require, local governments to provide sales tax incentives for solar installations.

Public Benefits Funds

Another policy tool that states can use to provide long-term funding for renewable energy programs, including solar, is a public benefit fund (PBF). Public benefits funds are typically formed through adding a small surcharge on electricity consumption by customers (typically served by investor-owned utilities), however some states have established PBFs as a result of utility merger settlements and other activities. States establish PBFs to provide direct incentives and financing for renewable energy projects, energy efficiency, low-income programs, business development and industry recruitment activities, as well as research and development. States can establish state level PBFs or grant municipalities authority over their local electric utility to establish PBFs. Additionally, states can allow municipal utilities or electric cooperatives to "opt-in" to state-level PBF programs. Nearly half of states have established public benefits programs that support solar projects.

Direct Cash Incentives

Direct cash incentives—rebates, grants and performance-based incentives—reduce the initial equipment costs for solar energy systems. The policy intent of direct cash incentives is to stimulate markets, such as early stage solar deployment, or for low-income customers. Although unlike tax incentives, direct cash incentives apply to a broad range of participants (including non-taxpaying entities), they require explicit funding mechanisms. Direct cash incentives are typically implemented at the state level and by individual utilities, however local governments may offer these incentives also. More than half of states offer direct incentives for solar that are either implemented at the state level or by individual utilities.

Rebates, which are incentive payments issued to a purchaser after a solar energy system has been installed, are one type of direct cash incentive. Rebate programs can be implemented at the state or local government level or by individual utilities. Sixteen states and territories have rebate programs that include various solar technologies—10 of which have rebates specifically for solar PV. A majority of these PV-eligible rebates are for residential customers and include several common approaches, such as percentage-based, production-based or flat-rate rebates, or a combination of these. While there are

common structures for rebates, states offer a range of compensation. For example, Wisconsin offers a rebate for 12 percent of residential and commercial solar PV installation costs, while California offers a rebate of up to 75 percent of system costs for solar PV on affordable housing. New Jersey's new residential construction rebate for solar PV is a flat-rate incentive based on housing type (single-family, multi-family, etc.) with individual maximums established. Delaware offers a rebate to Delmarva Power customers based on production, customer class and ownership model (for residential customers only). For example, residential customers with solar leases or power purchase agreements receive a flat incentive of \$1,000 while resident-owned systems receive \$0.55 per Watt for the first 5 kW and then up to \$0.20 per Watt for up to 50kW.⁶⁰

Grants provide funding for larger projects and typically involve more detailed, competitive applications. For example, Maryland has at least two state-implemented clean energy grant programs that incorporate solar: the Residential Clean Energy Grant Program and the Commercial Clean Energy Grant Program. The residential program provides financial incentives to homeowners that install solar water-heating, solar PV (up to 20 kW) and geothermal heating and cooling systems.⁶¹ Grants are available on a first-come, first-serve basis, and when funds are exhausted, additional funds may be appropriated in the annual budget. Through the commercial program, Maryland offers grants for solar water-heating, solar PV (up to 200 kW) and geothermal heating and cooling systems installed by businesses, nonprofits and local governments.⁶² Grants are available on a first-come, first-serve basis, and the program expires when funding is exhausted.

Performance-based standards, also known as production-based incentives, help secure financing and offset financing costs through providing a revenue stream. This type of incentive is based on the actual energy output of a renewable energy or solar energy system and are disbursed over a specified time period. Feed-in tariffs and RPS REC purchase programs are two types of performance-based standards. Performance-based standards exist for various utilities in nearly half of states.

Feed-in tariffs require energy suppliers to buy electricity produced from renewable resources at a fixed price, usually at a premium price over a long-term period. While this policy has not been widely adopted in the U.S., several states, localities or utilities have established feed-in tariffs.

Community Choice Aggregation

Another policy that states have implemented to encourage the adoption of renewable energy, is community choice aggregation. These policies enable local entities to aggregate electricity contracts within a specific jurisdiction to procure electricity as a group, rather than as individuals. Those with aggregation still retain their existing electricity provider for transmission and distribution services.

States may consider allowing aggregation as a way to give local governments the means to reduce electricity costs, provide power from local sources or purchase energy from renewable sources. A handful of states allow for community choice aggregation. In 2015, approximately 1.9 million customers received 7.4 million megawatt-hours of renewable energy through CCAs. For the most recent year compiled, Illinois had the largest number of CCAs with renewable energy, and California saw the largest market growth.⁶³

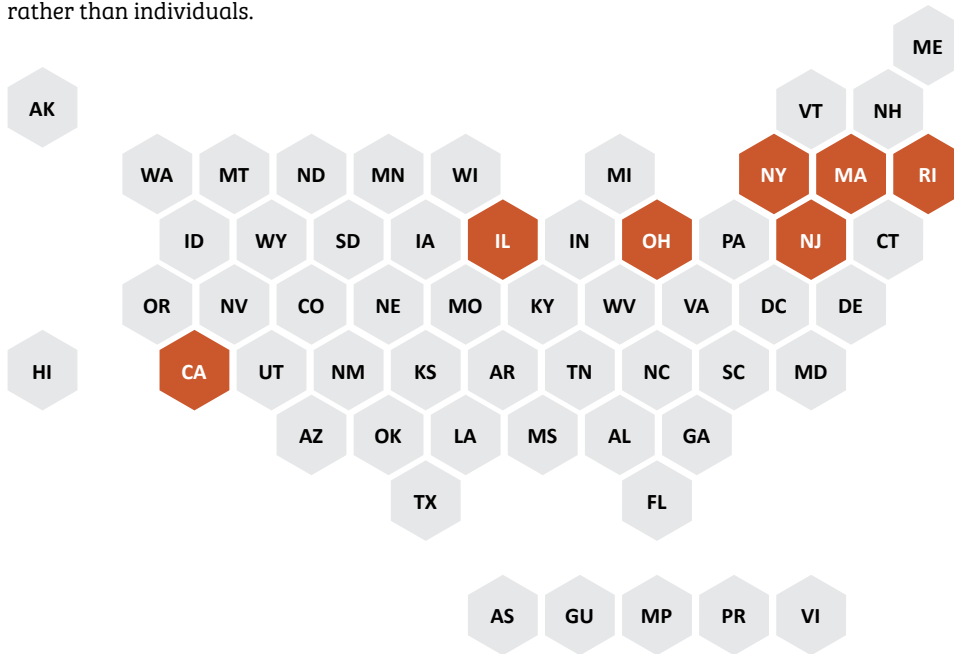
Industry Recruitment and Support

States and local governments have implemented various financial incentives to encourage growth in solar and renewable energy businesses, create jobs and provide customers with increased access to renewable energy. Industry recruitment and support incentives are typically loans, grants and tax incentives—including property tax abatements and corporate tax exemptions and credits. These incentives are designed to promote the establishment or expansion of renewable energy manufacturing operations and support research, development and commercialization efforts, as well as encourage private partnerships to invest in solar and renewable energy companies.

More than a dozen states currently have solar industry recruitment and support incentives. States have taken a variety of approaches with these incentives. For example, states may create programs that have minimum thresholds for job creation, production output and investment. Incentives may also be based on product sales from a manufacturing facility. Additionally, states can grant local governments the authority to establish industry development programs.

States with Community Choice Aggregation Policies

Community choice aggregation policies enable local entities to aggregate electricity contracts within a specific jurisdiction to procure electricity as a group, rather than individuals.



Source: NCSL

Bonds

A handful of states have established renewable energy bonds that include solar technologies. For example, New Mexico established a bond program that authorizes up to \$20 million in bonds to finance energy efficiency and renewable energy improvements in state government and school district buildings.⁶⁴ Idaho passed Senate Bill 1192 in 2005 allowing non-utility developers of renewable energy projects—including solar PV and solar thermal—in the state to request financing from the Idaho Energy Resources Authority, a state bonding authority. Finally, Utah created a local option industrial facilities and development bonds program that allows counties, municipalities and state universities to issue Industrial Revenue Bonds or Industrial Development Bonds to promote industrial development and manufacturing facilities. The program was expanded in 2013 to include energy efficiency upgrades and renewable energy systems as eligible projects.⁶⁵

Questions for Consideration

- What incentives does your state offer for solar energy? Are incentives directed to type, size and location of solar deployment?
- Have these incentives been effective in achieving your policy goals? Are any revisions needed?

Ownership Models

In addition to traditional ownership models, a variety of other arrangements have arisen in recent years. Ownership models vary based on size, customer access, financing and additional factors.

UTILITY OWNERSHIP

Depending on state law, utilities may be able to own a combination of community or shared solar, and smaller rooftop solar generation. Utilities see several financial and logistical benefits to owning distributed and shared solar energy generation. Utilities realize revenues and benefits through owning and maintaining distributed generation, as opposed to experiencing reduced cost recovery caused by lower electricity consumption and lost capital investment when the asset is owned by a consumer or third party. Since utilities have an existing billing relationship with their customers, they have access to a large base of potential solar customers, including low- and moderate-income households. Utilities also have an idea of where solar installations may benefit the grid and best satisfy congestion or peak demand needs. They may also have a streamlined process for permitting, financing and planning new energy installations that can reduce costs and time.

Utilities are capital-intensive entities with a large customer base that are often able to recoup investments through rates. Thus, they have access to favorable financing and may receive significantly more competitive interest rates than other entities. Utilities may have difficulty passing on the benefits of federal tax incentives to their rate base however, under the Internal Revenue Service's normalization rules. Finally, utilities can meet state Renewable Portfolio Standards by owning these assets. Increasingly, large corporations are seeking to meet aggressive renewable energy goals or carbon emissions reductions with commercial-scale renewable energy purchases. If utilities can satisfy this demand through distributed solar, they are at lower risk of losing electricity sales.

However, utilities are monopolistic enterprises and other solar stakeholder may be wary of the effects that a lack of competition may have on customer costs. Utilities' ability to include costs in rates places them at an advantage over independent power producers and third party companies, since they don't have to compete to keep costs as low as possible. Also, since they are virtually guaranteed an opportunity to recoup their capital costs, utilities may have a competitive advantage over non-utility entities that must remain profitable to survive.

Utilities in traditionally regulated states can own large-scale solar energy generation, while investor-owned utilities in restructured states may be restricted from owning generation, except in certain circumstances. Additionally, in the 17 states and Washington, D.C. that have authorized shared renewables, utilities can own those installations in just six of those jurisdictions. While this is a limited number of states, the Interstate Renewable Energy Council estimates that approximately 79 percent of all shared renewables programs nationally are utility-administered.⁶⁶

Although states may prohibit utilities from owning distributed solar generation, there have recently been more efforts to explore utility DG ownership. In July 2015, Georgia Power launched a solar sales and installation service through an unregulated arm of the utility. The entity, Georgia Power Energy Services, will determine if homeowners are eligible for a distributed solar system, and then either provide installation services or connect the customer with an installer. Georgia Power does not offer financing or leasing to customers. While the program received high customer interest in its first year, a small number of contracts have been signed.

In 2014 the Arizona utility Tucson Electric Power (TEP) received permission from the Arizona Corporation Commission to launch a utility-owned residential solar program. The program is limited, with a \$10 million spending cap, and adds customers in 3.5 MW blocks. Program participants have a \$250 processing fee and receive a set, 25-year compensation rate based on historical consumption. TEP contracts with third party entities to install and maintain the solar energy systems. Another Arizona utility, Arizona Public Service, has also launched a utility-owned residential rooftop solar program. The state Renewable Energy Standard requires investor-owned utilities to meet 30 percent of their annual requirement for renewable electricity sales through distributed generation.

A recent utility partnership involves the utility National Grid and the nation's second largest rooftop solar provider, Sunrun. The entities announced a collaborative effort experimenting with different rooftop solar approaches: rooftop sales to residential customers, using rooftop solar to help balance the grid by aggregating distributed generation and customer behavior research. The effort initially targets 100,000 single family homes in New York.

THIRD PARTY OWNERSHIP

Although not authorized in every state, third party solar developers and companies can help expand customer and utility access to solar energy, meet a Renewable Portfolio Standard or achieve corporate sustainability goals. These entities can either contract with utilities to provide power or certain services, or—as is more common in states where it is allowed—contract directly with retail customers to provide renewable power.

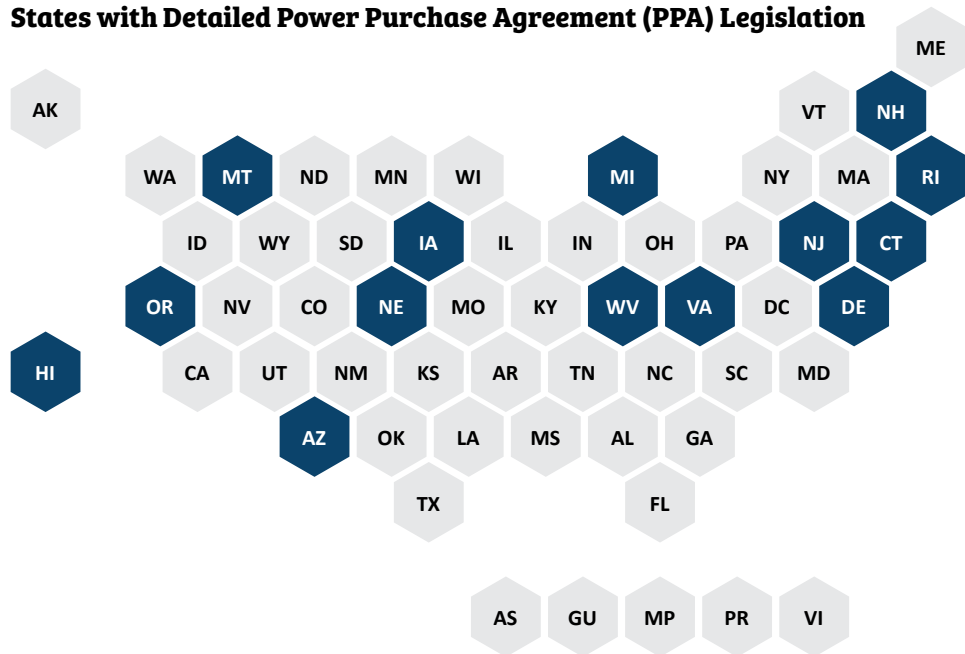
Third party entities can serve different functions, from installing or performing maintenance on solar equipment to owning, financing and building solar energy systems. As mentioned above, utilities can also contract with third parties for installations and maintenance, such as in Arizona and Georgia. These entities can expand or drive markets for solar energy and help meet customer demand for renewable energy. Third party companies may develop specialization in this area, leading to streamlined processes, increased efficiency and reduced costs. As businesses, they can transfer successful practices to new state or regional markets more easily than a utility. Third party solar companies can benefit from federal, state and local tax incentives and may have substantial experience in accessing these benefits. These entities also assume a larger share of risks and remain responsible for the operation and maintenance of systems. Third party financing may be structured so customers either pay no up-front costs or only a partial cost; customers may also be able to purchase the system before the end of a lease term.

However, third party entities are not allowed to sell electricity to end-use customers in a number of states and may not have access to financing rates as low as utilities. Also, consumer protection concerns surrounding third party entities and fair business practices for residential solar have increased in recent years (see more in “Consumer Protection” section, page 40).

Under the federal Public Utility Regulatory Policies Act (PURPA) of 1978, third party entities can build, own and maintain “qualifying facilities” of smaller grid-scale or commercial solar energy installations, selling the electricity at a utility's avoided cost rate to utilities, corporations, individuals or power markets through long-term power purchase agreements or leases. Power purchase agreements (PPAs), or energy service agreements, are contracts between a provider—typically an independent electricity generator or system owner—and a buyer that are used to finance and implement renewable energy installations.⁶⁷ PPAs may be attractive because they facilitate the delivery of predictable, lower cost energy, as well as renewable energy certificates and tax credits, without large upfront costs. PPAs also require the owner or developer to assume much of the risk, providing security and assurance to the customer. Corporations and private-sector entities represent a growing segment for purchasing new PPAs, accounting for more than 7 GW of domestic renewable energy capacity.⁶⁸

Although a majority of states have statutes mentioning or defining PPAs, 15 have enacted substantive legislation to authorize and regulate these agreements.

States with Detailed Power Purchase Agreement (PPA) Legislation



Source: NCSL

PPAs can help meet a state’s Renewable Portfolio Standard or allow third party rooftop solar providers to operate. To promote PPAs, most state legislation gives the public utility commission the power to direct or allow local utility companies to enter PPAs with qualifying independent generators, such as in Connecticut, Hawaii, Oregon and Rhode Island. Michigan and Washington have passed legislation requiring commission approval for utilities entering PPAs longer than a designated length of time. Additionally, state legislation—such as in Iowa—addresses interconnection by directing utilities to facilitate the transmission of electricity from third party generators directly to individual customers. Finally, a third party entity leasing to a tax-exempt entity cannot claim the federal Business Energy Investment Tax Credit unless a PPA is used.⁶⁹

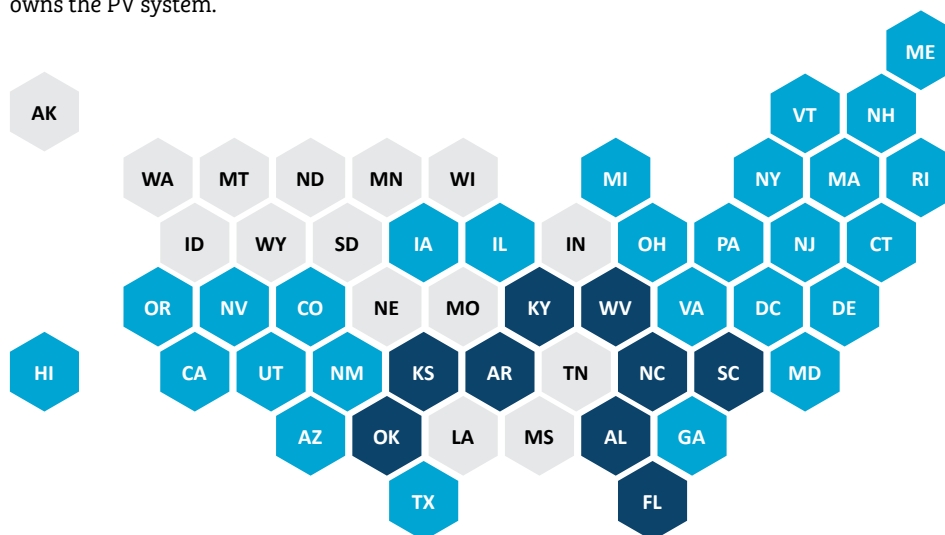
On the residential scale, third parties have developed a significant role offering customers financing through the same two avenues: PPAs and leases. As with commercial PPAs, a third party owns the solar system and acts as an intermediary between a utility and a customer. The third party entity installs a system at a customer’s home, typically at no cost. The third party sells the electricity generated to the customer at a fixed rate—typically lower than the utility rate in some markets—and the electricity reduces the customer’s bill. At the end of a PPA term, the customer can either extend the contract, purchase the system from the third party or have the system removed.⁷⁰

According to the Database of State Incentives for Renewables and Efficiency, at least 26 states, Washington, D.C. and Puerto Rico permit third party solar photovoltaic PPAs, while nine states explicitly disallow solar PV PPAs (their legal status remains unclear in the remaining states).⁷¹ In recent years, South Carolina enacted Senate Bill 1189 in 2014 authorizing solar leasing and Georgia enacted House Bill 57 in 2015 authorizing third party financing.



Legal Status of Third-party Power Purchase Agreements (PPA)

State authorization of third-party solar PV PPAs allows residential customers to purchase electricity generated by solar panels on their roof from a third party that owns the PV system.



- Disallowed by state or otherwise restricted by legal barriers
- Authorized by state or otherwise currently in use, at least in certain jurisdictions
- Status unclear or unknown



Note: Colorado, Nevada and Texas have system size limitations; Arizona has sector limitations; Louisiana, Mississippi and South Carolina explicitly allow solar leases; Virginia has limited capacity.

Source: Database of State Incentive for Renewables and Efficiency (DSIRE)

Under the lease model, a customer signs a contract with an installer or developer to pay for the solar system over a period of time, rather than for the power produced (although a minimum production guarantee is typically included). In states where solar residential PPAs are less common or face regulatory challenges, leases may still be permitted.

Third party entities have historically held a significant share of the residential solar market. GTM Research found that 72 percent of residential solar installed in 2014 was third party owned through leases or PPAs.⁷² Many states have seen third party ownership level off recently and several resources, including GTM Research, predict the third party owned market share in residential financing will decrease.⁷³

Third party entities can also be key in shared renewable installations. Washington, D.C. and 14 of the 17 states that authorized shared renewable programs or pilots have stated that third party entities can own and operate installations. Third party entities lead 40 percent of community solar programs, for example, according to the Smart Electric Power Association.⁷⁴

CUSTOMER-OWNED

Customer-owned distributed solar—made possible through cash and loan purchases—is dramatically on the rise. While third party owned distributed solar peaked at 72 percent of the residential market share in 2014, GTM Research and the Solar Energy Industry Association estimate third parties will hold less than a third of the market share in 2021.⁷⁵ Customer-owned distributed solar is increasingly cost-competitive and the demand for owning one’s own system is increasing. Certain third party entities, such as Tesla, now offer customer-owned options for distributed solar.

The customer-owned model exists on the residential, small commercial and community scales. In this model, a property owner purchases the solar energy system through a cash or loan payment. After a third party entity installs the system, the owner may be responsible for system operations and maintenance (O&M) directly, or signs a O&M contract or warranty. The owner may be eligible to receive tax benefits, however municipal entities and public entities with no taxable income are ineligible for the federal Investment Tax Credit. Entities may address how the tax benefit is allocated in the purchase cost differently. Owners may also be responsible for additional taxes depending on state tax law. Any increases in property tax value following a reassessment, for example, if a system is not tax exempt. While individuals do purchase solar energy equipment in many markets, states without net metering or financing policies tend to have markets of minimal size.⁷⁶ Low-income customers however, may have difficulty accessing this method of ownership.

While property owners receive the benefits of solar energy ownership, they also bear the risk and responsibility. For community-sized shared renewable facilities, this can place a significant burden on individual participants that must come together to plan and develop these systems. Consequently, only a handful of states—such as New Hampshire, Rhode Island, Vermont and Washington—allow individual customers or groups of customers to own shared renewable energy facilities.

Many entities offer direct purchase loan options for distributed solar, including third party companies (that may or may not also offer leasing) and banks. Utilities are increasingly exploring this option as well. For example, the PSE&G Solar Loan Program offers 10-year loans with an 11.18 percent interest rate and a minimum SREC value guarantee to mitigate volatility.⁷⁷ The New Jersey Board of Public Utilities approved a rate of return for PSE&G's program to prevent cross-subsidization with non-participating customers. Utility offerings can be solar specific or use existing loan programs, including on-bill financing (see "Financing" section, page 34).

RENEWABLE ENERGY CREDIT OWNERSHIP

An additional consideration regarding ownership models is not the specific solar hardware itself, but who owns the renewable energy certificates (RECs) from the systems. Solar generation results in two products: the underlying generation and a solar REC, which represents the renewable energy attributes of the generation. Only the entity who owns the REC can claim their electricity as renewable. RECs have monetary value (e.g. \$200/MWh), with the highest values in markets where utilities have a distributed solar mandates.⁷⁸

All ownership or financing agreements stipulate which entity owns the resulting RECs, and consequently the claim that they have purchased renewable energy. While this is subject to variation, there are several trends in REC ownership. In PPAs between utilities and third parties, third party generators typically own the RECs and sell them to utilities, allowing utilities to meet RPS requirements. State net metering and shared renewable energy legislation typically stipulates the entity that owns RECs. In shared renewable energy programs, RECs are usually conveyed to the utility, though in some cases the subscriber keeps the RECs, most notably in California.⁷⁹

Clearly communicating and stating in writing REC ownership, especially with distributed solar, is a consumer protection consideration. Customers should clearly understand how claims to renewable energy are tied to RECs, who owns RECs, whether they can be sold and the implications of a sale, as well as the risks associated with REC ownership and market value.⁸⁰

Questions for Consideration

- What entities can own different classes of solar energy in your state?
- Has your state authorized third party ownership?
- Has your state authorized utility ownership of distributed generation?
- Which forms of ownership are most common in your state? How common is the lease/PPA model?
- Should there be any changes to ownership and leasing policies?

Financing

Despite increasingly favorable economics, the cost of distributed solar remains a barrier for many. To increase customer access to solar, many states are exploring how innovative financing mechanisms and improved terms for traditional financing mechanisms can overcome market barriers. Financing can remove or reduce the up-front capital required for investment in solar technology. Certain programs can address the split incentive between renters and owners or incorporate private sector capital and expertise. Coordinated state financing efforts can collect and consolidate data, increase quality assurance, and improve consumer outreach and protection. Several traditional and innovative financing mechanisms are listed below.

LOAN PROGRAMS

To help customers overcome the barrier of high upfront costs of installing a solar energy system, states have implemented loan programs. While loans do not reduce the system cost, they allow customers to spread the cost of the system over time. More than half of states offer loans that may be applicable to solar projects.

Loan programs may vary in design, implementation and funding source. Programs can be funded by annual appropriations, public benefits funds, RPS or RES alternative compliance payments or other methods. Several programs are designed to be revolving loan programs, meaning that loan repayments replenish the fund so that additional loans can be disbursed each year. For example, Maryland's State Agency Loan Program revolving loan program was established in 1991 using oil surcharge funds.⁸¹ The program was supplemented in 2009 with the proceeds of carbon emission allowance auctions under the Regional Greenhouse Gas Initiative (RGGI). Montana's Alternative Energy Revolving Loan Program is funded by air quality penalties collected by the Department of Environmental Quality.⁸² The program provides loans to individuals, small businesses, local government agencies, the university system, and nonprofit organizations to install renewable energy systems. North Carolina enacted House Bill 1389 in 2009 creating a local option revolving loan program that authorizes, but does not require, cities and counties to establish revolving loan programs to finance residential and commercial renewable energy and energy efficiency projects.

PROPERTY ASSESSED CLEAN ENERGY

Property Assessed Clean Energy (PACE) enables property owners to implement energy improvements on their property and repay the costs over an assigned term (typically between 15 and 20 years) through an assessment on their property tax bill.⁸³ For many states, PACE offers an effective and voluntary solution to attract private capital to renewable energy, energy efficiency, water efficiency and resiliency projects, including rooftop and community solar systems. For instance, a 2015 project secured through the Washington D.C. PACE program provided financing for solar and energy efficiency upgrades to renovate a local YWCA, a non-profit property, that had fallen into disrepair. In addition to bringing the building above local code requirements, this project also deployed a 30 kW solar PV array, reduced the building's operating costs by an estimated \$6,000 per year and helped preserve 84 units of affordable housing.⁸⁴

PACE programs are differentiated between the commercial and residential sectors.

With programs active in 19 states and Washington, D.C., and authorizing legislation enacted in at least 33 states, the Commercial PACE (C-PACE) market is steadily growing.⁸⁵ C-PACE has proven to be a flexible and effective tool for financing upgrades in multiple types of buildings, including office, retail, industrial, multifamily, mixed use and agricultural facilities—accounting for over \$380 million in projects to date.⁸⁶ For example, in July 2016, a specialty hog processing facility in Missouri became the largest agricultural project in the United States to utilize PACE financing. The \$4 million project successfully retrofitted a 75,000 square foot facility to include a solar PV system, HVAC upgrades, and improved water and lighting efficiency.⁸⁷ Furthermore, a PACE assessment is an ad-valorem taxation, and therefore can be utilized by property owners that are typically exempt from property taxes, such as non-profit organizations.

The growth and success of C-PACE programs has primarily been led by local governments, with more than 2,500 municipalities creating C-PACE programs across the country.⁸⁸ However, C-PACE market growth has faced challenges in some jurisdictions due to its novelty and complexity, a lack of program standardization across jurisdictions, and the administrative and legal lifts required to move from program initiation to project completion. In 2014, the Connecticut legislature took an innovative step in the state's approach to clean energy financing by creating the Connecticut Green Bank. This entity replaced the state's previous PACE program, the Clean Energy Finance and Investment Authority, and was designed to remove barriers and streamline efforts for participation by standardizing program criteria and developing guidelines for municipalities. All municipalities in the state are eligible to join the program and all properties located within the boundaries of a participating municipality are eligible for financing.

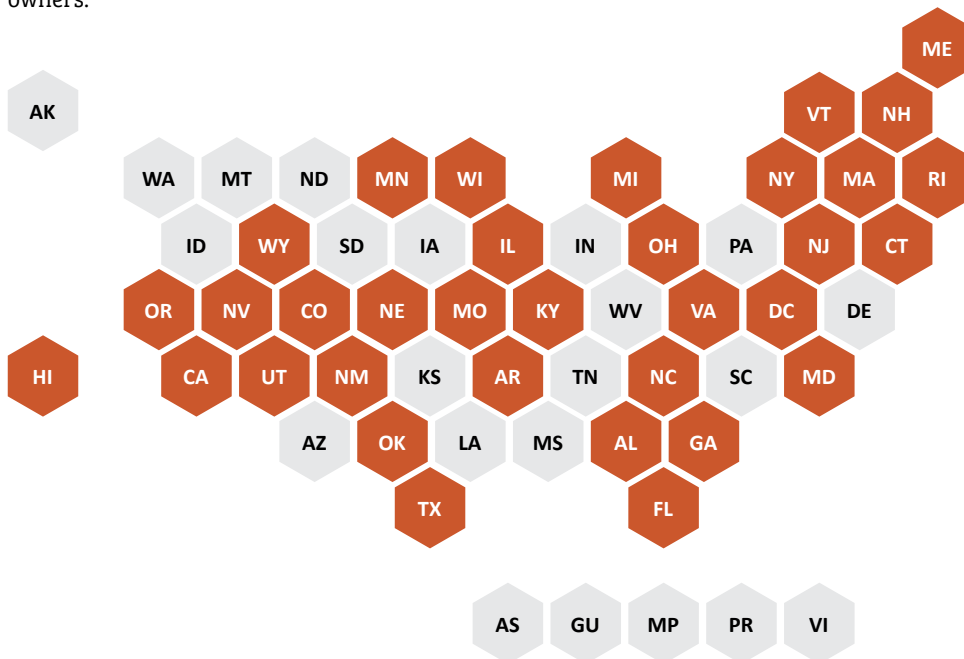
Legislatures and state energy officials can play multiple roles in supporting and advancing C-PACE in their states. NASEO's 2016 report, *Accelerating the Commercial PACE Market: Statewide Programs and State Energy Office Participation in PACE Financing*, highlights strategies and examples from diverse C-PACE markets, including Texas, Michigan, Connecticut, Colorado and California.⁸⁹

Residential PACE (R-PACE) programs have also helped thousands of homeowners, primarily in the state of California, finance solar improvements. Unlike conventional loans, which are based on the borrower's credit score, R-PACE financing takes the form of a special assessment and is typically available to any homeowner who is current on property tax and mortgage payments. The R-PACE obligation is attached to the property and can be transferred upon sale to the new homeowner. R-PACE is compatible with many common mortgage products, including those insured or underwritten by the Federal Housing Administration and the Department of Veterans' Affairs. Additionally, the U.S. Department of Energy released a guidance for residential PACE programs in fall 2016.⁹⁰ However, fewer states have R-PACE programs or enabling legislation due to the senior-lien status of R-PACE assessments over mortgage liens. Additionally, the Federal Housing and Finance Authority has encouraged mortgage lenders not to purchase liens with PACE mortgages. Consequently, of the 16 states with R-PACE enabling legislation, only California, Florida and Missouri have operating programs.

In 2010, the Florida legislature passed PACE-enabling legislation, House Bill 7179, which has resulted in five active financing programs in the state, three of which (Florida PACE Funding Agency; Ygrene Energy Fund; and RenewPACE) provide financing for residential renewable energy and energy efficiency projects. Increased interest in residential efficiency and clean energy improvements has led to steady growth in R-PACE markets, as demonstrated by the total financing amount for R-PACE nearly doubling between December 2015 and the first quarter of 2017.⁹¹

States with Property Assessed Clean Energy Financing (PACE) Programs

PACE programs allow local governments, state governments, or other inter-jurisdictional authorities, when authorized by state law, to fund the up-front cost of energy improvements on commercial and residential properties, which are paid back over time by the property owners.



Source: NCSL, PACENation

STATE ENERGY LOAN FUNDS

State Revolving Loan Funds (RLFs) enable state and territory energy offices and their partners to offer long-term, low-interest financing for a variety of uses, including energy efficiency and renewable energy. RLFs are unique financing instruments in which principal and interest repayments for existing loans are recycled to fund additional projects, essentially creating a sustainable source of capital that can be used to fund projects indefinitely. States have used RLFs to introduce the market to a variety of innovative financing tools, such as energy performance contracts, on-bill financing, PACE and public-private partnerships.⁹²

To meet states' specific market needs and maximize the impact of the funds, RLFs can and have been designed and implemented in a variety of ways. The Rhode Island Economic Development Cooperation RLF was initially funded by the federal American Reinvestment and Recovery Act of 2009 (ARRA) and offers low interest loans for in-state businesses to make investments in energy savings. Texas offers the LoanSTAR Revolving Loan Program, which makes energy-related financing available for state, public school district, public college, public university and tax-district-supported public hospital facilities. NASEO maintains the State Energy Loan Fund database, which tracks energy loan programs and includes key statistics such as funding source, fund size and program purpose and can provide energy officials with more in-depth knowledge regarding the various types of RLF models in use.⁹³

ON-BILL FINANCING

On-bill financing and on-bill repayment programs are two innovative solutions for property owners to pay for clean energy investments through their utility. Utilities can offer this type of financing for residential, commercial or industrial facilities by taking advantage of existing sources of capital, including revolving loan funds, public benefits funds, utility shareholder funds, grants or private investors.⁹⁴

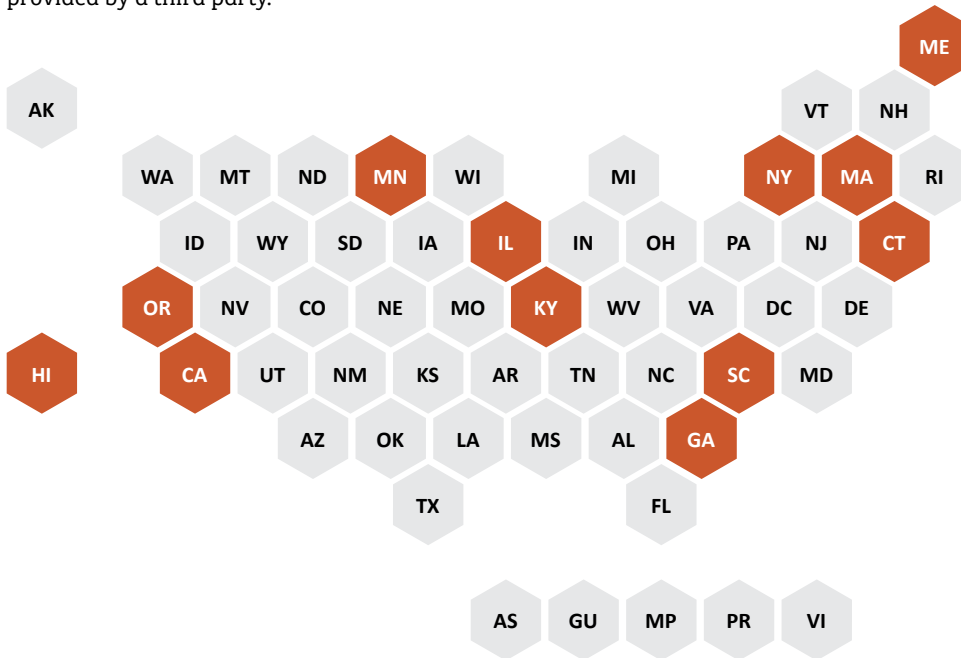
On-bill financing allows the utility to incur the cost of the energy upgrade, which is then repaid by the customer on their utility bill. Similarly, on-bill repayment requires the customer to repay the investment through a charge on their monthly utility bill. The difference is that the upfront capital for the loan is provided by a third party instead of the utility. On-bill financing gives utilities the freedom to manage these programs without the need to negotiate terms or identify third party partners, this method of financing is more commonly used than on-bill repayment.⁹⁵ On-bill repayment however, still allows for a streamlined revenue-collection process, as utilities already have a billing relationship with their customers and access to information about their energy usage patterns and payment history.⁹⁶

As customer demand for energy efficiency and clean energy upgrades increase, utilities are looking to on-bill financing as a potential solution to meeting this burgeoning need. To encourage greater residential solar penetration, Pedernales Electric Cooperative in Austin, Texas, created an on-bill financing program for customer-owned solar installations and battery storage. Likewise, the City of Tallahassee, Florida allows customers to borrow up to \$20,000 for solar PV systems, following a city energy audit, to be repaid on the customer’s utility bill.

Twelve states have enacted legislation to authorize public benefit funds for capital, to create pilot programs or to require utilities to offer on-bill financing or on-bill repayment. While a number of states initially authorized on-bill financing for energy efficiency, recently states like Connecticut and Minnesota have begun including renewable technologies as eligible for financing. Legislation intent on creating on-bill financing programs can explore a variety of topics and consider numerous factors. For example, states may select which technologies and upgrades are available for financing, or direct the state’s public utility commission to do so, rather than utilities. If a state implements on-bill repayment, stakeholders must determine whether utilities or third party financiers assume the risk of non-payment. Utilities in an additional 19 states administer on-bill financing programs, although there has been no legislative action to create these programs.

On-Bill Financing and Repayment Legislation

On-bill financing allows the utility to incur the cost of the clean energy upgrade, which is then repaid on the utility bill. On-bill repayment options require the customer to repay the investment through a charge on their monthly utility bill after the upfront capital is provided by a third party.



Source: NCSL



QUALIFIED ENERGY CONSERVATION BONDS

Qualified energy conservation bonds (QECBs) are federally subsidized bonds that enable state, local and private issuers to borrow low-interest capital to finance a wide range of eligible energy conservation projects. Since their establishment under the federal Energy Improvement and Extension Act of 2008, funding for QECBs grew from \$800 million to \$3.2 billion. Legislation authorizes a formula allocation for each state, which can be further sub-allocated to local governments that meet existing criteria. More than 37 states have taken advantage of QECBs, accounting for more than 229 QECB financed projects at a total of over \$1 billion in funding.⁹⁷

Nationally, the most common use of QECBs is to support capital expenditures in energy efficiency (67 percent).⁹⁸ However, on-the-ground examples demonstrate how these instruments are being used to increase installed capacity of renewable energy generation. In the largest known QECB issuance to date, the Department of Water and Power of the City of Los Angeles issued \$131 million to build two new 10 MW solar PV generators and expand an existing wind turbine facility.

Likewise, the North Carolina Agricultural Finance Authority established a green community project in 2012 to issue QECBs on behalf of the state to projects that promote renewable energy resource development on agricultural lands. A total of four solar installation projects have been funded through this program, as of October 2015, with a total QECB value of \$7,492,702.⁹⁹

STATE GREEN BANKS

States are exploring “green” energy banks as a way to promote renewable energy, energy efficiency and resiliency. Green banks are public-private partnerships that combine public funding with private capital and expertise to promote renewable and efficient energy technologies and lower the cost of investments.¹⁰⁰

These banks are public or quasi-public entities that provide an array of financing tools including direct loans, co-investing, PACE financing, on-bill financing or on-bill repayment, credit enhancements and bonds. An energy bank can also utilize innovative or new financing arrangements that may be deemed too risky for the traditional banking industry to assume without public support. State energy banks also serve to consolidate and coordinate existing renewable energy and energy efficiency programs—allowing a state to deploy a cohesive financing strategy. Energy banks require initial public funds, however state energy banks will ideally become financially self-sustaining.¹⁰¹

Connecticut established the nation’s first green energy bank. In 2000, the legislature created the Renewable Energy Fund (later renamed the Connecticut Clean Energy Fund) to fund more than \$150 million in renewable energy projects, education programs and technology investments. In 2011, the state legislature consolidated the Connecticut Clean Energy Fund and other state programs to establish a quasi-public green bank through Senate Bill 1243. Substitute Senate Bill 357 in 2014 renamed the bank to the Connecticut Green Bank. The bank coordinates state energy finance programs and has a mandate to enable efficiency improvements in at least 15 percent of single-family homes by 2020. Additionally, the bank is authorized to enter into contracts to perform loan organization services. The goals of the bank include energy security and reliability, as well as job creation and local economic development.

State green banks can allow for an increased focus on energy security, critical infrastructure and resiliency efforts. Following Superstorm Sandy, New Jersey experienced extensive damage to electrical transmission, distribution infrastructure and critical infrastructure systems. This led to the state forming an Energy Resilience Bank in October 2014.¹⁰²

The New Jersey Economic Development Authority and the New Jersey Board of Public Utilities have joint oversight of the Resilience Bank. The bank was initially funded with \$200 million in public capital from the state’s Community Development Block Grant Disaster Recovery allocation. The first series of projects will support the “islanding” of distributed energy resources at critical facilities, with a preliminary focus on water and wastewater treatment plants, including combined heat and power, fuel cells, retrofits, microgrids and off-grid solar inverters with battery storage.

Questions for Consideration

- What financing mechanisms are authorized and active in your state?
- Are existing financing mechanisms achieving policy goals?

Consumer Protection

Consumer protection is an increasing area of attention in distributed solar energy policy. Specifically, policymakers and energy offices want to ensure that individual homeowners and small business owners make fully informed decisions about whether to enter into contracts for solar energy and that they understand what the implications may be. Third party financing contracts may be for as long as 20 years and represent significant financial investments for customers. Additionally, the value proposition of solar energy—immediate monthly bill savings—may be based on potentially biased assumptions by salespeople about future electricity rates and contractual escalation rates.¹⁰³ Various stakeholders, including state governments, are also interested in ensuring consistency and proper valuation of homes and businesses with distributed solar during real estate transactions, such as appropriate disclosure and consistency across realty listings and appraisals.¹⁰⁴

Solar industry professionals are governed by state consumer protection policies and practices, falling under the jurisdiction of the state’s attorney general. In considering if additional consumer protection provisions are necessary, policymakers may consider the following areas:

- Fair business practices, including preventing deceptive marketing and lending.
- Fair disclosure of compensation for electrical generation, and whether compensation could be subject to any changes like ratemaking.
- Opportunities to increase consumer and stakeholder education, including available research and resources.
- Renewable energy credit (REC) ownership and opportunities to sell RECs.

Many stakeholders—including third party solar companies—have a strong interest in ensuring robust consumer protection standards and practices. Several entities have developed consumer protection best practices and guides. A full list is included in the Resource List Appendix (page 60).

Arizona became the first state to enact consumer protection legislation specific to renewable energy customers with Senate Bill 1465 in 2015. The bill requires manufacturers or installers of distributed energy systems to disclose certain information in lease, financing or sale contracts. For example, buyers or lessees must be informed that they are allowed to rescind an agreement within three business days of signing the contract—similar to federal mortgage lending practices—and before the system is installed. They must also receive a description or guarantee of the system’s energy output and the total purchase price or cost for the life of the agreement, including any interest or fees to be paid. Additionally, they must receive information on the total number of payments, payment frequency, the amount of payment and the payment due date. Legislation also requires the installer or manufacturer to disclose the following information:

- A written record of current tax obligations calculated in the year the agreement was signed.
- Tax incentives and rebates the buyer may be eligible for and any conditions or requirements to obtain the incentives.
- Warranty or maintenance obligations.
- The ability to modify or transfer ownership of a system or the real property to which the system is affixed.

- A summary of the total costs of operating, maintaining, financing and constructing the system.
- Acknowledgement that utility rates, structures and projected savings are subject to change.
- That tax incentives may change or be terminated.

Legislation also addresses disclosure requirements if the original owner sells the property to which the system is affixed, among additional provisions.

Nevada passed Assembly Bill 405 in June 2017, restoring compensation for new rooftop solar customers and adding several consumer protection provisions. The bill guarantees customers the right to self-generate electricity and to offset their internal usage at the full retail rate—becoming the first state to enshrine this in statute.¹⁰⁵ It grants customers the right to interconnect rooftop solar or solar-plus-storage systems in a “timely manner” and with minimal utility interference, provided the systems comply with health and safety codes. The bill also prohibits rooftop solar and solar-plus-storage customers from being treated as a separate rate class. Finally, the bill requires solar installers to disclose to customers information similar to that required by Arizona’s legislation.

Also in 2017, Florida passed Senate Bill 90, which requires solar installers to provide buyers or lessees with certain information and disclosures. These include notification that the buyer or lessee can rescind the agreement within three business days after signing, performance guarantees, a description of incentives, rebates and tax credits associated with the distributed energy system, a disclosure of warranty or maintenance obligations, and approximate state and completion dates for the installation of the system.¹⁰⁶

In April 2017, New Mexico enacted legislation—House Bill 199—which requires solar installers to disclose certain information to customers similar to Arizona’s and Florida’s requirements. New Mexico’s bill requires solar customers to consult tax experts and their utility companies for guidance related to solar installation.

Additionally, California enacted Assembly Bill 2693 in the 2016 session, providing a statewide consumer protection framework specifically for residential Property Assessed Clean Energy (PACE) financing (see “Financing” section, page 34). The bill authorized property owners to cancel their PACE contracts within three business days of signing them. Additionally, prior to signing any contractual paperwork, property owners would be provided a document with financing estimates, similar to federal mortgage lending practices. The bill also restricts parties from declaring specific monetary or percentage estimates on property value changes.

Questions for Consideration

- Are there consumer protection concerns that need to be addressed in your state?
- How should these concerns be addressed?
- Could stakeholders promote the development of best practices?
- Would legislative involvement be helpful?
- Is there a state organization with primary responsibility for consumer protection concerns related to solar installations and marketing?

Low- and Moderate-Income Customer Access

Low- and moderate-income (LMI) customers face a greater “energy burden”—the total annual gas, electric and heating fuel spending as a percentage of total annual gross household income—than other demographics. In a review of energy expenses in metropolitan areas, customers who earn at or below 80 percent of area median income were found to contribute more than twice that of median income customers and more than three times that of high-income customers.¹⁰⁷ Reducing this cost burden can have a direct impact on redirecting these expenses to other areas of need, such as housing and nutrition. This shift can also benefit organizations that support these population, such as shelters and service organizations.¹⁰⁸

While a higher energy burden makes LMI customers a compelling demographic for offsetting energy use with renewables, such as solar, these customers often have little access to renewables. Solar energy can remain inaccessible for several reasons including upfront capital requirements for investments, low credit scores, lack of home ownership or roof access, residing in multi-family properties or inefficient housing, and low awareness of programs or incentives. Those with low or limited credit also encounter barriers as well.

While 49.1 million households earn less than \$40,000 of income per year and make up 40 percent of all U.S. households, they account for less than five percent of solar installations.¹⁰⁹ Increasing access to solar to low-income customers can provide more equitable solar energy distribution. While most residential solar deployment has been in upper and middle income neighborhoods, the cost of incentives is spread to all customers. Policies to encourage deployment of solar in low-income communities are important to balance costs and benefits to all ratepayers.

There is a growing effort to ensure that these customers have access to solar energy. The Clean Energy States Alliance categorizes these approaches in several categories:

- Adapting financing for these customers.
- Compensation mechanisms, such as net metering and shared renewable energy.
- Direct incentives, such as interest rate buy-downs or grants.
- Energy assistance programs, such as including solar technology in federal Weatherization Assistance Programs or Low Income Housing Energy Assistance Programs.¹¹⁰

Several examples of these approaches are listed below: financing approaches, funding approaches for direct incentives and energy assistance programs, and shared renewables programs.

FINANCING APPROACHES

One avenue to increasing LMI access to solar is to implement innovative financing strategies that allow for broader credit score requirements, include credit enhancements, offer low-interest rates, require no upfront capital or benefit home renters.

On-bill financing and Property Assessed Clean Energy (PACE) are two strategies that can be tailored to increase LMI access to solar energy.¹¹¹ On-bill financing, also called on-bill repayment or on-bill recovery, provides financing for energy upgrades, including renewable energy technology, by allowing customers to pay for upgrades over a period of time via charges on their utility bill. PACE financing programs allow local governments to provide financing for energy efficiency, renewable energy and water efficiency projects that building owners pay back through property tax assessments. (For more information, see “Financing” section, page 34).

Another developing tool is state “green” energy banks. Green energy banks, also known as green banks, are public-private partnerships that combine public funding with private capital and expertise to promote renewable and efficient energy technology.¹¹² An energy bank can also utilize innovative or new financing arrangements that may be deemed too risky for the traditional banking industry to assume without public support.

One example of a financing strategy that has been designed to increase access for LMI customers is Energize NY's on-bill recovery program.¹¹³ This program offers two tiers of financing based on customer demographics. Tier 1 customers have stricter credit requirements. These lower-risk loans have been bundled and sold on the private market through the New York Green Bank. Tier 2 loans are financed by utilities and available to customers who may not meet Tier 1 criteria. Additionally, the program bases interest rates on area median income and lower interest rates are offered to customers with lower-than-median incomes.

Another instance of an LMI-directed financing program is Massachusetts' Solar Loan Program.¹¹⁴ This program ensures that annual interest rates do not exceed 3.25 percent and offers a credit enhancement to lenders to decrease their risk and expand eligibility criteria. Customers with incomes below median income thresholds may also be eligible for a loan principal buy-down.

FUNDING APPROACHES

Policymakers have also designed specific solar energy funding programs to address the barriers that LMI customers may encounter. For example, the California Solar Initiative (CSI) is a rebate program designed to encourage greater solar energy adoption.¹¹⁵ The CSI requires at least 10 percent of funds be directed to low-income residential housing. Senate Bill 1 enacted in 2006 established a Multi-Family Affordable Solar Housing (MASH) program within CSI. The MASH program specifically offered a per-watt incentive based on the size and the expected performance of a solar energy system. Similar to MASH, the California Public Utility Commission created the Single-Family Affordable Solar Housing (SASH) program.¹¹⁶ The MASH and SASH programs have subsequently been replaced by the Multi-Family Affordable Housing Solar Roofs Program. The state enacted Assembly Bill 693 in 2015 that will annually (between 2016 and 2020) direct the lesser of \$1 billion or 10 percent of cap-and-trade proceeds to the new Multi-Family Affordable Housing Solar Roofs Program.

In another instance of LMI-directed programming, the Colorado Energy Office expanded the scope of existing LMI energy efficiency services to include a solar energy option. The state's Weatherization Assistance Program is the first in the nation to be granted permission by DOE to use rooftop solar as an approved measure to reduce households' energy burdens.¹¹⁷ To qualify for rooftop solar assistance, installations must be deemed cost-effective and cannot exceed a DOE contribution of \$3,545. Customers must have high electricity use, limited access to community solar and have a high solar capacity factor to qualify.

SHARED RENEWABLE ENERGY PROGRAMS

A growing state policy, shared renewable energy, is increasingly being used to expand solar energy access to LMI customers.¹¹⁸ Shared renewable energy programs offer an alternative to onsite, "rooftop" solar, allowing multiple customers to invest in a medium-sized renewable energy facility and directly benefit from the energy produced (for more information, see "Shared Renewable Energy" section). While shared renewables programs include other renewable energy technologies, the majority of programs are shared or "community" solar (several shared wind programs exist in states). These programs provide access to solar energy for customers who are unable or unwilling to install solar energy systems on their homes or businesses. The National Renewable Energy Laboratory reports that about 49 percent of households and 48 percent of businesses are currently unable to host a solar photovoltaic system.¹¹⁹

In addition to increasing access to solar energy, shared renewables' benefits include decreased barriers for participants and siting flexibility. However, unless intentionally designed, programs can still present barriers for LMI customers. Several states—California, Colorado, Maryland, New York, Oregon and Rhode Island—have legislatively-established shared renewables programs that include various provisions to address LMI barriers to participation.

One approach is to design shared renewables programs to include specific LMI carve-outs. For example, California enacted Senate Bill 43 in 2013 authorizing the Green Tariff Shared Renewables Program. California requires at least 100 MW of the program's 600 MW cap to be located in "disadvantaged communities" and program participants must be "reasonably proximate" to the community solar facility that they subscribe to.¹²⁰

In 2010, Colorado enacted House Bill 1342 authorizing community solar gardens, requiring that community solar developers include at least 5 percent LMI subscribers at each of their arrays. This approach was difficult for the state’s investor-owned utility—Xcel Energy—to meet and was revised in 2016 as part of a settlement agreement, expanding the low-income carve-out to an aggregate requirement. Colorado has also experimented with grant-funded, dedicated LMI community solar arrays. One planned community solar installation by Grand Valley Power will exclusively serve low-income customers, and eligible participants must be at 80 percent or less of the area median income.¹²¹

Authorized through Senate Bill 1547, enacted in 2016, Oregon’s community solar program requires that 10 percent of the program’s total generating capacity is reserved for LMI customers. In 2015, New York established a two-phased community net metering program.¹²² Phase One, running from October 2015 through April 2016, required that 20 percent of community net metering facility subscribers be LMI customers or that projects were located in a utility-designated Community Distributed Generation Opportunity Zone.¹²³ Although these requirements do not apply to Phase Two, the New York Public Service Commission is investigating policies to increase LMI participation in community renewables programs.¹²⁴

In 2015, Maryland enacted House Bill 1087 creating a three-year community solar pilot program. The final community solar regulations were approved by the Maryland Public Service Commission in 2016 and include specific carve-outs for LMI customers.¹²⁵ The program allocates 30 percent of annual community solar program capacity to projects serving more than 30 percent of output to LMI customers, of which at least 10 percent is specifically dedicated to low-income customers. Additionally, the program allocates 30 percent of annual capacity to “small projects” (500 kW or less) including projects on rooftops, roadways or parking lots, brownfield projects and projects serving more than 51 percent LMI customers.

Another approach to increasing LMI access to shared renewable energy is to include LMI customers in the number of required participants. For example, Rhode Island enacted House Bill 8354 in 2016 authorizing community net metering and requiring participating systems to have at least three participants or at least one low- or moderate-income participant.

Questions for Consideration

- Does your state have policies in place to provide access to solar energy for low- and moderate-income customers (LMI)?
- Has your state authorized shared renewables policies or programs?
- Are there existing solar policies (i.e. shared renewables, financing) in your state that could be updated to address LMI customer access to solar energy?
- Are there state or federal funding sources that could be used by your state to support LMI access to solar?

Solar Integration

Since solar, unlike natural gas and coal, is only available during certain times of the day, and varies depending on weather and time of year, new approaches to shaping energy use and production are being developed to integrate this variable resource. States, utilities and grid operators are using new technologies, digital controls, forecasting and automated systems to shape energy production and consumption in ways that can take advantage of local solar resources. State policies often can support these efforts.

GRID OPERATION

Balancing Supply and Demand

To understand how solar power is integrated into the electric grid, it is important to first understand how the grid operates. Since electricity cannot yet be economically stored on a large scale, electric grid operators must ensure that the amount of electricity that power plants produce exactly matches the quantity of electricity that is being used at each moment. If operators fail to match power supply with demand on a second-by-second basis, instability and blackouts can result. To avoid potentially costly and dangerous outages, grid operators ensure that the grid is ready to match the fluctuations in consumer and commercial electricity demand that occur each day and throughout the year. Grid operators use weather and historical consumption trends to forecast electricity demand and determine how many power plants should be held in reserve, ready to increase or decrease production at a moment's notice. These "dispatchable" energy sources are often natural gas or hydropower. Coal and nuclear plants typically run at full output since it is more difficult to rapidly adjust their output. Since power plants and power lines can fail, additional power reserves are maintained so they are ready to deal with the largest likely outage. Since the changes in wind or solar production are generally are far smaller than a power plant outage, balancing authorities do not need to alter the amount of reserves.¹²⁶

Because the grid is designed to adapt to small and large changes in consumer electricity demand, it can adjust to the variations created by smaller amounts of solar energy without major challenges. When solar production reaches a certain percentage of grid production, the varying output of solar generation, which can change rapidly, requires a more flexible grid. A number of new technologies and management approaches are helping grid operators and utilities cost-effectively adapt the grid to variable renewable energy resources like solar.

A Flexible Grid

The flexibility of the grid across the United States is based on several factors, including the size of the energy balancing area, the amount of natural gas and hydropower in the energy mix, operational practices, and the area over which solar generation is distributed. Despite the rapid growth of solar, most states still have relatively small amounts and won't have to make significant changes to grid operation for some time. A few states, including California and Hawaii, have so much solar energy that they've had to make significant adjustments to how the grid is operated.

Forecasting

Solar forecasts, like forecasts for energy consumption, allow grid operators to accurately plan how much electricity will be needed to meet demand. Forecasting decreases uncertainty and costs in the planning process by allowing more efficient use of least-cost generation units and reducing the need for utilities to buy expensive power on the spot market. A number of utilities are using advanced forecasting systems, such as the National Center for Atmospheric Research's new Sun4Cast system, which provides 72 hour forecasts that are 50 percent more accurate than existing forecasting systems.¹²⁷

Are new power plants needed to "back up" solar power?

To maintain the continuous balance between electricity consumption and production, balancing authorities deploy power plants to follow changes in net load (electricity demand less solar and wind production). If there are larger amounts of variable electricity on the system, the grid operator may need to hold more power plants in reserve to handle drops in solar power. However, more accurate forecasting decreases uncertainty and lowers the amount of power that needs to be held in reserve. Even in cases such as Hawaii and California, which have seen large contributions from solar power, new "backup plants" have not been needed. Research by PJM, a regional transmission organization that coordinates the flow of wholesale electricity in 14 states, concluded that with adequate transmission and some additional reserves, that PJM would not have any significant reliability issues having 30 percent of its energy provided by solar and wind.¹²⁸

INTEGRATION SOLUTIONS

Demand Response

Demand response programs already are used across much of the country to cost-effectively meet demand and more regions are investigating its use for balancing variations in solar and wind output. These programs enable utilities to adjust a bill payer's heating, cooling or other energy services, in exchange for monetary credits on their monthly bill. Independent companies also recruit and aggregate demand response participants, and sell demand reduction on the wholesale market. If a balancing authority sees a sudden spike in demand or drop in energy production, it can adjust the energy consumption of program participants to balance the system, which reduces costs, lowers emissions and increases resilience. Using demand response is often less expensive than adjusting the output of dispatchable power plants. Demand response can be used during infrequent events, such as when a large amount of solar generation suddenly drops, rather than holding extra power plants in reserve.

In January 2016, the Supreme Court upheld FERC Order 745, which requires wholesale electricity markets to compensate demand response providers that reduce electricity load at the same rate as energy generators. This action gives a green light to regions with deregulated markets that are considering or already pursuing demand response programs. Barriers to demand response—including a lack of advanced meters and lack of authorization for third party demand response aggregators—remain in many states, especially those that lack competitive energy markets.

Legislatures in several states have addressed some of these demand response issues as components of energy efficiency and smart grid legislation.¹²⁹ Connecticut enacted Senate Bill 1078 in 2016 mandating the state issue RFPs for demand response systems, including energy storage. Minnesota encourages demand response by allowing utilities to share in the savings the demand side programs create for customers; the award increases as savings increase, provided they are cost effective and meet targets.¹³⁰ California enacted Senate Bill 1414 in 2014, which accelerates demand response use by requiring utilities and regulators to include demand response in resource adequacy and long-term procurement plans. It also requires regulators to ensure appropriate valuation of demand response resources. Some states include demand response as part of their efficiency efforts. Rhode Island's energy efficiency resource standard, for example, sets targets for demand response.¹³¹

Power Plant Flexibility

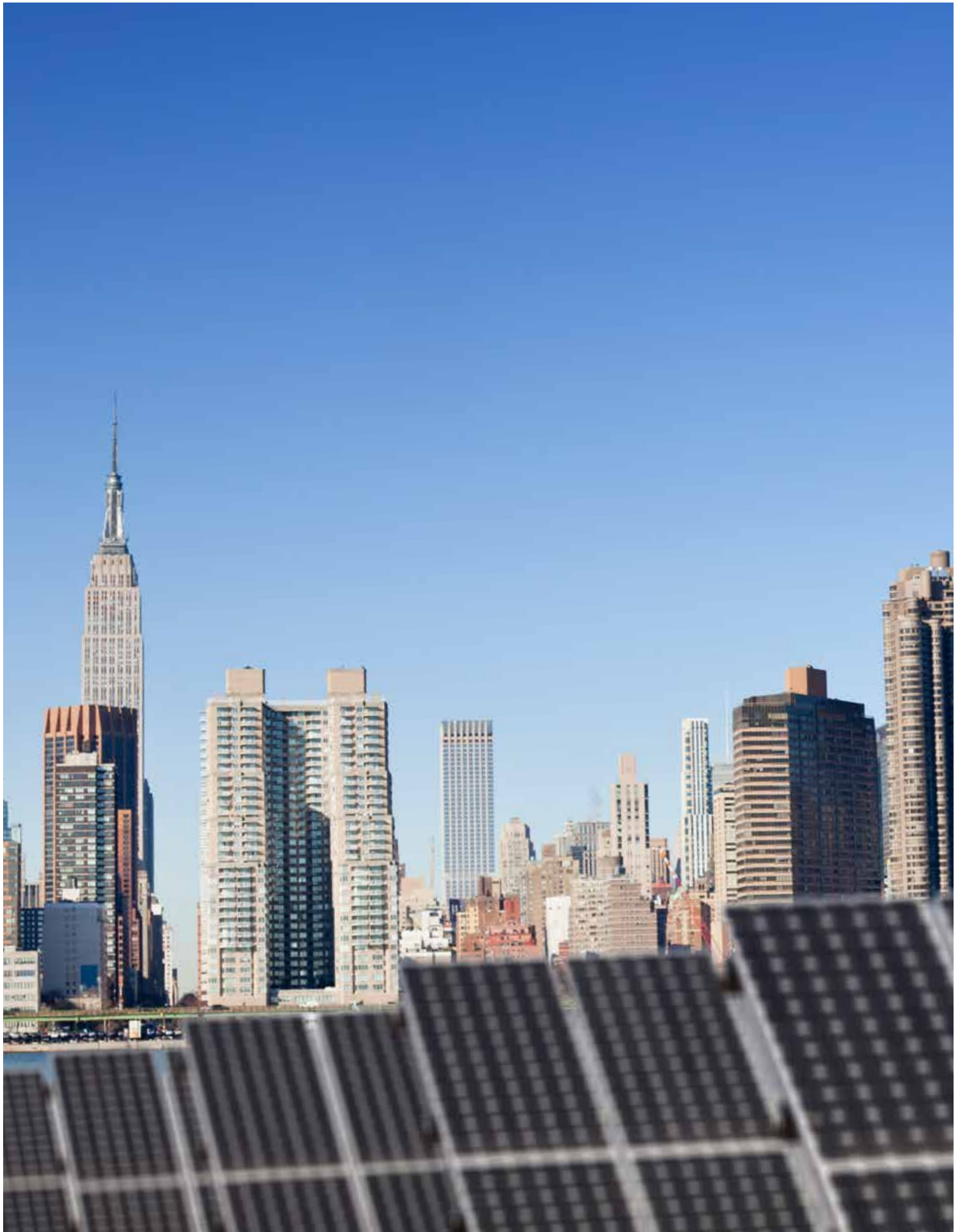
Since residential and utility scale solar installations are often capital-intensive but operate at near zero marginal cost, it is most cost-effective to use all the power they produce and use dispatchable generation, such as gas plants, to adjust to fluctuations in renewable output. Natural gas plants are the most flexible; coal and nuclear plants are less so.

Power plants can be built or retrofitted to provide large changes in output more quickly and efficiently. While these technologies add expense, the resulting increase in flexibility can lower the overall cost of the energy system. Since flexibility can provide a market benefit, policymakers may wish to incorporate an evaluation of plant flexibility into energy resource planning or provide incentives for utilities and power plants to invest in flexibility. Demand response, however, can often be a far less expensive approach to matching rapid changes in solar output.

Smart Inverter Technology

Inverters are needed at every solar installation to convert the direct current (DC) electricity produced by solar panels into alternating current (AC) electricity that is used by the grid and most appliances. Although these inverters are usually programmed to shut down when they detect disturbances on the grid, advanced inverters can continue operation while increasing grid reliability, allowing utilities to more easily integrate much higher levels of rooftop solar resources. Smart inverters can also manage the flow between solar panels and the grid and between on-site batteries or electric vehicle charging stations.

Instead of simply shutting down when grid disturbances are detected, which can make the disturbance worse by creating a sudden loss in power, they help the grid balance the quantity and quality of power



that comes from intermittent solar resources. An Arizona utility, APS, is testing smart inverters to determine the different reliability and integration functions that they can provide and developing a centralized control system to coordinate the response of smart inverters so they can better manage the grid. Utilities in Hawaii and California have also created advanced inverter programs, while the state of California is working on smart inverter standards.

Energy Storage

Advances in energy storage could significantly change how variability and uncertainty are managed by the grid. The energy storage market has seen explosive growth in the past two years, effectively doubling installations in 2016 compared to 2015, which saw nearly four times the growth of 2014.¹³² Rapidly declining costs, state legislation and an increased number of competitors entering the market are some of the factors driving this expansion. Utilities are finding that storage provides the grid with a multitude of benefits, including added flexibility, reliability and stability. It can be particularly helpful for renewable integration by shifting generation from periods of surplus to periods of need. While storage is not essential to integrating solar energy, affordable storage reduces integration challenges, particularly when states reach high levels of solar production. In regions where solar generation peaks a few hours before demand, energy storage allows surplus solar electricity to be used during peak demand when electricity is most costly. Batteries also can store or release energy as needed to adapt to fast changes in solar output, reducing the need to swiftly increase or decrease use of fossil power plants.

The ability to deploy battery storage rapidly on a large scale has proven extremely useful in the case of a massive leak in the Aliso Canyon natural gas storage facility, which caused severe gas constraints, increasing the threat of power outages in southern California. After approval by the PUC, vendors were able to place 70 MW of energy storage online in a short six months. By storing solar energy during the day so it can be used during the evening peak, the new batteries reduce the cost of meeting peak electricity demand in a constrained market.

Thermal energy storage is another advancing technology. Grid integrated water heaters and ice storage air-conditioning systems can harness wind and solar electricity to heat water or make ice, which can then be used later without relying on additional electricity. Portland General Electric, Arizona Public Service and Green Mountain Power in Vermont are all running pilots to test how customers' grid integrated water heaters can help optimize the use of solar and wind power, and many more utilities are expected to start their own programs soon.

As storage technologies have advanced and become commercially available, markets are looking to provide compensation for fast-responding resources such as energy storage. As discussed in more detail below, many regional transmission authorities are altering their markets to allow energy storage to receive payments more closely associated with performance.

A number of states have acted to promote the use of energy storage through mandates and incentives. The first state to act was California in 2013, when the PUC approved a proposal requiring the three major investor-owned utilities to procure 1.325 GW of cost-effective energy storage by 2020. The mandate was created as a result of Assembly Bill 2514, passed in 2010. California also passed Assembly Bill 1637 in late 2016 which provides a self-generation incentive program to increase the use of on-site energy storage systems that can store solar energy for on-site use, reducing peak energy demand while improving the efficiency and reliability of the distribution and transmission system. Oregon also created an energy storage requirement in 2015, while Massachusetts legislation (House Bill 4568) requires its Department of Energy Resources to set energy storage system targets that utilities must reach by 2020.¹³³

STATE ACTION

States are exploring a number of policy actions to help utilities integrate variable renewable resources. These include efforts to promote demand response, drive grid modernization, advance energy storage, improve forecasting and promote better transmission planning.

Washington passed House Bill 1826 in 2013 to promote technologies and practices that lower integration costs. The law requires integrated resource plans to identify methods and commercially available

technologies, including energy storage and demand response, for integrating renewable resources. It also requires electric corporations to identify additional spending necessary to integrate cost-effective distributed resources into plans, with the goal of yielding net benefits to ratepayers.

Washington also authorized \$28 million in funding with House Bill 1115, enacted in 2015, to support research, development and demonstration projects that use energy storage, demand response, smart grid and other technologies that support renewable integration. The funds include matching grants for utilities to develop projects that use and demonstrate these technologies.

Connecticut passed Senate Bill 1078 in 2015, allowing the commission to solicit long-term contracts for energy resources—including demand management and energy storage—that will help the state meet its Comprehensive Energy Strategy. It allows for coordination with other states in the region and gives preference to options that improve reliability, are cost effective and meet environmental goals, such as carbon emissions reductions.

Vermont enacted House Bill 40 in 2015, raising its renewable standard to 75 percent by 2032. As part of this mandate, 12 percent of the standard can be met with energy transformation projects, which could include energy efficiency, energy storage or demand response.

California took a big leap forward on the integration front, passing Senate Bill 350 in 2015, which increased the state's RPS to 50 percent of electricity sales. The law requires utilities to put together portfolios that meet the new requirement and utilize low emissions technologies and practices—such as energy storage and demand response—where cost-effective to do so. In 2014, California passed Assembly Bill 327 to advance metering technologies and practices that help with rooftop solar integration. The law allows energy corporations, beginning in 2018, to offer demand response and time variable pricing programs to residential customers. As discussed earlier, California utilities are beginning to implement their energy storage mandate; some of the first projects are to be delivered in 2017.

Minnesota enacted an omnibus bill House File 3, in 2015. As part of the State Transmission and Distribution Plan, it requires utilities to submit a biennial transmission project report that outlines their transmission plans and identifies investments in grid modernization—including energy storage, demand response technologies and advanced meters.

States also are exploring how transmission can help integrate more renewable energy. Nebraska passed Legislative Bill 1115 in 2014, which funds the Nebraska Power Review Board to conduct a study of future transmission needs and policies to export renewable electricity outside the state. The purpose of the study is to identify electric transmission and generation constraints and opportunities for exporting electricity to national and regional electricity markets.

Questions for Consideration

- Do utilities in your state employ demand response or energy storage?
- Does your state have, or is it considering, policies that promote renewable energy integration measures, such as demand response or energy storage?
- Does your state commission have a policy on how energy storage is treated in rate cases (i.e., are they part of generation, transmission, distribution, or a fourth stand-alone component)?
- Should the Legislature provide guidance to the PUC on how energy storage devices should be treated? If so, what guidance do you recommend?

PV System Soft Costs

While scale and technological innovation have rapidly decreased the costs of solar technology and manufacturing, non-hardware “soft costs” have not declined as quickly. Solar soft costs are the expenses associated with customer acquisition, permitting, inspection, interconnection, installation labor, taxation and system financing. For solar photovoltaic (PV) systems, these expenses represent up to 64 percent of the total cost.¹³⁴ Soft costs are paid by customers, so reducing these expenses increases competitiveness.

Although permitting, inspection and interconnection costs comprise a small portion of solar PV system costs, this process is one segment of soft costs that state policies can affect. Deploying solar PV systems typically encompasses two separate, but parallel, approval processes: one for the local jurisdiction, which oversees permitting and inspection and one for the electric utility, which oversees interconnection. The fragmented energy marketplace in the U.S. drives higher soft costs since permitting, inspection and interconnection processes vary significantly across 18,000 local jurisdictions and more than 3,000 utilities.¹³⁵

For small solar PV systems, the full utility interconnection approval process—including permitting and inspection—took an average of 67 days in 2015.¹³⁶ Delays in these processes can result in increased soft costs and higher overall system costs. The Lawrence Berkeley National Laboratory (LBNL) found that variations in local permitting procedures can lead to a difference in average residential PV system prices of approximately \$0.18/Watt (W) between the jurisdictions with the most-onerous and most-favorable permitting procedures.¹³⁷ This equates to a \$900 difference in system costs for a typical 5 kilowatt (kW) residential PV installation between jurisdictions. When considering variations in permitting practices as well as in other local regulatory procedures, the price difference increases to \$0.64-0.93/W between the most-onerous and the most-favorable jurisdictions: a price difference of between \$3,200 and \$4,700 for a typical 5 kW residential PV installation. In addition to increased system costs, delays in the permitting, inspection and interconnection processes may result in foregone energy production and customer dissatisfaction.

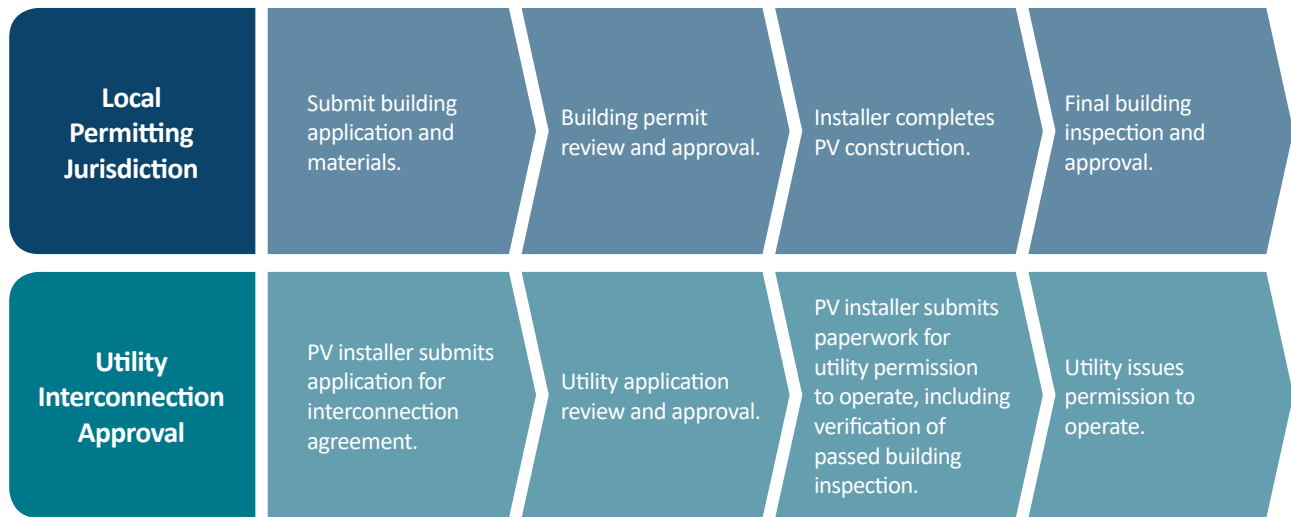
One avenue for state policies to assist in reducing soft costs is by streamlining and expediting the permitting, inspection and interconnection processes. Streamlining these processes may also lower other soft costs, such as customer acquisition costs, through reducing the costs incurred by solar installers due to customers abandoning delayed projects.

Several states have taken action to address permitting, inspection and interconnection soft costs. For example, California passed the Solar Permitting Efficiency Act (Assembly Bill 2188) in 2014 that required all city and county governments to adopt an ordinance that creates an expedited, streamlined permitting process for small residential rooftop solar energy systems with a capacity of less than 10 kW. Cities and counties are required to conform their permitting processes to the recommendations in the California Solar Permitting Guidebook.¹³⁸ The bill also requires that cities and counties provide all eligible systems with a simple checklist for the permit process.

Legislation enacted in Massachusetts in 2012 required the Department of Public Utilities (DPU) to develop recommendations for improved interconnection policies and processes.¹³⁹ In accordance with this legislation, the DPU established three basic tracks for interconnection.¹⁴⁰ The Simplified track, for systems with a capacity of 15 kW or less, has a maximum timeline for approval of 15 days. The Expedited track, for systems 15 kW or greater, has a maximum time frame of 40 days. All facilities that are not eligible for the Simplified or Expedited tracks are put on the Standard track, which has a maximum time frame for approval of 125 days.

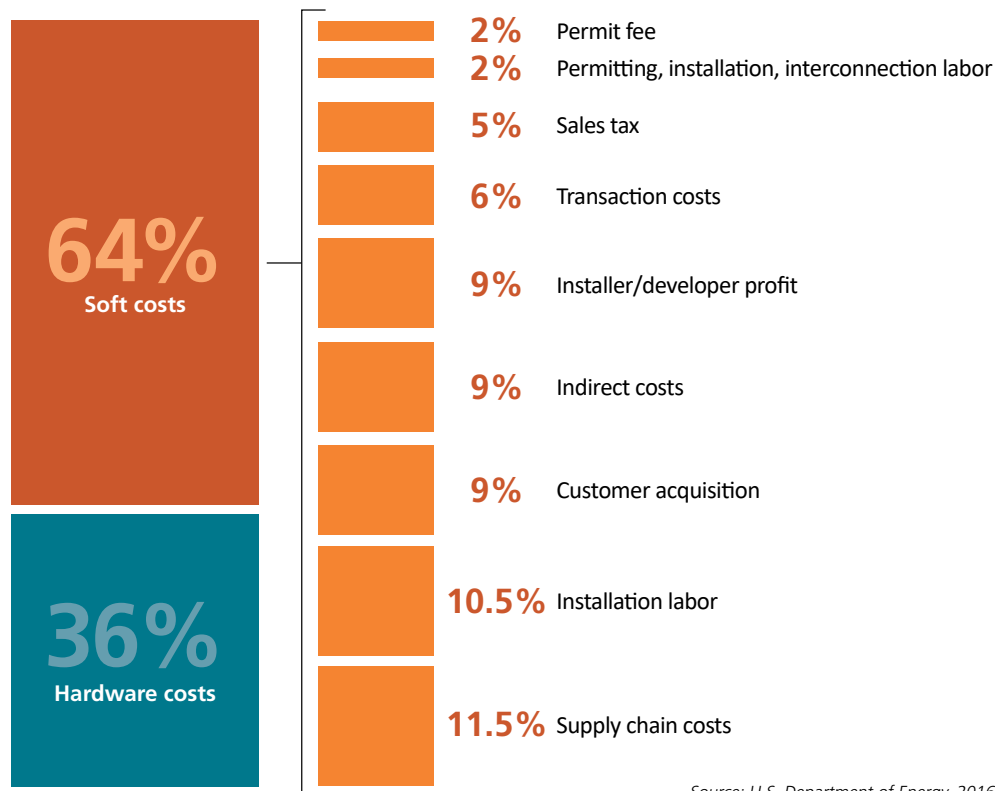
States can also decrease soft costs through reducing or eliminating the cost of obtaining permits. For example, in 2008, Colorado enacted Senate Bill 117 that placed a statewide cap on building permit fees for solar energy systems. For systems smaller than 2 MW, cities and counties cannot charge fees greater than a flat amount (\$500 for residential and \$1,000 non-residential systems) or the actual costs of issuing a permit for a residential system, whichever amount is less. For all systems 2 MW or larger, local governments cannot charge fees greater than the actual cost of issuing the permit. Colorado enacted House Bill 1199 in 2011 expanding these fee caps to apply to agencies, institutions, authorities and political subdivisions. Similarly, Connecticut passed Senate Bill 1243 in 2011 that established a local option for building

PV Building Permitting and Utility Interconnection



Source: National Renewable Energy Laboratory (NREL)

Solar Soft Cost Breakdown



Source: U.S. Department of Energy, 2016

permit fee waivers for renewable energy projects. Municipalities are authorized to waive the building permit fee for projects including solar energy systems.

Additionally, states can decrease building or interconnection permitting requirements or eliminate them entirely. For example, in Vermont, solar net-metered systems must receive a “certificate of public good” from the Vermont Public Service Board to interconnect. House Bill 56 enacted in 2011 established that for systems 5 kW or less, applicants are only required to “self-certify” that they comply with the interconnection requirements and certain siting requirements. Utilities, municipalities, and adjacent landowners have a 10-day period to raise any issues and request a hearing. If none are raised during this period, a certificate of public good is issued. In 2014, Vermont passed House Bill 702 increasing the capacity of systems eligible for the 10-day permitting process to 15 kW.

Arizona enacted House Bill 2615 in 2008 establishing standards for how construction permits are awarded for solar PV and water heating installations. Legislation allowed municipalities and counties to remove the requirement of obtaining a professional engineer’s stamp to approve a solar system installation.

Finally, allowing customers to access and submit permit applications online can reduce soft costs through decreasing labor and reducing delays caused by lost or misplaced applications. For example, in a 2015 order that established the state’s interconnection standards, the Mississippi Public Service Commission (PSC) included provisions that required electric utilities to make PSC-approved interconnection application forms available online and to establish processes for accepting applications electronically.¹⁴¹ An increasing number of states also require utilities to post information about the status of interconnection requests online.

Questions for Consideration

- Could your state’s permitting and interconnection process be streamlined or expedited?
- Is there consistency across multiple jurisdictions?
- Can any of the interconnection process be completed online or electronically?
- Does your state limit how much jurisdictions or utilities can charge for permits?
- Has your state considered education, training or assistance for local permitting authorities?

Building Policies and Codes

This segment contains numerous excerpts from the Clean Energy States Alliance (CESA) publication, “Standards and Requirements for Solar Equipment, Installation, and Licensing and Certification.” Visit CESA’s website for the full publication.

Building codes set minimum standards for structures and buildings to ensure public health, safety and welfare. Building code requirements related to installation, materials, wind resistance and fire classification can help ensure the safe installation and operation of PV systems.¹⁴²

Building codes may be adopted at the state or local level, depending on state law, although code enforcement typically occurs at the local level. States may allow localities to adopt stricter codes or may prevent local variation entirely. In Home Rule states, adoption may occur at the state or local level.

Jurisdictions generally require a PV system to pass a permitting and inspection process prior to commissioning. Inconsistency across jurisdictions in building code implementation can create challenges for solar installers and contractors. The permitting and inspection process can be lengthy, costly and uncertain in some jurisdictions.

Building codes in most states and local jurisdictions in the U.S. are based on various editions of the International Code Council’s “model” building and residential codes, and may be modified to meet local needs. The two most widely adopted codes are the International Residential Code, which applies to detached one- and two-family dwellings and townhouses three stories or less, and the International Building Code, which applies to buildings and structures not covered by the International Residential Code. These model building codes help promote code uniformity among jurisdictions.

These model codes are updated every three years to integrate emerging industry best practices. States vary in how quickly they adopt updated codes, however and jurisdictions can create innovative policies that go beyond the solar-related provisions in the model codes, to further encourage and streamline solar installations. Importantly, ambiguous or overly restrictive provisions in building codes can create unintended barriers for solar installations without providing additional benefits. The increasing popularity of rooftop PV installations and the pace at which solar technologies evolve mean that officials may need to evaluate building code provisions specific to rooftop solar periodically.

The current versions of the International Residential Code and the International Building Code require rack-mounted rooftop PV systems to be installed according to the manufacturer’s instructions, the National Electrical Code, and Underwriters Laboratories’ product safety standards [such as UL 1703 (PV modules) and UL 1741 (Inverters)], which are design requirements and testing specifications for PV-related equipment safety.

In 2010, Oregon enacted the first statewide solar code in the nation, the Oregon Solar Installation Specialty Code.¹⁴³ The solar code includes a prescriptive pathway to expedite permitting for solar installations that meet certain requirements, minimum structural requirements for the installation of PV components and support systems, and guidance for how jurisdictional authorities should process building permit applications and determine permit fees. Additionally, the Building Code Division within the Oregon Department of Consumer and Business Services created a checklist that allows installers to determine eligibility for the prescriptive pathway outlined in the solar code.¹⁴⁴

Some states and jurisdictions have created policies that encourage developers to design and build “solar-ready” structures. “Solar-ready” buildings incorporate several key design elements and considerations that allow rooftop solar PV systems to be easily added in the future. For example, Tucson, Ariz., passed a solar-ready ordinance in 2008.¹⁴⁵ To receive a permit, developers of new single-family homes or duplexes are required to plan for solar PV systems and solar water heating systems.

Other jurisdictions have adopted ordinances that require solar PV installation on certain buildings. At least four California cities—Lancaster,¹⁴⁶ Santa Monica,¹⁴⁷ San Francisco¹⁴⁸ and Sebastopol¹⁴⁹—have adopted ordinances requiring certain new buildings to install solar PV systems, with each city’s requirements varying slightly.

States and jurisdictions have also implemented requirements for buildings to be net-zero energy, also called zero-net energy. Net zero energy properties are those that produce as much or more power than they consume on an annual basis, usually through on-site generation such as wind or rooftop solar and comprehensive energy efficiency measures.

The state of California has a goal for all new residential construction to meet zero net energy standards by 2020 and for new commercial buildings to meet the standards by 2030.¹⁵⁰ The city council of Santa Monica approved an ordinance in November 2016 requiring all new single-family construction to be net-zero energy, making it the first city in California to adopt such an ordinance. The city of Lancaster recently strengthened its requirements for new construction passing a city ordinance that not only requires rooftop solar on new houses but also requires rooftop solar to meet all the energy needs of those homes.

Fire Codes

Rooftop PV systems present special considerations for firefighters and first responders. Potential system hazards include tripping, structural collapse due to extra weight from the system, fire spread (depending on the materials used), inhalation exposure to toxic materials, electrical shock and other hazards if battery energy storage systems are also present.¹⁵¹ Fire codes are designed to minimize the risk of fire,

protect public health and safety, and safeguard firefighters and other emergency responders.

Fire codes can address the location of rooftop PV systems to minimize tripping and electrocution hazards and provide first responders access to roof space. Firefighters may require access to the roof during a fire to create vertical ventilation (i.e., making a hole in the roof to allow heated gas and smoke to escape from the building).

The most widely-accepted fire code is the ICC's International Fire Code (IFC). Recent versions of the IFC include sections that relate to solar PV systems and their electrical components. Various versions of the IFC have been adopted by jurisdictions in at least 42 states and Washington, D.C.¹⁵² In addition to the IFC, the National Fire Protection Association (NFPA) produces the NFPA 1 Fire Code, which has also been adopted by jurisdictions in the U.S. While the National Electrical Code (NEC) includes provisions that are critical to first responder safety, the NEC relates primarily to electrical components.

Some jurisdictions have modified provisions in the IFC or created certain exceptions to them. For example, the city of Boulder, Colo., worked with stakeholders and the Boulder Chief Fire Marshal to adopt several amendments to the 2012 IFC.¹⁵³ The city's resulting fire code regulations struck a compromise between increasing rooftop solar PV potential while still addressing key fire safety concerns.

Electrical Codes

The National Electrical Code (NEC) provides comprehensive electrical safety design, installation, and inspection requirements for electrical conductors, equipment and raceways related to solar PV systems. The NEC, also called the NFPA 70, is developed by the National Fire Protection Association (NFPA) and updated every three years. The NEC devotes two of its articles to addressing solar PV systems: Article 690 (Solar Electric Systems) and Article 705 (Interconnected Electrical Power Production Sources).

The NEC requires that "qualified" individuals install solar panels, but it does not define the criteria for vetting installers, resulting in differing state and local government interpretations (see "Solar Training and Certification" section, page 54). Revisions in the past several code cycles have contained important updates designed to protect firefighters, contractors, installers and homeowners. For example, in 2011, the NEC was amended to expand signage and labeling requirements for all PV systems. Rapid shutdown and disconnection device provisions have been a major topic of discussion in the 2014 and 2017 NEC updates.

The NEC 2014 has been adopted by 35 states as of October 2016. While Massachusetts is the only state to have adopted the NEC 2017 (as of January 2017), there are nearly two dozen states in the process of adopting the new code. In some states, local jurisdictions have primary or complete authority over electrical code adoption.

Questions for Consideration

- What versions of building, fire and electric codes are in place?
- Are codes adopted at the state or local level, or a combination of both?
- How often should codes be reviewed and modified in your jurisdiction to reflect changes in technology?
- Has your state or any local jurisdictions adopted codes with solar PV provisions?
- Does the state offer any education or training to local code officials on solar PV specific provisions?
- Are adequate resources available to enforce building, fire and electrical codes?

Solar Training and Certification

This segment contains numerous excerpts from the Clean Energy States Alliance (CESA) publication, “Standards and Requirements for Solar Equipment, Installation, and Licensing and Certification.” Visit CESA’s website for the full publication.

State and local jurisdictions typically establish standards for electrical work and the qualifications required of contractors and individuals that perform that work. Most states have adopted the National Electrical Code (discussed in “Building Policies and Codes”), often with state or local modifications, as the standard for electrical installations. Because PV systems contain numerous electrical components and usually connect to the electric grid, many states or localities require qualified electric professionals to perform many aspects of PV installation.¹⁵⁴

Licensing and certification are the credentialing tools that states and local jurisdictions use to ensure that a solar installer is a “qualified person,” possessing the qualifications, competence, and expertise to provide solar installation services. A license is a grant of legal authority to those individuals who demonstrate the necessary degree of knowledge, experience and skill to safely and competently engage in the profession. Licensing is typically a mandatory requirement administered at the state level, and in some states at the municipal level. Certification is typically a voluntary credential that is administered by third party, non-governmental organizations. There are three variations of licensing and certification regimes employed by states and localities to illustrate different licensing models for rooftop solar installers: general electric licensing, limited electric licensing and third party certification. Most rules governing who is qualified to perform electrical work and the standards for the work are adopted at the state level; however, local jurisdictions in some states establish electrician licensing standards and requirements. As discussed further below, state or local government administered solar programs will often incorporate third party certification requirements into program rules.

Variations in state licensing and certification requirements can be significant and these differences have important implications for PV installations. Some important areas where licensing requirements may differ include:

- Whether the licensing function is administered at the state or local level.
- The type or level of license needed to perform PV installations.
- The components of a PV installation which are defined as electrical work and therefore require a licensed electrician to perform or supervise.
- The number of licensed electrical workers required to oversee non-licensed workers who also perform electrical work.

Many states require a general electrician license as a minimum credential to perform or oversee electrical work on PV installations. Others, however, allow individuals to obtain a limited license to perform electrical work but with specified limitations, such as limiting the size of the system or narrowing the components that can be installed with a limited license. In addition to licensure, some state or municipal agencies tasked with implementing solar incentive programs require solar contractors to hold a third party certification for the system to be eligible for the incentive. Utilities that offer solar incentives may also require that licensed professionals perform the PV installation for the customer to qualify for the incentive, including licensed general contractors and/or licensed electrical contractors.

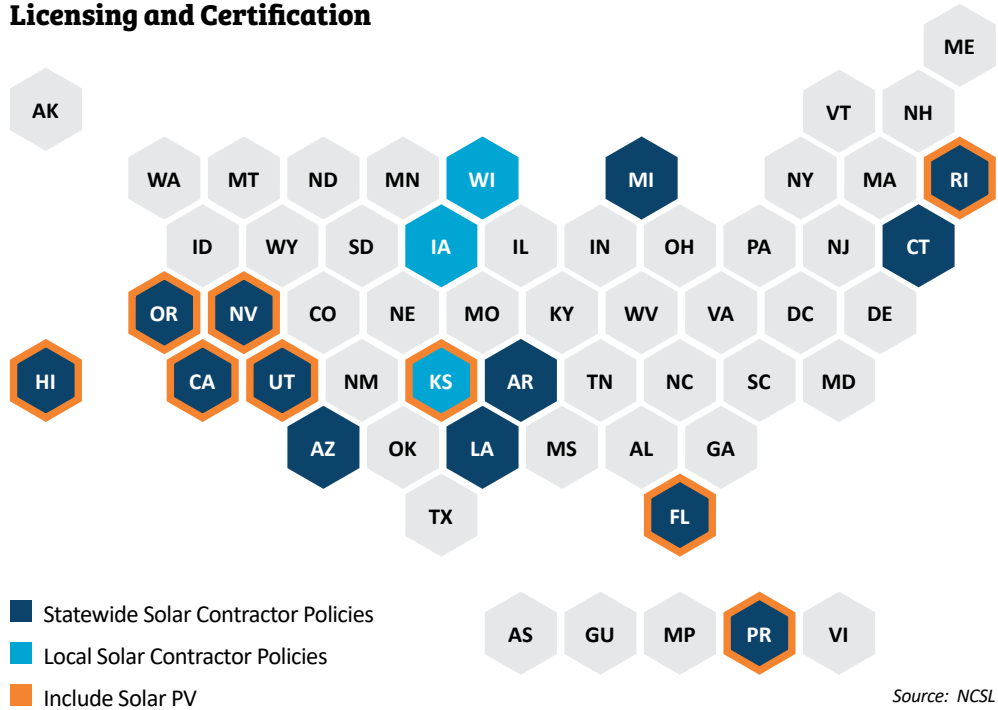
Licensing and certification requirements are important considerations for states and local jurisdictions because these requirements directly impact:

- The implementation of solar policy goals, including local or in-state investment.
- Pathways to employment in the state.
- Labor costs associated with deploying PV.

State Action

At least 12 states and Puerto Rico have statewide, comprehensive policies governing solar contractor licensing and certification. Additionally, cities in at least three other states have local solar contractor licensing policies. Of the 15 states with solar contractor policies, at least 11 states—and Puerto Rico—include solar PV.¹⁵⁵

Licensing and Certification



Source: NCSL

Several states have taken legislative action relating to solar training and certification. For example, Rhode Island passed House Bill 8200 in 2014 creating the Renewable Energy Professional Certificate. Certificates are issued by the Department of Labor and Training to registered contractors who have either an associate or higher degree in renewable or solar energy, or who have completed an approved certification course. Certificate holders can perform certain installation work and all ancillary, non-electrical work. While holders can bid for renewable energy jobs that entail electrical work, a licensed electrician must complete all electrical work for the project. Louisiana enacted Senate Bill 447 in 2014 requiring licensed contractors to be in compliance with the State Board of Licensing to install solar panels, through a solar PV installer certification. The bill specified that contractors with Building Construction, Electrical Work or Mechanical Work licenses as of August 1, 2014 will meet requirements for compliance. Contractors without certification from the North American Board of Certified Energy Practitioners must take a written exam. Contractors applying for Solar Energy Equipment classification, must have a Building Construction, Electrical Work, Mechanical Work or Residential Building Contractor certification and must complete a board approved training course in solar energy systems design. Additionally, Utah enacted Senate Bill 208 in 2013 exempting contractors with a specialty license for electrical work for photovoltaic installation, repair or maintenance earned in 2009 through 2011 to be exempt from an electrical license.

A handful of states have enacted or introduced legislation establishing solar training programs. For example, Illinois passed Senate Bill 2814 in 2016 that, among other provisions, created the Illinois Solar for All Program, which will prioritize new solar development in and job training for low-income communities. The bill requires all projects under the Illinois Solar for All Program, when possible, to include job training opportunities and to coordinate with existing job training programs. It also includes provisions to create a utility-funded solar installer training program specifically designed to reach certain individuals, including ex-offenders and former foster children. New York introduced legislation in 2017 that would have authorized vocational training for inmates on the installation of solar hot water systems in correctional facilities.

Questions for Consideration

- Does your state have policies in place addressing workforce training, licensing or certification?
- Would these policies be more effective at the state or municipal level?
- Which solar technologies should be included in workforce policies?

Solar Access and Rights

Although state- and local-level support for solar energy development has grown, solar energy customers may still face challenges such as local ordinances or homeowner association rules that restrict, prohibit or significantly increase the cost of installing solar energy systems. Investments in solar can also be compromised by trees or new construction on adjacent properties that obstruct sunlight.

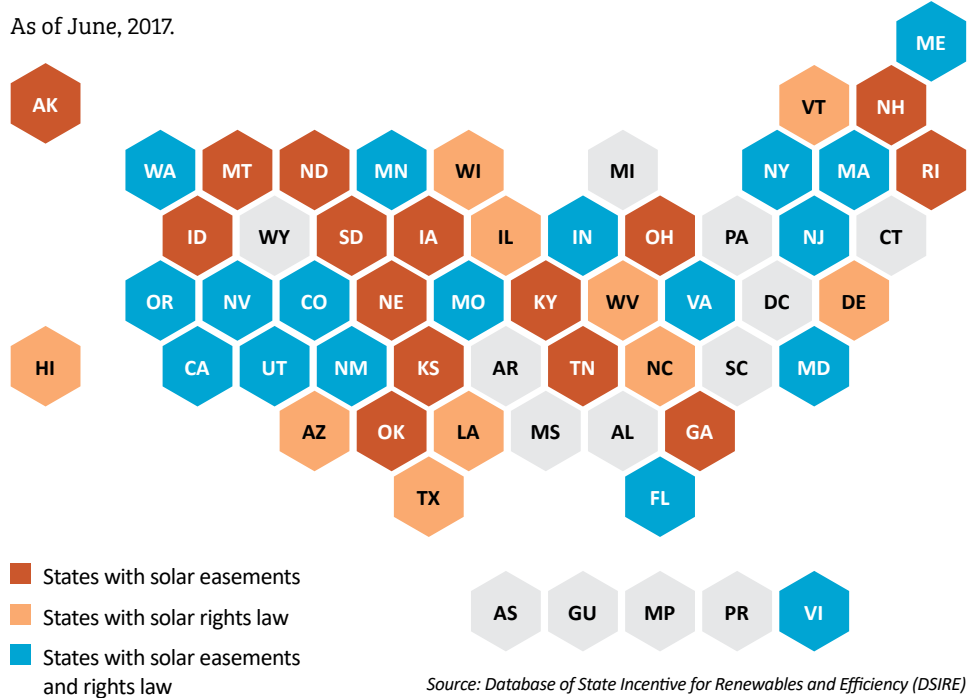
Solar access laws can be implemented at the state or local levels and protect solar energy customers from private prohibitions of solar energy installations and secure customers' access to sunlight. There are two types of solar access law: solar easements and solar rights law. Solar easements are the most common type of solar access law at the state level. These policies allow existing solar customers to secure rights to continued access to sunlight and protect against neighboring properties being developed in such a way that the solar customer's access to sunlight is limited or restricted, either through building construction, growing trees or other foliage.

Solar rights laws address local ordinances' or homeowner association's efforts to prohibit, restrict or significantly increase the cost of installing solar energy systems. These laws can define what type of equipment is included in the law, prevent covenant restrictions from prohibiting solar energy installations, define what constitutes an unreasonable restriction, provide exemptions, clarify which structures are included in the law, and award costs and legal fees for civil action expenses arising from disputes.

At least 42 states have authorized some type of solar access laws: at least 15 states have solar easements, at least 10 states have solar rights laws and at least 17 states have both solar easements and solar rights laws.¹⁵⁶

State Solar Access Policies

As of June, 2017.



Questions for Consideration

- Does your state have policies in place to protect solar energy customers from private prohibitions of solar energy installations?
- Does your state have policies in place to secure access to sunlight for existing and future solar energy customers?

Solar Photovoltaic Panel Recycling and Decommissioning

Solar photovoltaic panels are designed to last for at least 25 to 30 years. Given this long lifespan, the question of how to dispose of PV panels and modules once they have reached their end-of-life has not yet become a concern for many states or the solar industry generally. However, as solar panels from the early adoption stage are approaching their end-of-life, a small number of states are beginning to discuss disposal and recycling of end-of-life solar panels and modules. The International Renewable Energy Agency estimates that by the 2050s the cumulative global PV waste stream could reach 78 million tons, with up to 10 million tons of waste projected in the U.S.¹⁵⁷

Decommissioning policies may be established at multiple levels of government. In many states, decommissioning is a matter of local authority and may be addressed through private contracts, although state policy may establish a statewide standard or provide model ordinances for localities, such as in Massachusetts and North Carolina.¹⁵⁸ Forty-one states and Washington, D.C. have locally-determined decommissioning policies. Five states—Louisiana, Nebraska, Oklahoma, New Hampshire and Vermont—require decommissioning plans to be submitted in certain instances, such as for state-owned lands, to receive

a solar easement or for larger facilities. Another three states—California, Hawaii and New Jersey—have decommissioning policies that apply in certain circumstances, such as on agricultural lands or to receive a solar easement.¹⁵⁹ Federally, many types of panels are not classified as hazardous waste.

California enacted Senate Bill 489 in 2015 regarding recycling of end-of-use solar panels, however the bill did not specifically develop a panel recycling program. Many PV modules in the state are designated as hazardous waste and fall under the jurisdiction of the Department of Toxic Substances Control. The department released a notice of proposed standards for the management of hazardous waste solar modules in 2014.¹⁶⁰ The 2015 legislation has the stated intent to encourage PV recycling planning and notes that PV module manufacturers are encouraged to address end-of-life management. The legislation grants the department the authority to designate hazardous waste PV modules as universal waste through regulations, which allows another entity (or entities) to develop a recycling or disposal program for solar PV modules.

In 2016, Washington enacted House Resolution 4664 establishing a stakeholder process to develop recommendations for financing, takeback and recycling of solar modules sold before July 1, 2016. The stakeholder process includes solutions for takeback processes when a manufacturer is no longer solvent or doing business at the end of the module's useful life. Several additional states have considered or are currently considering bills regarding solar panel end-of-life management including Arizona, Hawaii and New York. In recent years, California has considered legislation in addition to the bill included above.

In their approaches to addressing solar panel recycling, states have generally placed the onus for end-of-life panel takeback and recycling on solar panel manufacturers. However, states have varied in their designation of PV modules and whether end-of-life panels are considered hazardous or universal waste. For example, as summarized above, California legislation allows PV modules to be designated as universal waste, allowing other entities to develop recycling or disposal programs for end-of-life panels. In contrast, legislation introduced in New York would specifically require end-of-use solar panels to be handled and managed in a manner consistent with the requirements for the disposal of hazardous waste.¹⁶¹

Questions for Consideration

- Has your state discussed approaches to PV recycling, disposal or take-backs?
- Which stakeholders should have responsibility for decommissioning—governments, PV system owners, manufacturers or installers?
- Should the cost of decommissioning be incorporated into existing programs and practices?
- What procedure should exist if the party initially responsible for end of life removal and disposal of solar systems is no longer available?

APPENDIX: RESOURCE LIST

Solar Policy, Markets and Overview

- *The Effect of State Policy Suites on the Development of Solar Markets*, NREL, http://www.nrel.gov/tech_deployment/state_local_governments/publications_state_policy_suites_solar_market.html
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- *State Energy Planning Guidelines*, National Association of State Energy, <https://www.naseo.org/data/sites/1/documents/publications/NASEO-State-Energy-Planning-Guidelines.pdf>
- *Status and Trends in the U.S. Voluntary Green Power Market (2015 Data)*, NREL, <http://www.nrel.gov/docs/fy17osti/67147.pdf>
- *U.S. Solar Market Insight: Executive Summary, 2016 Year in Review*, Solar Energy Industries Association (SEIA), <http://www.seia.org/research-resources/solar-market-insight-report-2016-year-review>

Rate Design, Valuation, Utility Regulation and Regulatory Reform

- *50 States of Solar* various quarterly and annual reports, North Carolina Clean Energy Technology Center (NCCETC), <https://nccleantech.ncsu.edu/resource-center-2/fact-sheets-publications/> *Complementary full text reports are available to state legislators upon request
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- *Distributed Energy Resources Rate Design and Compensation*, National Association of Regulatory Utility Commissioners Staff Subcommittee on Rate Design, <http://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0>
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- *Regulatory Considerations Associated with the Expanded Adoption of Distributed Solar*, NREL, <http://www.nrel.gov/docs/fy14osti/60613.pdf>
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- *Smart Rate Design for a Smart Future*, RAP, <http://www.raonline.org/knowledge-center/smart-rate-design-for-a-smart-future/>
- *Valuation of Solar Generation Assets*, SEIA, <http://www.seia.org/research-resources/valuation-solar-generation-assets>
- *Value of Solar: Program Design and Implementation Considerations*, NREL, <http://www.nrel.gov/docs/fy15osti/62361.pdf>

Solar Soft Costs

- *Benchmarking Non-Hardware Balance-of-System (Soft) Costs for U.S. Photovoltaic Systems, Using a Bottom-Up Approach and Installer Survey*, NREL, <http://www.nrel.gov/docs/fy14osti/60412.pdf>
- *Soft Costs*, U.S. Department of Energy SunShot Initiative, <https://energy.gov/eere/sunshot/soft-costs>
- *SolSmart*, U.S. Department of Energy and the Solar Foundation, <http://www.gosparc.org/home-2>

Financing

- *On the Path to SunShot: Emerging Opportunities and Challenges in U.S. Solar Manufacturing*, NREL, <http://www.nrel.gov/docs/fy16osti/65788.pdf>

Solar Integration and Storage

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NCSL acknowledges LexisNexis was used for our state policy research.

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Funding for this report was made possible by a grant from the U.S. Department of Energy.

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