Returning Champions

State Clean Energy Leadership Since 2015

PREPARED BY

CleanEnergy States Alliance

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Executive Summary

This report shows the range of strategies and programs that states across the country have been implementing since 2015 to advance clean energy markets. It builds on a 2015 report by the Clean Energy States Alliance (CESA) titled *Clean Energy Champions: The Importance of State Programs and Policies*. That report argued that state clean energy leadership had been essential to robust clean energy expansion in the US, even though the federal government and the private sector were also taking important actions. Because the federal government had not dictated a top-down, one-size-fits-all approach, individual states had been able to innovate and experiment—creating policies, incentives, and programs to meet the specific needs of their populations, economies, and geographies.

With the federal government becoming less aggressive since 2017 in promoting clean energy, the policy innovation role of the states has become even more important. Moreover, as market penetration of clean energy has increased, the issues that need to be addressed regarding rates, siting, interconnection, and equity have become more complicated.

Returning Champions: State Clean Energy Leadership Since 2015 is primarily descriptive and draws on previously published studies to paint a textured picture of state activities. While it covers some well-known policies and programs, it also highlights several less obvious and less recognized state examples that have had a major impact.

There is so much going on in the states that it is impossible to discuss every state and every relevant policy initiative in a report of this length. States are making progress with clean energy in ways that are not included here, and many of the programs highlighted in the original *Clean Energy Champions* report continue to drive clean energy leadership. But this report emphasizes new state clean energy programs since 2015.

Four thematic chapters, briefly described below, highlight some of the most important issues that the states have been focusing on over the past few years regarding clean energy advancement. The report also features 21 case studies to show some of the diverse ways in which states are creating a clean energy future.

1. States Implement Ambitious Goals and Standards

Energy, economic development, and climate mitigation goals and targets can be important drivers of social change and market transformation. Before 2015, there were various state goals related to clean energy, but many new and ambitious goals have been announced since then. The declining cost of clean energy technologies has made higher targets more achievable and less expensive. Some governors and other state leaders have embraced more aggressive clean energy targets as part of a response to the threat of climate change.

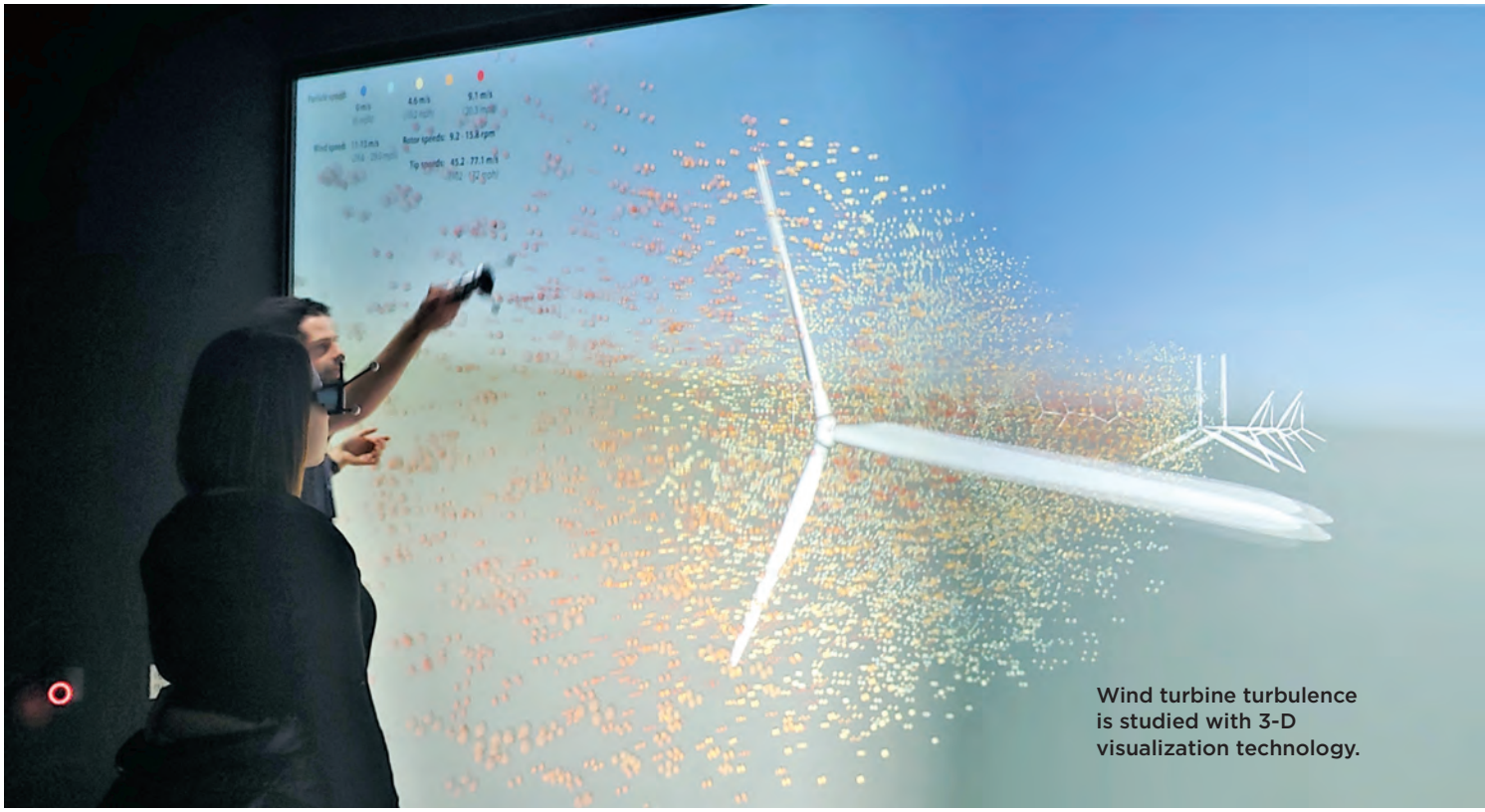
A state renewable portfolio standard (RPS) has probably been the single most important state policy mechanism for advancing clean energy and has been established in 29 states plus the District of Columbia (DC). It requires electricity suppliers to get an increasing share or amount of their electricity from renewable energy and other clean energy technologies. Since 2015, only one state has weakened its RPS, while 14 states plus DC have strengthened their RPSs, most often by raising near-term targets and creating new, higher, longer-term targets. States have also added new RPS features, such as including renewable thermal technologies that generate heat rather than electricity.

Twelve states plus DC have established 100 percent clean energy goals, sometimes within an RPS and sometimes separate from it. Some of these goals are enforceable, while others are not. Several states have created distinct goals and mandates for energy storage.

Twelve states plus DC have established 100 percent clean energy goals, sometimes within an RPS and sometimes separate from it. Some of these goals are enforceable, while others are not (e.g., being expressed through a Governor's executive order that can be overturned by a future Governor). In addition, several states have created distinct goals and mandates for energy storage. And in a pioneering initiative, California has made solar photovoltaics (PV) the standard for new homes, requiring the vast majority of new homes to incorporate PV, either on the roof or in a community solar installation.

2. States Help Commercialize Emerging Technologies

Some of the technologies with great potential for transitioning the United States to clean energy are not yet able to compete in the marketplace without assistance. They may not have developed their



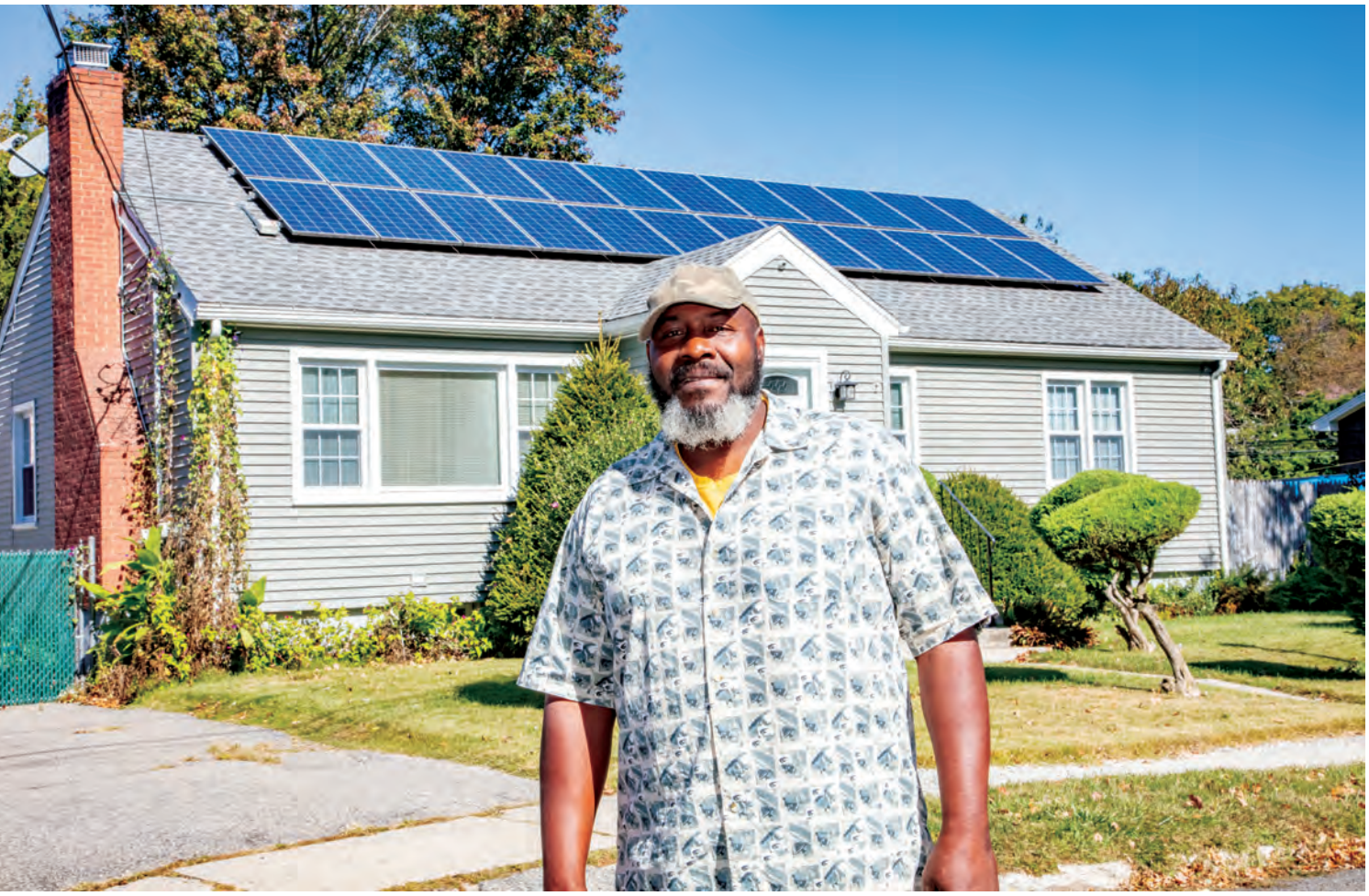
Wind turbine turbulence is studied with 3-D visualization technology.

supply chains sufficiently or achieved the operational efficiencies necessary to bring down costs. In other cases, consumers may be unfamiliar with the technologies or products, or existing regulations may not account fully for their benefits and advantages. States have taken a wide range of steps to help these relatively new clean energy technologies compete for customers. Offshore wind farms, electric vehicles, air source heat pumps, battery storage, microgrids, hydropower from irrigation systems, and advanced biomass and biogas systems all have brighter futures because of the actions taken by states over the past few years.

3. States Modernize the Electrical Grid and Heating Systems

For at least a decade, it has been obvious that the electricity grid would need to adapt to accommodate performance characteristics of clean energy technologies. States have tackled three key issues: (1) how to incorporate wind, solar, and hydropower facilities whose output can vary by time of day and season, (2) how to enable large numbers of smaller distributed generation systems (rooftop solar, combined-heat-and-power, biogas digesters, fuel cells, small wind turbines) to be installed in or on buildings and properties, and (3) how to bring electric vehicles into the electricity system in ways that reduce electricity costs and increase reliability rather than make the grid more costly and difficult to manage. Some states have addressed these issues as part of overall efforts to modernize the grid. Through more narrowly targeted efforts, some states have considered the best methods for compensating distributed solar generation and for directing additional distributed generation to the locations where it would have the greatest value to the grid.

State have also taken action to address the difficult challenge of replacing fossil fuels for space and water heating in buildings. To achieve that, older electric heating and hot water equipment must be retired, while oil, propane, and natural gas boilers, furnaces, and water heaters must make way for air source heat pumps, ground source heat pumps, and solar thermal technologies.



4. States Address Equity and Consumer Protection

The growth of the clean energy economy—with significant cost savings and numerous jobs spreading through society—has caused states to focus on fairness, especially to ensure that low- and moderate-income (LMI) households receive an appropriate share of the benefits. States understand that LMI households' circumstances (e.g., frequent status as renters rather than homeowners, limited financial resources for paying the upfront cost of clean energy technologies) can make it difficult for them to participate. Recognizing that state intervention is necessary, since 2015 many states have initiated or expanded programs to bring the benefits of clean energy, especially solar energy, to LMI households and communities

The growth of the clean energy economy—with significant cost savings and numerous jobs spreading through society—has caused states to focus on fairness, especially to ensure that low- and moderate-income households receive an appropriate share of the benefits.

States have also addressed a different type of fairness by implementing a wide range of consumer protection measures. Providing sound information, requiring clean energy companies to make disclosures to potential customers, and imposing state standards and regulations for clean energy equipment and clean energy installation companies all help ensure that residents are treated fairly by clean energy vendors.

The Path Forward

The states can and should continue to move the nation towards a clean energy future. In doing so, they should keep the following in mind:

1. Innovation Remains Key to the States' Success

Since the turn of the century, the states have been seedbeds of ingenuity and innovation for the creation of new clean energy markets. They should continue to place a priority on innovation and to replicate successful innovations from other states.

2. States Need Leadership Strategies for Achieving Targets

Many states have adopted bold and laudable goals for clean energy. Without concerted, ongoing attention and financial support, those goals will not be achieved, especially in those cases where target dates are set far in the future. States should systematically assess all the obstacles that need to be overcome to reach their goals and then put in place detailed year-by-year plans for overcoming the obstacles and ensuring steady progress.

3. Retain Bipartisan Support for Clean Energy at the State Level

States of different regions, sizes, and political perspectives have all implemented clean energy policies and programs. State policymakers, the clean energy industry, and other stakeholders should continue to set a tone that allows for bipartisan and nonpartisan discussion on issues related to clean energy.

Nevada Governor Steve Sisolak at the signing of bipartisan legislation strengthening the state's RPS.

4. Clean Energy Issues Will Continue to Get More Complicated

With greater market penetration of clean energy technologies, states have had to address complex issues that often require sophisticated economic, engineering, and technical knowledge. This trend will continue and likely intensify. The electricity grid will need to be reimagined to accommodate and make the best use of clean energy technologies and energy storage. Although issues involving equity and consumer protection do not involve engineering or sophisticated economic modeling, they are also complicated and are likely to become more so in the coming years.

5. Electric Vehicles and Building Electrification Will Require More Attention

States have been focusing more in recent years on electric vehicles and electrifying building heating and cooling systems, but they will need to make much greater progress in both of those technology areas if they are to reach their energy and climate goals. Because these technologies add to the overall electricity load, it is essential that they be implemented in ways that provide benefits to the electricity grid and that minimize costs for ratepayers.

6. The Core Clean Energy Technologies—Solar, Wind, and Energy Storage—Can Advance Even Faster

Clean energy progress since 2015 has primarily been a story of greater implementation of solar, wind, and energy storage. Those technologies will continue to improve in efficiency and performance and to decline in cost. They still have tremendous potential to be used much more widely to improve the nation's electricity supply. States can play a central role in making that happen.

Highlights from Case Studies

This report's 21 case studies illustrate the breadth of pioneering and influential state programs and projects that have been implemented since 2015. They also point out the ways in which specific states have been leaders. Most states have implemented multiple successful programs to support clean energy, but the report has room for only one or two case studies about any state. Here are capsule summaries of the case studies:

Many states have implemented policies and programs that directly incentivize the installation of clean energy generation.

- **California** required new homes constructed in the state after January 1, 2020 to incorporate solar PV, either on the roof or in a community solar installation.
- **Colorado** worked with its major investor-owned utility, Xcel Energy, to establish ambitious clean energy targets that will reduce emissions in the electricity sector by 80 percent in 2030 and 100 percent in 2050.
- **Connecticut** implemented a multi-faceted program to bring solar and energy efficiency to LMI homeowners in ways that significantly reduce their energy costs.
- The **District of Columbia** set a goal of bringing the benefits of solar energy to 100,000 LMI residents, and then took wide-ranging actions aimed at achieving that goal.
- **Hawaii** worked to modernize its electricity grid and implemented planning processes and project procurement to make high levels of renewable energy market penetration technically feasible.
- **Illinois** implemented robust consumer protection measures to ensure that residents and organizations that install solar have transparent, positive customer experiences.
- **Iowa** designed and executed a wide-ranging strategy for developing the state's bioenergy resources.
- **Maryland** simultaneously advanced clean electricity and clean transportation through a program that provided grants for solar panels on parking lot canopies, along with EV charging stations.
- **Massachusetts** rolled out a comprehensive suite of energy storage policies and programs, including incorporating energy storage for the first time into its three-year energy efficiency plan.
- **Massachusetts** prepared for a growing offshore wind industry by developing important facilities and supporting a suite of workforce development initiatives.
- **Michigan** worked to create community solar pilot programs that would benefit low-income residents.
- **Minnesota** implemented community solar on a large scale so renters and building owners with shaded roofs can participate in the solar economy.
- **New Hampshire** implemented the first comprehensive program to incorporate thermal technologies into its RPS.
- **New Jersey** advanced microgrids in a systematic, sustained way that helps modernize the grid and harden the state's electricity infrastructure.
- **New Mexico** developed a novel solution for bringing solar to manufactured homes in the state.
- **New York** developed a comprehensive, long-term policy approach for reducing emissions from the heating and cooling sector.

- **New York** supported "non-wires alternatives" that can overcome electricity system constraints without costly upgrades to the distribution system infrastructure.
- **Oregon** helped irrigation districts transition to modern water delivery systems while reducing energy consumption, generating renewable electricity, increasing agricultural production, and lowering water use (see photo above).
- **Rhode Island** laid the groundwork for the nation's first offshore wind farm to open in 2016.
- **Vermont** supported wood heat in ways that provide both environmental and economic benefits.
- **Washington** provided grants to public and private electric utilities for projects that advance a range of grid modernization approaches.

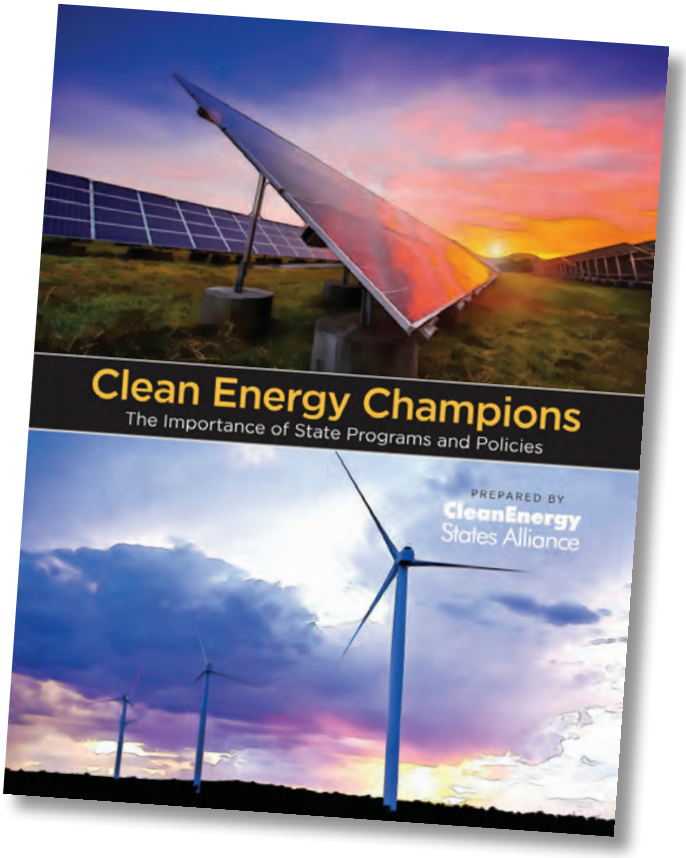
Conclusion

The United States is experiencing a transition to clean energy in great part because states have been able to propel clean energy policy implementation, and because governors, legislators, and state agency staff have given significant attention to clean energy. They have put in place innovative policies and have modified them over time, as necessary. They have provided significant funding to carry out those policies and to staff the agencies that oversee them. By taking a similar leadership approach in the future, the states will continue to be a central pillar of clean energy growth.

Introduction

In 2015, the Clean Energy States Alliance (CESA) published *Clean Energy Champions: The Importance of State Programs and Policies*[1] to highlight the role that the states were taking to advance clean energy. Although the federal government and the private sector were also taking important steps to foster clean energy development, state leadership was essential to the growth of the clean energy industry. Because the federal government had not dictated a top-down, one-size-fits-all approach, individual states were able to innovate and experiment—creating policies, incentives, and programs to meet the specific needs of their populations, economies, and geographies. From that experimentation, and through the networking strength of CESA and other nonprofits working in this space, effective and replicable ideas were adapted and adopted by other states.

In the years since the release of the original *Clean Energy Champions* report, the role of states has become even more important to advance clean energy markets. Since 2017, the federal government has become less aggressive in promoting clean energy, leaving more of the policy innovation role to the states. And as market penetration of clean energy has increased, the issues that need to be addressed regarding rates, siting, interconnection, and equity have become more complicated and sometimes contentious. Because the state public utility commissions and energy agencies have responsibility for regulating



In the years since the release of the original *Clean Energy Champions* report, the role of states has become even more important to advance clean energy markets. As the market penetration of clean energy has increased, the issues that need to be addressed regarding rates, siting, interconnection, and equity have become more complicated.

electric utilities and have extensive knowledge of local markets and market players, they are best placed to address many of these issues.

The states have not shied away from these challenges. CESA is publishing this 2019 report to show the range of issues that the states are currently addressing and to present some of their key solutions for reaching their clean energy goals. Four thematic chapters in this report highlight some of the most important issues that the states have been focusing on over the past few years regarding clean energy advancement. The report also features 21 case studies to highlight some of the diverse ways in which states are leading to create a clean energy future.

Although this report covers a lot of ground, there is so much more going on in the states that it is impossible to discuss every state and every relevant policy initiative in a document of this length. For this report, we have chosen to highlight four trends in state action that we believe to be especially noteworthy:

1. Adoption and implementation of more ambitious clean energy and climate goals
2. Development of new policies and programs to commercialize emerging clean energy technologies
3. Efforts to modernize the electric grid and to advance renewable heating & cooling systems
4. Addressing equity and consumer protection issues

States are making progress on clean energy efforts that are not included in this report; and many of the state programs highlighted in the original *Clean Energy Champions* report continue to drive clean energy leadership. But in this report, we will emphasize new state clean energy programs since 2015.

CHAPTER 1

Becoming More Aggressive: States Implement Ambitious Goals and Standards

Clean energy, economic development, and climate mitigation goals and targets can be important drivers of social change and market transformation. For state policymakers, having clear metrics can be a good way to know if they are making as much progress as expected. Moreover, when enshrined in state law or regulation, a goal can provide an enforceable threshold for consumers and institutions to take concrete actions. For decades, there have been various state goals related to clean energy, but many new and ambitious goals have been announced since 2015, often with considerable fanfare.

Part of the reason that states are setting more aggressive goals is the declining cost of clean energy technologies like wind, solar, and battery storage. The improved economic case for these technologies has made higher targets more achievable and less costly than previously assumed. Some governors and other state leaders have also embraced new targets knowing that strong leadership and bold policy actions are necessary to reduce the threat of catastrophic climate change. The main ways states have recently used goals and targets to drive clean energy deployments and expand markets are described below.

Renewable Portfolio Standards Become Stronger

A state renewable portfolio standard (RPS) requires electricity suppliers to get an increasing share or amount of their electricity from renewable energy and other clean energy technologies. RPSs, or similar policies under a different name such as a clean energy standard, have been established in 29 states plus the District of Columbia. They have probably been the single most important state policy mechanism for advancing clean energy. According to Lawrence Berkeley National Laboratory, non-hydro renewable energy capacity in the United States has generated 3,710,000 gigawatt hours (GWh) since 2000, with 45 percent of that being required by state RPSs. Although some of the RPS-required generation would likely have occurred without the RPS, there is no doubt that this has been a significant state policy to drive the growth of renewable energy generation. RPSs remain especially impactful outside the Great Plains region and Texas, where the favorable

Part of the reason for states setting more aggressive goals is the declining cost of clean energy technologies, like wind, solar, and battery storage. The improved economic case for these technologies has made higher targets more achievable and less costly than previously assumed.

economics of wind energy enables large-scale development, largely without the financial incentives of an RPS.[2]

When *Clean Energy Champions* was published in 2015, it seemed like RPSs could be losing momentum, as some states were considering scrapping their RPSs or scaling them back. That year, Kansas replaced its RPS with a voluntary renewable energy goal. But since then, only Ohio has weakened its RPS, while 14 states plus the District of Columbia have made significant increases to their RPSs, most often raising the near-term targets and creating new, higher, longer-term targets (see Table 1). In many cases, the final target year was pushed ahead from an original date of 2015–2022 to 2030 or later. Illinois did not change its RPS targets, but the 2016 *Future Energy Jobs Act* took other steps to make the RPS more effective and spur additional renewable energy development. As a result of these state actions, more than half of state RPSs have been significantly strengthened since 2015.

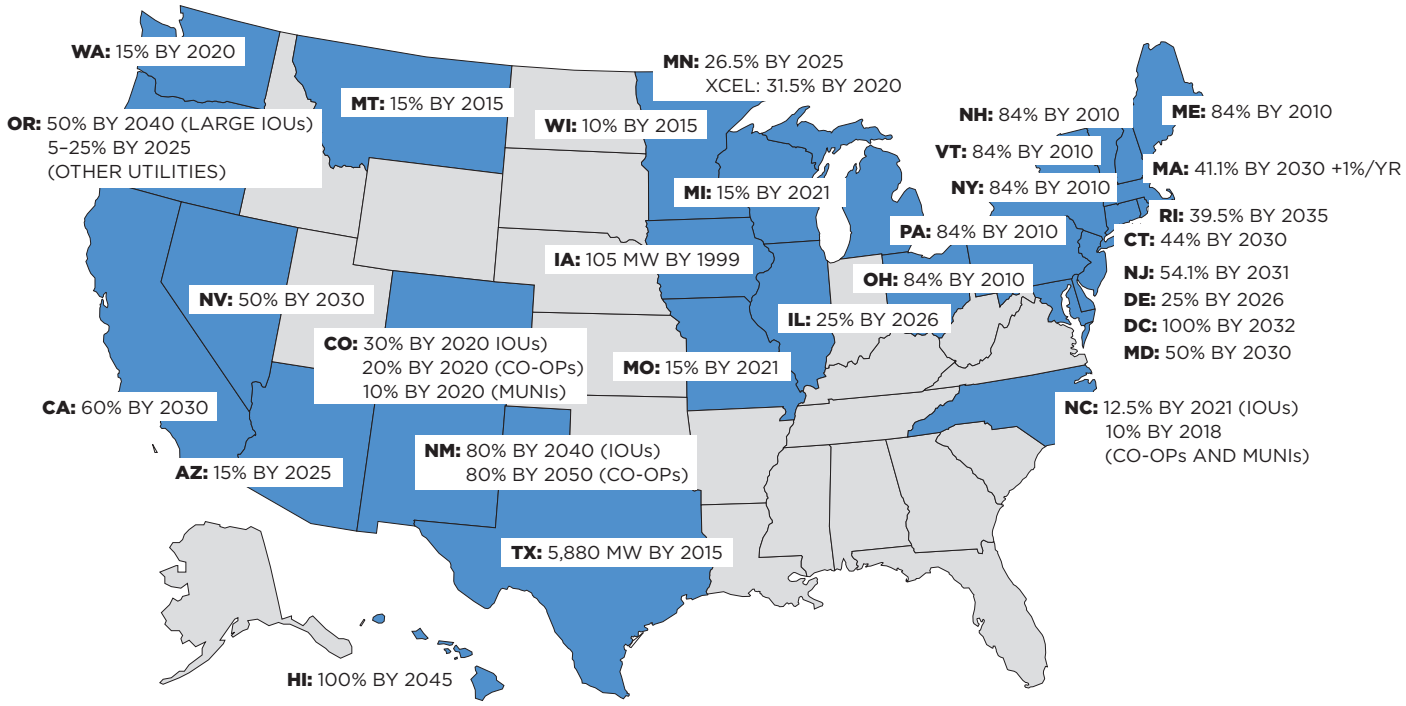
Admittedly, one of the reasons that only one state has weakened its RPS is because several states, such as Montana and Wisconsin, already reached their peak target, so there would be little practical impact of RPS-weakening legislative action. In those states, by not creating new RPS targets, the RPS has faded as a driver of renewable energy development. Nevertheless, the trend towards stronger RPSs is striking and notable. Many of the states have adopted very aggressive RPS targets, with nine states mandating at least 50 percent clean electricity; Hawaii and the District of Columbia now have targets of 100 percent renewable energy. In addition, in early 2019, the Commonwealth of Puerto Rico passed a law requiring 100 percent renewable energy by 2050.

Although most of the RPS-strengthening actions were taken by states with Democratic governors and legislatures, there was often solid bipartisan support. In the case of Nevada, for example, the RPS was increased by unanimous votes in both houses of the legislature. When Nevada Governor Steve

FIGURE 1

RPS Policies Exist in 29 States and DC

Apply to 56% of Total US Retail Electricitiy Sales



Target precentages represent the sum total of all RPS resource tiers, as applicable. In addition to the RPS policies shown on this map, voluntary renewable energy goals exist in a number of US states, and both mandatory RPS policies and voluntary goals exist among US territories (American Samoa, Guam, Puerto Rico, US Virgin Island).

Source: Berkeley Lab (July 2019)

TABLE 1
States that Have Strengthened their RPSs since 2015

State	Previous Maximum Target*	New Maximum Target*
California	33% by 2020	60% by 2030
Connecticut	23% by 2020	44% by 2030
District of Columbia	25% by 2025	100% by 2032
Hawaii	40% by 2040	100% by 2045
Maine	40% by 2017	84% by 2030
Massachusetts	1% annual percentage increases	2% annual percentage increases through 2030 and 1% thereafter (equals 41.1% in 2030)
Maryland	20% by 2022	50% by 2030
Michigan	10% by 2015	15% by 2021
Nevada	25% by 2025	50% by 2030
New Jersey	22.5% by 2020	54.1% by 2031
New Mexico	20% by 2020	80% by 2040
New York	30% by 2015	70% by 2030
Oregon	25% by 2025	50% by 2040
Rhode Island	14.5% by 2019	38.5% by 2035
Vermont	Did not have an RPS	75% by 2032

* The share of electricity that must be generated from eligible clean energy technologies. In a few states, there was more than one increase in the maximum target between 2015 and 2019. Here, we list only the original target in 2015 and the final target as of August 2019.

Sisolak signed the legislation, he gave one of the pens used to the Republican Senate leader and remarked, "I'm joining leaders on both sides of the aisle to send a message to the country and the world that Nevada is open for business as a renewable leader, and our commitment to growing our clean energy economy will not falter or fade due to the political climate."[3]

States have also moved to make their RPSs more ambitious by adding new features to the RPS. Following the lead of New Hampshire, several states—Maine, Massachusetts, and Oregon—expanded their clean energy standards to include renewable thermal technologies that generate heat rather than electricity (see Case Study 13).

Vermont created a novel energy transformation tier to its renewable energy standard that requires retail electricity providers to reduce their customers' fossil fuel consumption, whether or not the fuel is supplied by the utility. Utilities can support distributed renewable electricity generation or a wide range of other technologies, including weatherization, biofuels, heat pumps, heating system improvements, heating fuel changes, and transportation measures.

Case Study 13

New Hampshire
See page 69.

Perhaps the most intriguing variant on an RPS has been the concept of a clean peak standard. Rather than simply adding more renewable energy into the electricity mix, a clean peak standard addresses the fact that electricity demand varies over the course of a day, with costs being much higher during times of greatest electricity use, i.e., during peak demand. A clean peak standard requires a certain amount of clean electricity to be produced during those times of high demand.

After the concept of a clean peak standard was proposed by policy advocates, Arizona and California gave serious consideration to adopting one. Then, in 2018, Massachusetts became the first state to

establish a clean peak standard through legislation. The Massachusetts Department of Energy Resources is currently working on the considerable technical challenges involved with the implementation of a standard that is linked to only specific hours in the day. The Department has produced an initial proposal and has solicited public comment.[4]

States Set Bold 100 Percent Goals

Over the past year, more states have established goals for moving towards 100 percent carbon-free or emissions-free electricity, as shown in Table 2. In some cases, a state has set a general goal that does not necessarily establish the state's RPS as the mechanism for achieving the goal; the state will later determine all the mechanisms for achieving the goal. Some of the states' goals are enforceable,

TABLE 2
States with 100 Percent Clean Energy Goals

State	The Goal	Notes
California	100% carbon-free electricity by 2045	2018 legislation. State agencies are required to submit plans by January 1, 2021 for achieving the goal.
Colorado	100% carbon-free electricity by 2050 for Xcel Energy	This 2019 law codified a pledge previously made by Xcel Energy, whose service territory covers approximately 60% of the state's electricity load.
Connecticut	100% carbon-free electricity by 2040	Governor's executive order in 2019. It asks the Department of Energy and Environmental Protection to develop a plan.
District of Columbia	100% renewable energy by 2032 through the RPS	2018 legislation
Hawaii	100% renewable energy by 2045 through the RPS	2015 legislation
Maine	100% clean energy by 2050	2019 legislation
Nevada	100% carbon-free electricity by 2050	2019 legislation. Policy mechanisms for achieving this aspirational goal were not included in the legislation.
New Jersey	100% carbon-free electricity by 2050	Governor's executive order in 2018. In 2019, the Board of Public Utilities issued a draft master plan for achieving it.
New Mexico	100% carbon-free electricity by 2045	2019 legislation
New York	100% carbon-free electricity by 2040	2019 legislation. A Climate Action Council will be empaneled to develop a scoping plan of recommendations to achieve greenhouse gas reduction targets and carbon neutrality economy-wide.
Virginia	100% carbon-free electricity by 2050	Governor's executive order in 2019.
Washington	100% zero-emissions electricity by 2045	2019 legislation. Applies to all utilities, which are required to submit plans explaining how they will meet the goal.
Wisconsin	100% carbon-free electricity by 2050	Governor's executive order in 2019.

A battery storage system in California

while others are not; for example, goals being expressed through a Governor's executive order can be overturned or ignored by a future Governor.

Energy Storage Gets Its Own Mandates

As more electricity generation comes online from variable resources like solar and wind, it has become clear to the electricity industry and to state policymakers that much more energy storage will be necessary to ensure that electric capacity is available at the times it is needed, and that renewable energy generators are not curtailed at times when generation exceeds consumption.

California was the only state to require energy storage development before 2015. State legislators passed a law in 2010 directing the California Public Utilities Commission (CPUC) to open a proceeding to determine whether to mandate storage development and, if so, to set appropriate targets for procuring viable and cost-effective energy storage systems. As a result, the CPUC required the state's three largest investor-owned utilities to procure 1.3 gigawatts (GW) of storage capacity by 2020. The CPUC set capacity targets for each utility, separate from the RPS. The targets were divided into sub-targets for storage connected at the transmission, distribution, and customer levels. Electric service providers and community choice aggregators also received mandates to purchase energy storage projects equal to one percent of their 2020 annual peak load, with installation and operation of the projects required by the end of 2024.

Other states have moved forward with storage requirements since 2015. In that year, Oregon passed a law that requires the state's two largest utilities to procure "qualifying energy storage systems that have the capacity to store at least five megawatt hours (MWh) of energy." A 2016 Massachusetts

law required the Massachusetts Department of Energy Resources to study possible energy storage procurement targets and to implement them, if deemed appropriate. After analysis and a stakeholder engagement process, the Department adopted a target for electric distribution companies to procure 200 MWh of viable and cost-effective energy storage systems by January 1, 2020.

New York's energy storage roadmap included a target of 1,500 MW of storage by 2025. The Public Service Commission then made that an interim goal and added a further goal of 3,000 MW of storage by 2030, both of which Governor Cuomo codified with the signing of the *Climate Leadership and Community Protection Act* in July 2019.

More recently, New Jersey and New York have come out with highly ambitious energy storage targets. In 2018, New Jersey passed a law that requires the state's Board of Public Utilities to "initiate a proceeding to establish a process and mechanism for achieving the goal of 600 megawatts (MW) of energy storage by 2021 and 2,000 MW of energy storage by 2030."[5] New York's energy storage roadmap included a target of 1,500 MW of storage by 2025. The Public Service Commission then made that an interim goal and added a further goal of 3,000 MW of storage by 2030, both of which Governor Cuomo codified with the signing of the *Climate Leadership and Community Protection Act* in July 2019.

While these mandates have been important for commercializing energy storage technologies and building a market for them, the states have also taken other actions to advance energy storage, as will be discussed in Chapter 2.

Case Study 1

California
See page 45.

Making Solar the Standard for New Homes in California

Because of the tens of thousands of homes constructed each year in California, the California Energy Commission has long realized that it was important to include the new home market in the state's strategies for transitioning to clean electricity. It offered financial incentives and conducted outreach to the building industry in order to encourage builders to incorporate solar photovoltaics (PV) into new home construction.

By 2018, the Energy Commission believed that the economics of solar were sufficiently favorable and the market was ready to meet a mandate for the inclusion of PV systems in new home construction, with a few exceptions. As of January 1, 2020, the vast majority of new homes constructed in California will be required to incorporate PV, either on the roof or in a community solar installation (see Case Study 1).

States Can Spur Renewable Energy Development without New Policies

Some of the states with the largest amounts of renewable energy generation, especially in relationship to their electricity consumption, are not the ones that have implemented the most dramatic new policy innovations since 2015. This is especially the case for wind energy, where the available wind resource varies dramatically from state to state, and where it is sometimes possible to develop wind projects without state financial incentives. Similarly with solar, the available solar resource makes a big difference in how much PV electricity gets installed in a state. A recent report by Environment America compiled the changes in wind and solar generation by state from 2009 through 2018. The top ten states in terms of wind and solar growth are listed in Table 3.

TABLE 3
Growth in Solar and Wind Production, 2009–2018[6]

States Ranked by Size of Increase in Electricity Generation	Solar Energy Growth	Wind Energy Growth
1	California	Texas
2	Arizona	Oklahoma
3	North Carolina	Kansas
4	Nevada	Iowa
5	Texas	Illinois
6	Massachusetts	California
7	New Jersey	North Dakota
8	Florida	Colorado
9	Utah	Minnesota
10	Georgia	Michigan

These lists underscore the complex relationship between state policies and renewable energy generation. Geography, the resource type, and the amount of available land for energy development can make a significant difference in market potential in states. But that does not mean that state policies are irrelevant. Some states that are not on the two lists in Table 3 have achieved significantly greater growth in clean energy generation than they would have without favorable policies in place. Moreover, their policies and renewable energy goals sometimes spur clean energy development in neighboring states. According to Lawrence Berkeley National Laboratory, about 10 percent of generation additions to meet RPSs have been built in non-RPS states.[7] For example, some wind farms in North Dakota and South Dakota benefit from being able to receive payments for selling electricity that helps Minnesota meet its RPS targets.

On the other hand, even if states with high renewable energy growth have not been among the most active policy innovators since 2015, state government action still played a role in advancing clean energy. Geography and market forces are not the only determinants of growth in those states. In some cases, such as with wind energy growth in Texas and solar expansion North Carolina, important state policies set in place before 2015 continue to stimulate renewable energy project development. In other cases, states have created a welcoming business setting for infrastructure projects and have avoided impeding clean energy project development.

CHAPTER 2

Moving towards Maturity: States Help Commercialize Emerging Technologies

Some of the technologies with great potential for transitioning the United States to clean energy are not yet able to compete in the marketplace without assistance. They may not have developed their supply chains sufficiently or achieved the operational efficiencies necessary to bring down costs to be competitive with well-established technologies. In other cases, consumers may be unfamiliar with these technologies or products, or existing regulations may not account fully for their benefits and advantages. States have taken a wide range of steps to help these relatively new clean energy technologies compete for customers. Offshore wind farms, electric vehicles, air source heat pumps, battery storage, hydropower from irrigation systems, and advanced biomass and biogas systems all have brighter futures because of the actions taken by states over the past few years.

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Offshore Wind Gathers Momentum

It may seem odd to consider offshore wind an immature technology, given that the first project was installed off the coast of Denmark in 1991. Europe has more than 4,500 offshore turbines installed, and new offshore wind projects in Europe's maturing market are now being built without any special subsidies or incentives. Yet in 2015, there were still no offshore wind turbines installed in the United States, despite the potential for offshore wind to provide large amounts of clean electricity to coastal population centers.

According to the US Department of Energy (DOE) in its 2015 visioning study on the future of wind energy and in its 2016 *National Offshore Wind Strategy*, the technical potential for offshore wind is so great that, even if only a small percentage gets developed, the nation could get seven percent of its entire electricity supply from offshore wind by 2050. This scenario, which DOE modeled in the strategy, would yield 14 percent of the electricity needed by the coastal and Great Lakes states nearest to where the wind projects would be installed.[8]

In general, the wind blows more steadily and stronger offshore than on land, but the cost of developing offshore wind is greater and more complicated. This has required both the federal government and the states to undertake a range of activities to make it possible for this resource to be developed. The federal government has funded essential research, set rules for project development,

and defined and leased sections of the ocean for offshore wind development. However, none of this would have led to any wind turbines in the water without the actions of the states.

With extensive planning and special funding from the State of Rhode Island, the first offshore wind farm in American waters started generating power off the coast of Block Island in December 2016 (see Case Study 19). This relatively small project, with five six-MW turbines, excited offshore wind supporters and seemed to galvanize action by other states. In early 2017, the Long Island Power Authority offered a power purchase agreement to the developer of a 15-turbine, 90-MW project off the east coast of Long Island, NY (since increased to 130 MW). Also in 2017, Maryland, which had earlier created a special financing mechanism through its RPS to support offshore wind, selected two developers to develop projects totaling 368 MW.

At the same time, other Northeast and Mid-Atlantic states were making plans for even larger offshore wind developments, creating a sense of momentum and a burst of activity to ensure that goals turned into reality. A 2016 Massachusetts law requires the Commonwealth's utilities to solicit 1,600 MW of offshore wind by 2027, and that goal was later increased to 3,200 MW by 2035 (see Case Study 10). In 2017, New York Governor Andrew Cuomo set a state target of 2,400 MW by 2030 and later set an expanded goal of 9,000 MW by 2035. New Jersey Governor Phil Murphy directed the New Jersey Board of Public Utilities to develop action plans to meet a goal of 3,500 MW by 2030. When the Maryland legislature strengthened the state's RPS earlier this year, it required the development of 1,200 MW of offshore wind by 2030.

Case Study 19

Rhode Island
See page 81.

Case Study 10

Massachusetts
See page 63.

Offshore wind turbines off the coast of Block Island, RI

Under the Massachusetts law, a solicitation was held and a power purchase agreement was signed for an 800-MW project. In October 2019, a developer was selected for a second 800-MW project. Rhode Island piggybacked on the first solicitation with a procurement of an additional 400 MW, which leveraged Massachusetts' buying power and resulted in unexpectedly low prices for both states. Connecticut held its own solicitations in parallel, procuring a total of 300 MW through two procurement mechanisms. Then in June 2019, New Jersey selected a developer for a 1.1-gigawatt (GW) project, and the next month New York selected winning bidders for two large projects totaling nearly 1.7 GW, which is the largest commitment to offshore wind in the US.

The states have undertaken environmental impact and ocean studies, funded a wide range of research, developed ports, supported workforce development activities, and initiated stakeholder processes with the fishing industry and other parties.

The states have not neglected other actions necessary to build what will become a multi-billion-dollar industry employing tens of thousands of people. They have undertaken environmental impact and ocean studies, funded a wide range of research, developed ports, supported workforce development activities, and initiated stakeholder processes with the fishing industry and other parties.

Although on a slower timeline, states outside the Maryland to Massachusetts region are also working to develop offshore wind. North Carolina and Virginia each hope to develop more than 2,000 MW. California policymakers view offshore wind as an important component of meeting the state's goal of getting 60 percent of the state's electricity from renewable energy by 2030. California has the added challenge that the waters off its coast are deeper than off most of the Atlantic coast, thereby making conventional foundations for wind turbines impractical and requiring floating turbines, which are still in the pilot-project stage in Europe. Nevertheless, California is actively exploring how the state can move forward with offshore wind.

Incentives and Infrastructure for Electric Vehicles

Petroleum has been the basis for fueling the transportation sector for more than a century and currently supplies 92 percent of total transportation sector energy use, according to the US Energy Information Administration. Transportation is responsible for about three-quarters of all US petroleum use. If the nation is to reduce reliance on fossil fuels, transportation must be a top priority for action. States have realized that and have taken a wide range of actions in recent years to support cleaner alternatives, especially electric vehicles (EVs), to gain a foothold in the marketplace and to attract customers.[9]

States have provided rebates, tax benefits, lower registration fees, and other incentives for the purchase of EVs. Eight states offer rebates for the purchase of electric vehicles, and a law passed in Maine in March 2019 mandates that Efficiency Maine establish an EV rebate program. Other states are considering adding rebate programs. Colorado currently has the most generous rebates with $5,000 offered for the purchase of new EVs in 2019 and $4,000 in 2020. Delaware's Clean Vehicle Rebate Program provides incentives for several different types of vehicles, such as plug-in hybrids and natural gas vehicles, with the largest rebates ($3,500) reserved for battery electric vehicles. In conjunction with available federal tax credits, these incentives are helping consumers to abandon internal combustion engines in favor of EVs.

Incentives go beyond personal vehicles to fleets of trucks and buses, especially school buses. California has been a leader in this regard, with the California Energy Commission currently

Home EV charging in Vermont

implementing a $94 million school bus replacement program, most of which is being used to retire old polluting diesel buses and replace them with new electric buses. As the Commission notes, "Priority is being given to grant applicants in disadvantaged, low-income communities, which are disproportionately affected by air pollution and other consequences of petroleum-powered transportation, including health problems related to low air quality."[10]

Some states have set goals for EV adoption. For example, in 2018, North Carolina Governor Roy Cooper issued an executive order calling for at least 80,000 zero-emissions vehicles to be registered by 2025. Colorado, Massachusetts, New Jersey, New York, and Virginia also have state goals. California has an ambitious goal of having 1.5 million EVs on the road by 2025; and in 2016, issued a roadmap for how to get there. In 2018, Governor Jerry Brown issued an executive order increasing the goal to five million zero-emissions electric vehicles in 2030.

An especially active realm for state action has been to expand EV charging infrastructure. This has been important because the lack of convenient charging is a main barrier to more widespread consumer adoption of EVs. A May 2019 poll indicated that the lack of charging stations is the most frequently given reason for why consumers would not consider purchasing an EV, with 62 percent of the public raising this as a concern.[11]

Creation of EV charging infrastructure is a logical focus of state activity, because it relates to the state's customary role of regulating utilities. The states are considering what kinds of publicly available EV chargers are needed, where they should be built, who should build them, whether utilities can own them, and how they can be profitably operated.

In 2019, New Mexico passed a law that makes it clear that EV charging stations will be exempt from utility regulations and that requires the state's investor-owned utilities to submit plans for

Case Study 8

Maryland
See page 59.

transportation electrification, including charging infrastructure. Maryland approved a program to deploy more than 5,000 EV charging stations and has also created an innovative program to link EV charging to electricity-generating solar canopies at parking lots (see Case Study 8). Hawaii established rebates for installing EV charging stations for public, commercial, or multi-unit dwelling locations. The Massachusetts Department of Environmental Protection has several grant programs for charging stations at municipal government buildings, public colleges, multifamily housing, workplaces; and elsewhere, the Arizona Commerce Corporation established a policy that encourages investor-owned utilities to support EV commercialization by implementing pilot programs and favorable electricity rates.

Last year, the New York Power Authority committed to spend up to $250 million on EV infrastructure, mostly for EV charging stations, and the state of New York also provides rebates to public and private organizations, as well as municipalities, to install charging stations at workplaces, multifamily buildings, and public parking facilities.

The states' EV infrastructure efforts have been assisted by funding from Volkswagen's 2016 settlement for illegally evading vehicle emissions standards. As part of the car company's agreement with the federal government, Volkswagen provided nearly $3 billion for an Environmental Mitigation Trust to be used by states and territories. Depending upon the size of the state and other factors, individual states received anywhere from $8 million to more than $400 million.

States are permitted to use up to 15 percent of those funds on EV charging infrastructure, and 35 states are using the full 15 percent for that purpose.[12] States can use the remaining 85 percent for a variety of purposes, including purchasing new diesel, natural gas, and electric vehicles. Most states will end up using some of that money for EVs, but some states have given special priority to EVs. A May 2019 report by US PIRG and Environment America assessed the states' plans and gave special praise to Hawaii and Wisconsin for using the full 85 percent for electric bus purchases. The other states that weighted their plans most heavily towards EVs were Rhode Island, Vermont, California, Massachusetts, and New York.[13]

Energy Storage Gets a Boost

The deployment of energy storage has been growing rapidly, in great part because of state policies and programs. During the first quarter of 2019, 271 MWh of storage was brought online, more than double the amount during the same period in 2018 and more than the entire amount deployed annually in 2015 and earlier years.[14]

During the first quarter of this year, 271 MWh of storage was brought online, more than double the amount during the same period in 2018 and more than the entire amount deployed annually in 2015 and earlier years.

In addition to the important step of setting energy storage goals (see Chapter 1), states have implemented various measures that have enabled the commercialization of storage technologies and have contributed to the dramatic growth in storage deployment. Colorado, for example, passed legislation in 2018 integrating energy storage into utilities' integrated resource planning processes and required the Public Utilities Commission to adopt procurement rules for storage. Minnesota enacted legislation in 2019 that "requires utilities to assess energy storage in their integrated resource plans and authorizes utilities to undertake energy storage pilot projects."[15] To help meet New York's ambitious goals for energy storage, the state earmarked $400 million for incentives for installing storage projects. The New York Power Authority also committed $250 million for grid-scale energy storage projects.

In 2017, Massachusetts awarded $20 million in grants to support 26 energy storage demonstration projects aimed at piloting innovative, broadly replicable energy storage use cases/business models with multiple value streams. Then in early 2019, the state took the pioneering step of including energy storage in its three-year energy efficiency plan (see Case Study 9). For the first time, residential and commercial battery storage customers in Massachusetts can get performance payments for peak load reductions using energy storage behind the meter. This opened up an important new source of incentives for energy storage.[16] Rhode Island now offers a similar program, and other states are considering the idea, including Connecticut, New Hampshire, and Vermont.

Case Study 9

Massachusetts
See page 61.

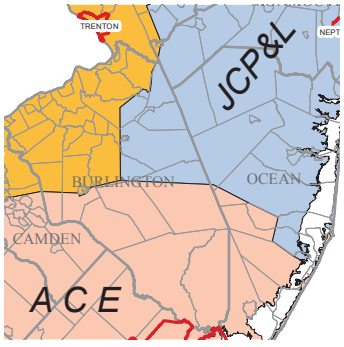
Microgrids Get a Head Start

Microgrids are locally sited energy grids covering a single building, a few buildings, a campus, or a community. In most places and at most times, the microgrids remain connected to the wider electricity grid, but they can disconnect and continue operating if the wider grid goes down.

California, Connecticut, Maryland, Massachusetts, New Jersey, New York, and Wisconsin have all promoted and helped fund microgrids that include clean technologies such as battery storage, solar, and fuel cells. Among notable actions since 2015, the New York State Energy Research and Development Authority (NYSERDA) awarded $11 million to 11 communities across the state for the development of comprehensive engineering, financial, and commercial assessments associated with installing and operating a community microgrid.

Since 2015, the California Energy Commission has awarded more than $90 million for 32 microgrid-related projects at fire stations, community colleges, medical centers, wastewater treatment plants, and other sites.[17] As New Jersey is drafting its new Energy Master Plan to move toward 100 percent clean energy by 2050,

Case Study 14



New Jersey
See page 71.

microgrids are being seen as a way to provide power and enable essential services in the event of a grid outage. For information about New Jersey's microgrid activities, see Case Study 14.

New Ways to Use Biomass

Organic materials, such as wood, have been used for energy for thousands of years, but states are helping commercialize new technologies that use biomass efficiently to provide clean energy. As was reported in *Clean Energy Champions* in 2015, states continue to invest in technologies that take food, animal, and yard waste and use it to generate electricity.

States have also promoted high-efficiency wood boilers and stoves—often using wood pellets—to replace older polluting wood burning equipment. New York, for example, offers $1,500 rebates when residents purchase a new US EPA Certified wood pellet stove and recycle an existing wood stove or insert. Households with incomes below 80 percent of median qualify for larger rebates. Vermont has also given special attention to promoting efficient, advanced wood heating technologies (see Case Study 20).

Case Study 20

Vermont
See page 83.

Iowa has taken a systematic, comprehensive approach to incorporating greater use of biomass into the energy mix. The Iowa Economic Development Authority developed and is implementing a Biomass Conversion Action Plan (see Case Study 7).

Case Study 7

Iowa
See page 57.

Strategies for Other Clean Energy Technologies

States have also advanced other emerging technologies. Initiatives to promote air source and ground source heat pumps for heating and cooling buildings are discussed in Chapter 3. Oregon has a pioneering program to modernize agricultural irrigation systems in ways that generate sufficient excess water pressure in pipes to add hydroelectric power generators to the systems (see Case Study 18).

The California Energy Commission annually provides millions of dollars for research and demonstration projects for emerging technologies. Since 2015, the many funded technologies have included smart inverters, solar thermal heat pumps, micro combined-heat-and-power systems, and waste heat recovery and conversion technologies.[18]

Some states have supported emerging technologies by providing assistance to start-up companies, rather than through research and demonstration projects. The Massachusetts Clean Energy Center's InnovateMass offers grants and technical support to companies "deploying new clean energy technologies or innovative combinations of existing technologies with a strong potential for commercialization."[19]

Case Study 18

Oregon
See page 79.

New York provides a range of support to clean energy start-ups, including funds for research and development projects, as well as opportunites to be housed in, and receive services from, clean energy incubators.[20] In 2016, New York launched the 76West Clean Energy Competition, a $20 million competition focused on supporting entrepreneurs who build clean energy businesses and stimulate economic development. In early 2019, the New York Power Authority (NYPA), in conjunction with the Urban Future Lab (UFL) at New York University, launched the NYPA Innovation Challenge to incentivize and reward startup technologies related to EV infrastructure, energy storage, and demand flexibility. The winners receive training and guidance from UFL staff and the opportunity to test, commercialize, and scale the technology through NYPA.

CHAPTER 3

Tackling the Hard Stuff: States Modernize the Electrical Grid and Heating Systems

In the years since 2015, states have had to take on thorny technical issues so that the clean energy transition can remain on track. At the end of the 20th century, when states might have had 100 homes with solar, for example, electric distribution companies and electricity system regulators did not need to modify the ways in which they bill customers or manage the electric grid. But now, when there can be 100,000 solar homes or 50 large wind farms connected to the grid, state regulations, programs, and practices need to change. Not only are the issues complicated, requiring sophisticated economic and technical knowledge, but they are often contentious. States have been approaching these issues in a serious, systematic manner.

For at least a decade, it has been obvious that the electricity grid would need to adapt to accommodate performance characteristics of new clean energy technologies. As the market penetration of clean energy has increased, this imperative has become more urgent and states have moved more decisively since 2015.

Modernizing the Grid

For at least a decade, it has been obvious that the electricity grid would need to adapt to accommodate performance characteristics of new clean energy technologies. As the market penetration of clean energy has increased, this imperative has become more urgent and states have moved more decisively since 2015.

Three key issues that need to be addressed are how to (1) incorporate wind, solar, and hydro facilities whose output can vary by time of day and season, (2) enable large numbers of smaller distributed generation systems (rooftop solar, combined-heat-and-power, biogas digesters, fuel cells, small wind turbines) to be installed in or on buildings and properties, and (3) bring electric vehicles into the electricity system in ways that reduce electricity costs and increase reliability rather than make the grid more costly and difficult to manage.

Some states have tackled these issues as part of overall efforts to modernize the grid. In general, the grid needs to become more flexible and adaptable. The GridWise Alliance, a coalition of companies interested in grid modernization, graded states in late 2018 on their actions related to grid modernization; it found that almost all of 30 states that submitted data increased their scores from the previous year.[21]

California and Illinois were found to have the most comprehensive grid modernization efforts, with California being the grid modernization pioneer and Illinois undertaking a wide range of actions since 2015. In Illinois, the 2016 *Future Energy Jobs Act* required long-term planning, recommended steps to reduce peak demand, and offered incentives to develop clean energy. The *Act* has been implemented in many ways, such as including rebates for smart inverters, that provide greater flexibility for both consumers and utilities. In addition, the Illinois Commerce Commission hosted working groups that have produced insights into "regulatory and business model reform, technology deployment and metering, and communication and customer data." And in 2018, the Commission established "regulatory accounting treatment for cloud-based computing solutions" that can make it easier to integrate distributed energy resources into the system.[22]

However, many other states have also taken steps to modernize the grid. For example,

- More than three-quarters of Arizona's customers now have advanced electricity meters, and the state is updating its resource planning rules.
- Texas has similar advanced metering market penetration.
- In Maryland, the Public Service Commission's "ongoing investigation, Transforming Maryland's Electric Grid, addresses rate design, electric vehicles, competitive markets, interconnection, storage, and distribution system planning."
- Rhode Island's Power Sector Transformation Initiative, started by Governor Gina Raimondo, paved the way for a Power Sector Transformation Plan by the state's major electric utility that "includes cybersecurity, a system data portal, distribution-feeder monitoring, data system control enhancements, GIS enhancements to integrate and utilize DERs, AMI deployment beginning in 2020, and storage incentives."
- Virginia's legislature took the lead in that state by passing the *2018 Grid Transformation Act*, which "requires grid modernization plans, storage pilots, and requirements for three GW of solar and wind."
- In Ohio, PowerForward, a yearlong review of consumers' electricity experience by the Public Utility Commission, "advanced a regulatory paradigm to support innovation while envisioning the distribution grid as an open access platform enabling various levels of customer engagement."[23]
- New York has a $140 million grid modernization program focused on accelerating the adoption of a digitally enhanced and dynamically managed electric grid through the development and demonstration of grid modernization technology.
- In Hawaii, the Hawaii Public Utilities Commission has given high priority to grid modernization, which it determined was "the 'backbone' necessary to . . . support integration of additional levels of renewables" and to "assist in both improving and ensuring system reliability and flexibility."[24] With that in mind, the Commission directed the state's largest utility, Hawaiian Electric, to develop a strategy to modernize the island grids it serves (see Case Study 5).
- In the state of Washington, the Department of Commerce has provided three rounds of grants to public and private electric utilities for projects that advance a range of grid modernization approaches (see Case Study 21).

Case Study 5

Hawaii
See page 53

Case Study 21

Washington
See page 85.

Grappling with Net Metering

In almost every state where solar PV first entered the marketplace, rooftop solar adopters were compensated for their solar electricity generation through "net metering." With this approach, the utility credits the PV system owner at the full retail rate for the electricity the system generates that is added to the grid rather than being used onsite.

Although net metering remains the most common compensation mechanism for residential solar electricity generation, some states have begun to move beyond it. In some cases, utilities or solar opponents have attacked net metering as a way to slow solar development. But in other instances, consideration of alternatives to net metering stems from a sincere desire to establish a more accurate measure of solar electricity's actual value to the electricity system and to ensure that those ratepayers who do not install solar are not unfairly disadvantaged as solar's market penetration increases.

Minnesota examined the value of solar before 2015 and designed a value of solar tariff that could be used by utilities. As part of its Reforming the Energy Vision, New York required utilities to begin shifting customers from net metering to a new Value of Distributed Energy Resources tariff (released March 2017) under which project revenue is based on the different ways that distributed generation provides value to the electricity system. California and Oregon are developing value of solar methodologies that are likely to be applied in those states.

Hawaii began replacing net metering in 2015, due to a large amount of distributed solar having been added to the grid. After an interim transition period, in 2018, it gave distributed generation system owners two options for how they can be compensated for new installations. Both options are designed to enable large numbers of distributed generation installations to be integrated into the electricity grid in ways that do not threaten grid stability and that avoid increased costs for the electricity system.

In the first, a Customer Grid Supply Plus tariff sets an island-specific credit rate for electricity supplied to the grid. This rate is available until a capacity limit that has been set for each island or utility is reached. Customers who apply for this tariff must install equipment that allows the utility to remotely control the system's output. The second option, the Smart Export tariff, is aimed at renewable energy systems that are combined with energy storage so that electricity can be discharged at times of peak energy need, and it includes island-specific bill credit rates.

Directing DER Development Where It Makes the Most Sense

Rooftop solar, battery storage, combined-heat-and-power (CHP), and other distributed energy resources (DERs) have greater value in some locations than others. In some locations, DERs can provide benefits to the utility grid, such as deferring upgrades to the electricity distribution system, thereby saving money for all ratepayers. On the other hand, too much solar and other DERs in the wrong place can exacerbate congestion on distribution systems and require faster ramping up of peaking power plants.

States have become much more aware of the desirability of directing DER development where it will have the most value. In some cases, they have focused on shifting development away from congested locations by requiring or incentivizing "hosting capacity" studies that identify those locations facing congesting. Hosting capacity is a measure of the amount of distributed generation that can safely and reliably be accommodated at a particular place on the distribution grid under present conditions.

A battery storage unit at a substation in Massachusetts

In 2015, the California Public Utilities Commission required investor-owned utilities to experiment with hosting capacity analysis. This eventually led to publicly accessible information online showing the capacity of individual distribution grid feeder lines. In Minnesota, the Public Utilities Commission has worked with Xcel Energy on hosting capacity analyses in that utility's service territory. Connecticut, Hawaii, Nevada, New York, Rhode Island, and some other states have also explored ways to incorporate hosting capacity analysis into utility planning.

In other cases, rather than identify problematic locations for DERs, states have focused on identifying the best locations for DER development. To make this work effectively, state policymakers need to work closely with regulators and the local utility companies, because identifying high-value locations is only a first step. Effective strategies need to be designed to ensure that sufficient DER development takes place in those best locations.

New York has experimented with several strategies for directing DERs to preferred locations. For example, as part of the state's Reforming the Energy Vision strategy, the Public Service Commission sought to defer capital investments through the use of distributed resources. One of two categories of eligible projects were those that "provide the greatest locational benefits to the larger power grid." This led New York, like some other states, to focus on "non-wires alternatives"—technologies and distribution system management measures that provide flexibility in managing demand without upgrading infrastructure (see Case Study 17).

Case Study 17

New York
See page 77.

The Rhode Island Office of Energy Resources in collaboration with the local utility, National Grid, identified a few communities where development could defer system upgrades and then implemented a pilot program to incentivize DERs in those communities. Since then, the state has worked with the utility to develop a statewide plan for non-wires alternatives. National Grid produced a Rhode Island System Data Portal with information for the public on the status of the state's distribution grid, including information on specific feeders and substations.

In New Hampshire, based on action by the legislature, the state's Public Utilities Commission initiated a major study to determine the locational value of DERs in different locations. The results will be used by the commission in determining future tariffs for net-metered and other distributed generation.

To optimize energy efficiency in buildings and minimize carbon emissions, older electric heating and hot water equipment must be retired—while oil, propane, and natural gas boilers, furnaces, and water heaters must make way for air source heat pumps, ground source heat pumps, and solar thermal technologies.

Clean Energy for Heating Buildings and Water

Given the challenges that the states and utilities face in transitioning the electricity system towards clean energy generation, the overall progress in recent years has been both impressive and accelerating. Although replacing fossil fuels for space and water heating in buildings will be more difficult, states have embraced that challenge as well and are making progress, even if it is in less dramatic fashion than with electricity generation.

To optimize energy efficiency in buildings and minimize carbon emissions, older electric heating and hot water equipment must be retired—while oil, propane, and natural gas boilers, furnaces, and water heaters must make way for air source heat pumps, ground source heat pumps, and solar thermal technologies. These cleaner technologies should be given preference in new building construction.

But because buildings last a long time, it is not possible to decarbonize the building sector by only focusing on the construction of new buildings; it is also necessary to transition to cleaner heating systems in existing buildings. However, as analysts Jan Rosenow and David Farnsworth point out, "retrofitting buildings for energy and carbon reductions is a challenging process because it depends on affirmative decisions made by millions of individuals, most of whom actually live in the buildings needing to be improved."[25]

However, those millions of individuals have other competing demands on their time and money. Many potential clean energy consumers do not feel they have enough information to make wise decisions about a bewildering array of product and technology choices. Most vendors are more familiar and comfortable with fossil fuel technologies. Moreover, home and building owners are most likely to install a new heating or hot water system when their existing system fails, but at that point, there is pressure to make a quick decision. It can be difficult to motivate a building owner to select a system that will yield long-term savings if the upfront installation costs are higher.

States have been taking steps to advance clean energy technologies for buildings in both general and specific ways. As a general strategy, by continuing to incentivize energy efficiency in buildings, states advance better technologies. The American Council for an Energy-Efficient Economy's most recent annual assessment of state actions related to energy efficiency in buildings highlights continued strengthening of building codes, training for code compliance, support for zero net energy buildings, and implementation of home energy scores.[25] As a few examples:

- A Delaware law will require new buildings to be zero-energy capable by 2025 in the case of residences, and by 2030 in the case of commercial buildings.[27] In other words, the building must be energy efficient enough so that onsite energy generation, if the owner chose to install it, would be enough to meet the building's entire net energy need.
- A New Jersey law requires commercial buildings larger than 25,000 square feet to use EPA's Portfolio Manager tool to benchmark energy and water use.[28]
- Massachusetts developed a "stretch code" in 2009, which allows municipalities to adopt a pre-determined building code option that is more stringent than the baseline state energy code for buildings. In recent years, other states with statewide building codes—New York, Rhode Island, and Vermont—either adopted or began developing stretch codes, as has the District of Columbia. The New York Stretch program, for instance, seeks to achieve 10-15 percent energy savings beyond what is required by the standard code.[29]
- Energy Trust of Oregon has been promoting the use of home energy scoring systems so that homeowners and home purchasers have an understanding of a house's energy use and are motivated to implement energy efficiency measures. The scoring program is voluntary statewide but mandatory in the City of Portland as of 2018.[30]

As for programs and strategies more specifically targeted at promoting heat pumps and other alternatives to fossil-fueled space and water heating, several states have taken action in recent years.

As for programs and strategies more specifically targeted at promoting heat pumps and other alternatives to fossil-fueled space and water heating, several states have taken action in recent years. In 2017, New York, through NYSERDA, issued a Renewable Heating and Cooling Policy Framework as the start

of a long-term effort to make heat pumps a widely used technology.[31] The framework analyzed the market and set out a wide range of possible policy and programmatic actions. Since then, NYSERDA has offered incentives to consumers, provided training to installers, and supported community-based outreach campaigns (see Case Study 16). Connecticut and Massachusetts have also issued clean heating strategies.

Case Study 16

New York
See page 75.

In Maine, where a high percentage of buildings rely on oil or propane for heating, the state has had an active program through Efficiency Maine to provide generous rebates for the installation of heat pumps in residences and commercial buildings. Building on initial success over several years, in June 2019, Governor Janet Mills signed legislation that seeks to more the double the number of installations to 20,000 annually, with a goal of having at least 100,000 in place by 2025.

The Massachusetts Clean Energy Center launched its first incentive program for residential air source heat pump customers in 2014 and expanded it to commercial customers in 2016. In July 2018, the Massachusetts legislature passed a law that allows the state's efficiency programs to account for fuel-switching benefits, thereby enabling those programs to offer significant incentives for residential customers displacing oil, propane, and electric resistance heat.

In California, the California Public Utilities Commission and the California Energy Commission have both taken steps to encourage electrification of space and hot water heating.

Residential air source heat pump

CHAPTER 4

Ensuring Fairness: States Address Equity and Consumer Protection

The burgeoning growth of the clean energy economy—with significant cost savings and numerous jobs spreading through society—has caused states to focus on fairness, especially to ensure that low- and moderate-income (LMI) households receive an appropriate share of the benefits. This became an issue for states in the few years leading up to 2015 but has become much more important since then. States understand that LMI households' circumstances (e.g., frequent status as renters rather than homeowners, limited financial resources for paying the upfront cost of clean energy technologies) can make it difficult for them to reap the benefits of clean energy. State intervention is necessary to spread the advantages equitably through society.

This awareness on the part of states has played out at a time of growing public concern about economic inequality. In the energy sphere, studies have shown that many LMI households pay a debilitatingly high proportion of their limited income on energy. Clean energy is seen as a way to relieve some of the energy burden on those households and reduce wealth inequality.

States have also addressed a different type of fairness. By implementing consumer protection measures, they ensure that residents are treated fairly by clean energy vendors.

Programs for LMI Households and Communities

Since 2015, many states have initiated or expanded programs to bring the benefits of clean energy, especially solar energy, to LMI households and communities.[32] Here are some notable efforts:

- For the past decade, California has created robust programs to expand solar installation and job opportunities for LMI residents, but in 2015 it made a major addition to its repertoire when the state enacted legislation to create a program that is now called Solar on Multifamily Affordable Housing (SOMAH). The program seeks to install at least 300 MW of solar on about 210,000 housing units. In addition, in 2018, when legislation committed $800 million for clean energy technologies, including home energy storage, about one-third of the funding was set aside for projects benefitting low-income residents.

Case Study 2

Colorado
See page 47.

- In 2016, the Colorado Energy Office worked with US DOE to get approval to include rooftop solar installations in the state's Weatherization Assistance Program (WAP), which had previously only covered energy efficiency measures (see Case Study 2).
- The Connecticut Green Bank implemented a pioneering program aimed at LMI single-family homes. It addresses some of the specific obstacles to solar

installations for those homes, by using an alternative to FICO credit scores to qualify for financing, requiring third-party ownership structures that avoid the need for large down payments, funding marketing to reach potential customers, and offering special incentives for solar companies to enter the market. About 2,500 households now have solar on their homes through the program (see Case Study 3).

- Legislation in the District of Columbia in 2016 established the Solar for All program, which aims to cut the electric bills of at least 100,000 LMI households in half by 2032. The District's Department of Energy and the Environment has awarded grants to applicants for the first projects as part of that program (see Case Study 4).
- As part of legislation to revamp and strengthen the Illinois RPS, that state created the Illinois Solar for All program with a funding stream of $150 million, plus a share of the utility budgets, for projects for LMI households and for public facilities and nonprofits that serve LMI communities. The program has a significant job training component so that LMI residents can enter the clean energy industry.
- In 2016, Massachusetts launched the Affordable Access to Clean and Efficient Energy Initiative. It coordinates the agencies that serve the energy and housing needs of the Commonwealth's LMI residents and allocated $15 million for clean energy and energy efficiency technologies for LMI residents.
- Also in Massachusetts, the Mass Solar Loan program's special incentives to help low-income residents go solar include a 1.5 percent interest rate buy down, which functions as a reduction in the interest rate borrowers pay. They can also reduce their loan principal through a 30 percent reduction up to $10,500 (less for moderate-income households). A publicly funded loan loss reserve enables lenders to protect their loans to income and credit-score eligible borrowers.
- After analyzing the housing stock for New Mexico's LMI population and realizing that much of it was manufactured housing whose roofs were not suitable for solar installations, the New Mexico Energy, Minerals, and Natural Resourced Department developed a unique "PV on a Pole™" technology that it is testing at some manufactured homes (see Case Study 15).
- In New York, NYSERDA is investing at least $234 million between 2016 and 2019, and more than $700 million over the life of its ten-year Clean Energy Fund, to improve energy affordability and access to clean energy solutions for LMI residents. In 2019, New York initiated the development of a healthy homes pilot to identify occupant benefits and quantify health care cost savings associated with combined energy and in-home health interventions targeting asthma trigger reductions for Medicaid recipients.
- Energy Trust of Oregon provided extensive outreach to community-based organizations and other groups that serve LMI residents and communities to train them on solar issues and also to get input on what the groups needed to be able to implement solar. Starting in 2018, Energy Trust offered grant funding to help the organizations develop innovative program models to bring solar to LMI communities. Grants ranging from $5,000 to $10,000 were provided to nine organizations. These

Case Study 3

Connecticut
See page 49.

Case Study 4

District of Columbia
See page 51.

Case Study 15

New Mexico
See page 73.

LMI solar innovation grants are intended to help awardees cover solar program development costs such as staff time, energy studies, and professional services—like consulting with a grant writer. Grant recipients can use funding to develop a new program or refine an existing solar program.

- In early 2019, the California Public Utilities Commission adopted an *Energy and Social Justice Action Plan* to serve as a roadmap for advancing equity in the Commission's policies and for increasing investment in clean energy resources to benefit LMI communities.[33]

Resiliency as an Important Component of LMI Initiatives

Low-income households have often suffered disproportionately when severe storms or other factors cause power outages and other damage to homes because they have few financial resources for dealing with those disasters. States have taken action to help low-income communities improve their resilience in the face of grid outages from severe weather and other causes. The move towards greater resiliency, often involving microgrids, solar plus battery storage systems, and other onsite generation, was spurred in part by the disastrous impacts of Hurricane Sandy in 2012. In the aftermath of the storm, New Jersey, New York, Connecticut, and other states funded projects to protect the operations of fire stations, community shelters, hospitals, and other community institutions in LMI communities. Later storms, especially Hurricane Maria in Puerto Rico, as well as wildfires and earthquakes in the West, have stimulated additional efforts to improve community resilience.

When designed well, the state-supported projects not only provide resiliency during outages but can offer economic benefits at other times.[34] In 2018, the Maryland Energy Administration (MEA) launched a Resiliency Hub Grant Program. It provides funding to help support the installation of

A resilient energy storage system at the Cimmaron Forestry Office in New Mexico

solar+storage systems in LMI neighborhoods. These systems will create free resiliency centers for the surrounding neighborhood during electrical outages. As MEA notes, the Resiliency Hubs "are designed to provide emergency heating and cooling capability; refrigeration of temperature sensitive medications and milk from nursing mothers; plug power for charging of cell phone and computer batteries; as well as emergency lighting. Resiliency Hubs may also be designated locations (by the city, county, or state) for the distribution of emergency services."[35]

The District of Columbia's Solar for All program has been crucial for establishing a resiliency center as part of a community solar project at Jubilee Housing's Maycroft Apartments. By installing PV along with a battery storage system, apartment residents, "some of whom rely on electricity-dependent medical equipment and refrigeration for medication, now have access to an on-site resiliency center and community space in the event of a power outage, along with energy savings through community solar benefits."[36] (See Case Study 4.)

Government agencies have advanced important resiliency initiatives that are not specifically focused on LMI communities, but still provide important public benefits, including to LMI households.

In other cases, government agencies have advanced important resiliency initiatives that are not specifically focused on LMI communities, but still provide important public benefits, including to LMI households. For example:

- In 2017, the third round of Massachusetts' Community Clean Energy Resiliency Initiative awarded $9.7 million for nine hospital resiliency projects. Three of the projects included energy storage systems and all nine incorporated "advanced control and operation of the hospitals' combined heat and power plants such that they can island and operate through an outage."[37]
- Puerto Rico is rebuilding and transforming its entire electricity system. This major undertaking includes many microgrids and even more numerous single-facility solar+storage projects.
- The New Mexico Energy Conservation and Management Division made the remote Cimarron District Office of the State Forestry Division more resilient by installing solar and a battery storage system. During a wildfire emergency, the office, which has frequently had power outages because of snow and winds, will now be able to continue to communicate with the community, local fire departments, and other agencies.

Case Study 4

District of Columbia
See page 51.

Shared Solar Projects for Those without Suitable Roofs

Many people are unable to place a solar PV system on their roof, because it is too shaded, or it is structurally unsuitable. Renters have the problem of not owning roof space. An increasing number of states have allowed the development of large shared- solar projects to which households can purchase subscriptions and receive the same benefits as if the PV system was on their roof. These projects, often called "community solar projects," can be developed by utilities, solar companies, or community groups. As these projects have proliferated, states have taken steps to ensure that LMI households are not left out of the community solar market. For example:

- The Colorado Public Utilities Commission, in 2016, oversaw a legal settlement through which the state's largest utility, Xcel Energy, agreed to manage a previously mandated requirement that five percent of participants in community solar projects be low-income and also agreed to contract for up to four MW of community solar projects entirely designed for low-income subscribers.
- In 2016, the Maryland Public Service Commission approved rules creating a pilot community solar program that includes 60 MW of projects set aside for LMI customer participation. The Maryland Energy Administration then launched the Maryland Community Solar Pilot Program in 2017. Under the residential component of that program, LMI "residents who subscribe to a community solar array under an ownership model are incentivized at a higher rate."[38]

Case Study 11

Michigan
See page 65.

- The Michigan Energy Office started with three LMI community solar pilots, one at an electric coop, one at a municipal utility, and one at an investor-owned utility (see Case Study 11).
- In 2017, Oregon adopted rules for its community solar program that mandate that at least 10 percent of the generation be for low-income households.
- In 2018, New Jersey established a community solar pilot program that earmarks 40 percent of the overall program capacity for LMI projects.
- Also in 2018, NYSERDA announced the first awards under its Solar For All program, which has a goal of providing community solar subscriptions to 10,000 low-income New Yorkers at no cost to the subscribers. The program is open to households with incomes up to 60 percent of state median income and that pay their own electricity bills.
- The Illinois Solar for All program described above includes a large community solar component with more than $56 million set aside to help LMI families subscribe to projects and more than $37 million for innovative community solar pilot projects in partnership with LMI community organizations.
- In 2018, Connecticut established a statewide shared clean energy facilities (SCEF) program with an annual capacity of 25 MW. Then this year, the Connecticut Department of Energy and Environmental Protection developed program rules that require each SCEF facility to have 50 percent LMI subscriber participation.
- In early 2019, the California Department of Community Services and Development provided $4.4 million for two community solar pilot projects that are designed to primarily benefit low-income households and test innovative models that can be replicated elsewhere.
- Also in 2019, the New Hampshire Public Utilities Commission offered grants of up to $200,000 for community solar projects that will directly benefit LMI residents.

Information and Regulation to Protect Consumers

Consumer protection is a significantly more important issue for clean energy than it was five or ten years ago, because there are now so many more consumers installing clean energy technologies or contracting to purchase clean energy generation. States understand this and are acting to help consumers make wise decisions and avoid being treated unfairly. The states are often especially concerned about the potential financial risks that LMI households take when installing solar, because

those households have little ability to withstand financial reversals. However, states realize that all consumers need good information and protective regulations.

Since 2015, more states have provided guides, websites, and other materials to inform consumers about their clean energy options and the implications of different decisions. The District of Columbia, Maryland, Massachusetts, Mississippi, South Carolina, Rhode Island, and Vermont produced general solar energy guides that are widely available to consumers.[39] Massachusetts, New Mexico, and New York published consumer guides focused specifically on the advantages and disadvantages of different solar financing options.[40] States like Connecticut improved their websites by incorporating a wide range of consumer-friendly materials.[41] The Minnesota Department of Commerce placed on its website useful consumer advice specifically focused on community solar and also funded Clean Energy Resource Teams to develop and disseminate additional information (see Case Study 12).[42]

States have long provided consumers with protection through standards and regulations for clean energy equipment and clean energy installation companies. But in recent years, they have also implemented other types of consumer protection measures. Probably the most important recent consumer protection trend for residential solar installations has been to require certain solar contract disclosures—

Case Study 12

Minnesota
See page 67.

provisions, statements, or mandatory information—to be included in all executed solar contracts.

Because solar installation is usually a transactive process between a solar company and a customer, the point of sale (or lease or power purchase agreement) offers a place for states to exercise leverage, ensuring customers have access to key information and guarding against misleading sales representations. In some cases, state solar contract disclosure requirements simply promote transparency, but in other cases, they impose substantive standards for solar companies to comply with and attest to in their customer contracts. State-level mandatory disclosure requirements have been adopted in 15 states.[43]

Minnesota started the trend towards solar contract disclosure requirements in 2013 when, as part of establishing a community solar program, the legislature directed the Minnesota Public Utility Commission "to identify the information that must be provided to potential subscribers to ensure fair disclosure of future costs and benefits of subscriptions."[44] Then, in 2015, Arizona enacted a law, not just for solar installations but for all distributed generation systems. The law was amended the following year and currently sets out a three-day contract rescission period for consumers to change their mind and requires disclosures related to how the system is described, which financing terms must be disclosed, and how a solar retailer can provide an energy production output guarantee. Some of the other states that later adopted disclosure requirements, such as Florida and New York, also apply them to all distributed generation systems. When expanding Illinois' solar programs in 2018, the Illinois Power Agency put into place an unusually comprehensive set of disclosure requirements and related consumer protections (see Case Study 6).

Case Study 6

Illinois
See page 55.

Oregon, through Energy Trust of Oregon, has taken an innovative approach to consumer protection for solar installations. It created a network of solar trade contractors who must meet high installation and customer service standards. Energy Trust offers cash incentives to consumers for installing rooftop solar, but only if the system is installed by an approved solar trade ally contractor. To become a trade ally, contractors formally enroll, sign a contract agreeing to meet the program's standards, and then meet certain insurance and licensing requirements; they receive training and support from Energy Trust.

Energy Trust also conducts up-front technical design reviews and post-installation site verifications to confirm that all systems receiving a cash incentive meet installation requirements that exceed city, county, and/or national electrical codes. In 2017, Energy Trust launched a Solar Trade Ally Rating initiative to help customers select the most qualified solar contractors and help contractors improve their performance. Consumers can see ratings based on three aspects of the contractor's service: customer service, program service, and installation quality. Trade allies with high ratings have access to benefits such as no-cost customer leads and financial support for business development opportunities.

CHAPTER 5

Conclusions and the Path Forward

As the previous chapters of this report have shown, state investments, policies, and programs have been essential to clean energy growth in the United States. Without state action, there would not be nearly as much electricity generation from clean energy technologies nor as many clean energy jobs. And the states are setting the stage for much greater clean energy use in the future.

This chapter draws conclusions from the states' experiences since 2015, and it points out implications for future activities.

1. Innovation Remains Key to the States' Success

Since the turn of the century, the states have been seedbeds of ingenuity and innovation for the creation of new clean energy markets. The case studies in the next section of this report illustrate

the range of creative programs and policies that have been developed for advancing clean energy. Going forward, it will remain important for states to sustain their clean energy leadership to achieve climate, economic development, and health goals. Among the steps states can take to unleash further innovation are to:

- Identify emerging clean energy issues and topics that have not received adequate attention.
- Develop targeted forms of support for specific emerging technologies that hold special promise for their state or region.
- Connect with stakeholders, such as community and environmental justice groups in under-resourced communities, that state energy agencies may not have fully engaged and involve them in program development.
- Develop pilot projects to enable ideas to be tested before they are launched on a broad scale.
- Emphasize program evaluation.
- Build in options for programs to be refined and to evolve over time.
- Eliminate programs and activities that are no longer necessary.

2. Beyond Setting Goals, States Need Leadership Strategies for Achieving Targets

Many states have adopted ambitious and laudable goals for clean energy. But without concerted, ongoing attention and financial support, those goals will not be achieved, especially in those cases

where target dates are set far in the future. Some of the goals raise complicated technical and financial issues that policymakers have only begun to consider.

States should systematically assess all the obstacles that need to be overcome to reach their goals and then put in place detailed year-by-year plans for overcoming the obstacles and making steady progress. They should evaluate their progress annually to see if they remain on track. Those states that have embraced aggressive clean energy goals should work together to share ideas, experiences, lessons learned, and best practices so that they can identify and act on the best ways to move forward.

3. Retain Bipartisan Support for Clean Energy at the State Level

Although there are sharp disagreements on energy policy between the political parties at the federal level, clean energy has been less of a partisan flashpoint in the states. States of different regions, sizes, and political perspectives have all implemented clean energy policies and programs. Part of the reason for the broad-based support is that state government leaders have perceived a wide range of reasons for embracing clean energy, including job creation, energy resiliency, environmental quality, business development, consumer cost reductions, and financial assistance for specific communities and population groups within a state. Furthermore, state leaders are aware that clean energy development is popular with voters from across the political spectrum.

There are still many discussions and coalitions that span party lines and ideologies. State policymakers, the clean energy industry, and other stakeholders should continue to set a tone that allows for bipartisan and nonpartisan discussion on issues related to clean energy.

Although partisan battles over clean energy policy at the state level have occurred, there are still many discussions and coalitions that span party lines and ideologies. State policymakers, the clean energy industry, and other stakeholders should continue to set a tone that allows for bipartisan and nonpartisan discussion on issues related to clean energy. By participating in groups like CESA, the National Association of Regulatory Utility Commissioners (NARUC), the National Association of State Energy Official (NASEO), the National Conference of State Legislators (NCSL), and the National Governors Association, state policymakers can learn from each other across state lines and political affiliations, and they can identify the policy ideas that make the most sense for their state.

4. Clean Energy Issues Will Continue to Get More Complicated

As noted in Chapter 3, with the increased market penetration of clean energy technologies, states have had to address complicated issues that often require sophisticated economic, engineering, and technical knowledge. These trends will continue and likely intensify. The electricity grid will need to be reimagined to accommodate and make the best use of clean energy technologies and energy storage. Although states have already turned their attention to these issues, they will need to design new policies and programs to meet the challenges of transforming the electricity delivery system and modernizing grid infrastructure. They should seek to find ways to access additional technical expertise and to create innovative policy solutions.

In Chapter 4, which looks at equity and consumer protection, this report highlights issues that do not involve engineering or sophisticated economic modeling but are nevertheless complicated and are likely to become more so in the coming years. States' early efforts to address equity have revealed how difficult it can be to overcome some of the barriers to implementing solar and other distributed

generation technologies in ways that provide meaningful financial benefits to LMI households and communities. The transition to electric vehicles and to renewable heating and cooling systems for buildings presents additional equity challenges. On the consumer protection side, as new clean energy technologies enter the market and the number of consumers using them increases, more consumer protection issues are certain to emerge.

On the consumer protection side, as new clean energy technologies enter the market and the number of consumers using them increases, more consumer protection issues are certain to emerge.

5. Electric Vehicles and Building Electrification Will Require More Attention

As discussed in Chapter 3, states have been focusing more in recent years on electric vehicles and electrifying building heating and cooling systems. But if they are going to reach their climate goals, it will be necessary to make much greater progress in both of those technology areas. Because these technologies add to the overall electricity load, it is essential that they be implemented in ways that provide benefits to the electricity grid and that minimize costs for ratepayers. All this will take more staff resources on the part of state energy programs and will require additional policies and programs.

6. The Core Clean Energy Technologies—Solar, Wind, and Energy Storage—Can Advance Even Faster

Clean energy progress since 2015 has primarily been a story of greater implementation of solar, wind, and energy storage technologies. Although state policymakers and program managers now need to give more attention to some of the other topics described above, they should not diminish their efforts related to increasing deployment of solar, wind, and energy storage. Those technologies will continue to improve in efficiency and performance and to decline in cost. They still have tremendous potential to be used much more widely to improve the nation's electricity supply. States can play a central role in making that happen.

. . . . . .

We are now experiencing a transition to clean energy because many states have been able to propel clean energy policy implementation, and because governors, legislators, and state agency staff have given significant attention to clean energy as an issue. They have been willing to put in place innovative policies and to modify them over time, as necessary. They have provided significant funding to carry out those policies and to staff the agencies that oversee them. By taking a similar leadership approach in the future, the states will continue to be a central pillar of clean energy growth.

Case Studies

CASE STUDIES

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CASE STUDY 1

California Makes Solar the Standard in New Homes

In May 2018, the California Energy Commission made a dramatic announcement: starting on January 1, 2020, new homes constructed in the state will be required to incorporate solar PV, either on the roof or in a community solar installation. Across the country, the media, policymakers, and the building industry took notice of this announcement and viewed it as a game changer that would significantly expand the solar market and turn PV from an optional accessory into a standard feature for new homes.

The solar requirement was approved by the Energy Commission as part of its 2019 Building Energy Efficiency Standards, which also included updated thermal envelope standards, ventilation requirements, and nonresidential lighting requirements. Before making these changes, the Energy Commission analyzed the potential costs and benefits and calibrated the requirements by climate zone and building size, so that they would yield positive cash flow for homeowners. The average new home will be required to install a PV system of at least 2.8 kilowatts (kW). The Energy Commission estimates that, assuming a 30-year mortgage, "the standards will add about $40 per month for the average home, but save consumers $80 per month on heating, cooling, and lighting bills."[1]

New solar home in California

1 California Energy Commission, "2019 Building Energy Efficiency Standards," accessed February 22, 2019, p. 1, *https://www.energy.ca.gov/title24/2019standards/documents/2018_Title_24_2019_Building_Standards_FAQ.pdf*

The new, ambitious building efficiency standards were the culmination of a long effort by the state of California to target and improve the quality of new home construction. In 2007, the Energy Commission launched the New Solar Homes Partnership (NSHP), providing financial incentives and support to homeowners, builders, and developers to encourage the construction of energy-efficient solar homes. California policymakers targeted new homes, both because they represent a large market for solar and because this strategy lowers upfront installation costs by incorporating the solar energy systems seamlessly into the design of a building and installing them while all the other construction activities of the home are underway. Builders can optimize PV system design to maximize solar production and tailor the building's electrical and roofing construction to easily accommodate the system.

The buildings that Californians buy and live in will operate very efficiently while generating their own clean energy. They will cost less to operate, have healthy indoor air and provide a platform for "smart" technologies.

Because NSHP gave many California builders significant experience with solar installations and rigorous energy efficiency measures, they are well prepared to meet the new standards. According to the California Building Industry Association, several major homebuilders began offering housing with installed solar as a standard feature in 2012, and "most, if not all . . . relied on NSHP incentive funding, which has provided key financial support in making a variety of business models work."[2]

The NSHP incentivized solar installations for 45,257 sites, totaling more than 141.6 MW of capacity as of December 31, 2018. Although this was an impressive achievement, the new standards will accelerate the pace of solar development. Not every new residence will include solar, because there are exceptions for homes that are shaded by external barriers, building plans approved prior to 2020, and multi-story buildings with limited roof space; but because of the new building standards, the vast majority of new homes will include solar with its economic and environmental benefits.

According to analysis by Greentech Media, based on an estimate for the Energy Commission that more than 74,000 single-family homes would be constructed in 2020, "residential solar sales are expected to increase 14 percent over a four-year timeframe from 2020 through 2023 (assuming the same number of homes are built over that period). That amounts to an upside of nearly 650 MW-DC compared to GTM's base-case forecast for the residential solar segment."[3]

The exact number of new homes to be constructed with solar remains uncertain, but Commissioner Andrew McAllister points out: "The buildings that Californians buy and live in will operate very efficiently while generating their own clean energy. They will cost less to operate, have healthy indoor air and provide a platform for 'smart' technologies that will propel the state even further down the road to a low emissions future."[4]

Other states will be watching closely to see how California's Building Energy Efficiency Standards are implemented by builders and received by home buyers. The California Energy Commission hopes that success in California will encourage other states to follow its lead by making solar the standard for new homes. — *Warren Leon*

2 Clean Energy States Alliance, *State Leadership in Clean Energy Awards: New Solutions for Market Transformation* (Montpelier, Clean Energy States Alliance, 2016), p. 4, *https://www.cesa.org/assets/2016-Files/SLICE/New-Solutions-for-Market-Transformation.pdf*.

3 Julia Pyper, "Everything You Need to Know about California's New Solar Roof Mandate," Greentech Media, May 21, 2018, *https://www.greentechmedia.com/articles/read/everything-you-need-to-know-about-californias-new-solar-roof-mandate*.

4 Quoted in California Energy Commission, "2019 Building Energy Efficiency Standards," p. 1.

CASE STUDY 2

Colorado Accelerates Clean Energy with Xcel

Wind turbines in Colorado, with Rocky Mountains in the distance

While some investor-owned electric utilities view clean energy adoption as a threat to their business models, that's not the case everywhere. In Colorado, Xcel Energy is leading the way in embracing renewables and has become an important partner in the state's efforts to decarbonize its electricity supply and to make clean energy more accessible for all consumers.

Colorado has long been a bastion for clean energy. In 2004, it became the first state to adopt a renewable energy standard by ballot initiative and has since increased the standard three times. Colorado now ranks 8th among US states in installed wind capacity (with 3,703 MW of capacity) and 12th nationwide in installed solar capacity (with 1,227 MW of capacity).

A significant part of Colorado's clean energy success stems from the state's close partnership with Xcel Energy, the largest electric utility in the state, serving over half of the electric load. Since 2005, Xcel has reduced its carbon emissions 38 percent. In 2018, Xcel Energy proposed the Colorado Energy Plan, which will help transition the state to a clean energy future. The plan aims to cut approximately four million tons of greenhouse gas emissions each year and promises a 55 percent renewable energy supply for Xcel Energy by 2026, with significant investment in energy storage, solar, and wind. It also calls for the early retirement of two coal-fired power plants (accounting for 725 MW of capacity) and their replacement with new renewable generation.

Soon after the Colorado Energy Plan was approved, Xcel Energy announced even more ambitious goals. In late 2018, Xcel Energy became the first major investor-owned utility in the country to voluntarily announce a 100 percent carbon-free goal, pledging to transition its electricity supply to zero carbon by 2050. In 2019, the utility went a step further by coming out in favor of a bill (Senate Bill 19–236) introduced in the Colorado legislature to place into statute Xcel Energy's carbon reduction ambitions. Alice Jackson, the president of Xcel Energy in Colorado, said, "[t]he bill holds us accountable, and we embrace that."[1]

Now signed by Governor Jared Polis, the law requires Xcel Energy to reduce emissions from the 2005 level 80 percent by 2030, with a deeper goal of 100 percent by 2050. The law also requires Xcel Energy to consider the social costs of carbon dioxide emissions in the plans it submits to the Colorado

1 Avery, Greg, *Denver Business Journal*, "These Xcel-Backed Bills Loom Large in the Colorado Legislature" (Apr. 29, 2019), *https://www.bizjournals.com/denver/news/2019/04/29/xcel-backed-colorado-bills.html*.

PV array at Devil's Thumb Ranch in Colorado

Public Utilities Commission. "The basic idea is that the Commission take into account the cost of all the effects of a project," said Will Toor, Executive Director of the Colorado Energy Office.[2]

Xcel Energy has also been a valued partner in Colorado's efforts to bring solar to low-income customers.[3] In 2010, Colorado enacted community solar legislation requiring community solar developers to include hard-to-reach subscribers, including low-income utility customers. As a result, five percent of each community solar garden became reserved for low-income customers. In 2016, the utility agreed to manage the five percent low-income community solar requirement and to contract for up to 4 MW of additional, 100 percent low-income-customer subscribed community solar gardens. Now, when Xcel Energy conducts solicitations for renewable energy credits from community solar projects, it includes criteria that consider the level of low-income participation in the projects.

Xcel Energy is also in the third year of a low-income rooftop solar program in conjunction with the Colorado Energy Office's Weatherization Assistance Program (WAP). Under the program, up to 300 Xcel Energy customers who qualify for energy efficiency services under WAP will have rooftop solar installed on their homes. Xcel Energy provides incentives to supplement WAP's expenses, and households receive long-term electricity bill reductions from solar combined with efficiency improvements like insulation, air sealing and furnace replacement.

While some utilities may be throwing up impediments to clean energy adoption, Xcel Energy is helping to propel Colorado into a clean energy future. Keith Hay, the Director of Utility Policy for the Colorado Energy Office, sums it up succinctly: "Xcel is an important partner in helping us meet Governor Polis' goals of decarbonizing the Colorado electric sector and putting us on a path to 100 percent clean energy by 2040."[5] *—Nate Hausman*

2 Jaffe, Mark, *The Colorado Sun*, "Colorado Is Overhauling Climate Goals with an Eye on Scrubbing Carbon from Its Electricity" (Apr. 25, 2019), *https://coloradosun.com/2019/04/25/colorado-climate-goals-carbon.*

3 Colorado has been a leader in making solar accessible to low-and -moderate income residents. For example, the Colorado Energy Office and the nonprofit solar provider GRID Alternatives worked with non-regulated utilities across the state to establish eight community solar demonstration projects, totaling 1,485 kW of installed capacity and serving over 350 low-income households. Each household that received a community garden subscription also received weatherization services and energy efficiency education. In 2016, the Colorado became the first state in the nation to receive approval from the US Department of Energy to integrate rooftop solar installation into its Weatherization Assistance Program (WAP).

4 Private correspondence with author, July 11, 2019.

CASE STUDY 3

Connecticut Brings Solar to LMI Homeowners

Low- and moderate-income (LMI) Americans have had less access to solar than those with higher incomes. Even LMI residents who own their own homes face barriers to installing solar. The Connecticut Green Bank, a quasi-state agency established by the Connecticut General Assembly, analyzed the obstacles and developed tools to bring cost-effective solar, combined with energy efficiency, to the state's LMI homeowners.

Barriers to solar for LMI homeowners can include access to financing, perceived and real credit issues, inability to take advantage of tax credits, and contractors' customer acquisition strategies. Furthermore, many LMI homeowners don't know anyone in their communities who has solar and are unlikely to even think of solar as a possibility.

Connecticut's solar incentive program for homeowners, the Residential Solar Incentive Program (RSIP), had been successful from the start in stimulating residential solar investment and development, but it served few low-income customers. In 2015, the Green Bank created a new incentive for LMI homeowners that was three times higher than its standard incentive.

Because many LMI households do not have enough tax liability to take advantage of the federal solar tax credit, only third-party-owned systems are eligible for Connecticut's LMI incentive. The tax

A happy solar home owner in Connecticut

Bridgeport, CT homeowners with their new solar system installed

credit incentive is taken by the solar company that owns the PV system, which is then able to offer a reduced price to the customer for the electricity generated by the system. To qualify for the program, contractors must submit their proposed product pricing, marketing strategy, and qualifications, and agree to abide by program rules. These additional program requirements ensure that Green Bank-supported solar projects for LMI homeowners will have a positive economic benefit for the homeowners and include strong consumer protection. For instance, price escalators, which increase the price customers pay over time, are not permitted with the LMI program.

Recognizing that contractors interested in serving LMI solar markets may face unique challenges, the Green Bank also issued a solar financing RFP to identify solar PV system providers for underserved markets. The purpose of this financing opportunity was to help the selected provider(s) establish solar businesses in Connecticut that focused on serving LMI customers and to further ensure that contractors utilizing the LMI incentive would be successful in reaching underserved markets.

PosiGen Solar was the first company to be approved both for the low-income RSIP and for the additional financing opportunity. Since 2015, PosiGen, in partnership with the Connecticut Green Bank, has been providing solar and energy efficiency to Connecticut residents through a program known as Solar for All. Any homeowner can participate, but PosiGen specifically targets LMI homeowners. PosiGen's model includes an alternative underwriting approach to qualify customers and community-based marketing—two key ingredients to reaching the low-income market. In addition to an energy efficiency audit that is required of all participating customers, PosiGen offers energy saving services that allow customers to undertake deeper energy efficiency upgrades.

Since 2015, PosiGen has deployed 2,500 residential solar systems in Connecticut. Sixty percent of these systems have been eligible for the LMI RSIP, while the others were installed at homes that did not qualify for the special LMI incentives and received the standard incentive instead. PosiGen has recently opened a second Connecticut office in Hartford. Including its work in other states, PosiGen has provided energy upgrades to 13,000 homeowners.

Isabelle Hazlewood of the Green Bank says that the Solar for All program has "cracked the nut" for how LMI homeowners can go solar, and tremendous potential exists for more LMI homeowners to be served by this model, both in Connecticut and elsewhere.[1] —*Diana Chace*

1 Private correspondence, June 10, 2019.

CASE STUDY 4

DC Helps Affordable Housing Tenants Benefit from Community Solar

In 2016, Washington, DC set a goal of bringing the benefits of solar energy to 100,000 low- and moderate- income residents. New Partners Community Solar, which had developed the first community solar project in the District of Columbia (DC), is partnering with the District to continue building innovative solar projects to benefit the tenants of affordable housing. Together, the District and its grantees, including New Partners, are demonstrating that solar can benefit everyone.

The Renewable Portfolio Standard Expansion Amendment Act of 2016 established DC's Solar for All Program with the aim of expanding the District's solar capacity, increasing the amount of solar generated within the District, and providing access to the benefits of locally-generated solar energy for low-income households, small businesses, nonprofits, and seniors. Solar for All's specific targets are to provide the benefits of solar energy to 100,000 households at or below 80 percent of Area Median Income and to reduce their energy bills by 50 percent by 2032. The program is administered by the DC Department of Energy and Environment (DOEE).

One of the obstacles preventing low-income DC residents from going solar is that most of them are renters. Community solar, where electricity customers subscribe to a single large solar project and receive credit on their electric bills for the electricity generated by the solar facility, is a way for renters

A Resiliency Center at the Maycroft Apartments was made possible by the DC government's solar programs and the participation of New Partners Community Solar, Jubilee Housing, and other groups.

to access solar benefits. A community solar array can be located on top of a multi-family building, on an office building, at a parking garage, or anywhere that has the necessary space and sunlight.

In July 2017, Solar for All DC Innovation and Expansion Grants worth $13.2 million were awarded to nine applicants. Projects funded include community solar and single-family residential solar installations, as well as other solar projects that benefited low-income District residents in other ways.

One of the grant awards went to New Partners Community Solar, a non-profit organization started by the law firm Nixon Peabody. New Partners had previously built a community solar project on the roofs of three downtown buildings. That 182-kW project was the first community solar project in the District, and New Partners had just begun issuing credits to 100 low-income District households earlier that year; the subscriber households are all tenants of subsidized housing and receive subscriptions at no cost.

DOEE's Solar for All 2017 Innovation and Expansion Grants will result in the installation of approximately 14 MW of community solar and single-family solar projects serving low-income District residents by the end of 2019.

With the new $2 million Solar for All grant, New Partners moved on to the next phase of its project: building an additional 1.1 MW of solar at five other locations in the District, and once again distributing all the electricity credits to tenants of subsidized housing. The new locations include a school, a parking garage at the Anacostia Metro Station, and three more downtown buildings. The Anacostia array is the largest at over 500 kW. The five new arrays are scheduled to be completed in the summer of 2019 and will serve 325 families.

In addition to the grant from DOEE, the project was funded through tax equity investment and loans. Revenue to pay back the loans is earned by selling Solar Renewable Energy Credits, which represent the environmental attributes of the project and are bought by electric energy suppliers to comply with the District's Renewable Portfolio Standard.

Additionally, New Partners, with technical assistance support from Clean Energy Group, supported efforts by Jubilee Housing and The Pepco Foundation, to develop a Resiliency Center at The Maycroft Apartments—the first affordable housing in the District to boost energy resilience with solar and battery storage. The project pairs community solar at Maycroft with a battery storage system to power critical loads, such as lighting, device charging, and refrigeration in the Resiliency Center during a grid outage, while delivering an average of $40 per household in utility bill savings for 100 residents throughout the year.

DOEE has provided ongoing assistance and served as a liaison with other District agencies, the utility Pepco, and property managers of potential sites. Daniel White of DOEE notes that New Partners has created a successful model for community solar development in the District. The project has been particularly successful at addressing the real estate limitations that can make solar development difficult in the District. One solution has been installing panels on south-facing vertical surfaces, such as the sides of large buildings. The project is also building solar canopies to create shade in places where shade is valuable, including rooftop terraces, the school playground, and the top of the parking garage.

Overall, DOEE's Solar for All 2017 Innovation and Expansion Grants will result in the installation of approximately 14 MW of community solar and single-family solar projects serving low-income District residents by the end of 2019. The next step for DOEE is to learn from these projects and to continue to reduce barriers to low-income solar deployment in the District. *— Diana Chace*

CASE STUDY 5

Hawaii Solves Distributed Energy Integration Challenges by Modernizing Its Grid

Abundant sunshine and high retail electricity rates have spurred breakneck residential solar adoption in Hawaii. At the end of 2018, 18 percent of the residential customers of Hawaiian Electric, which serves 95 percent of the state's residents, had adopted solar.[1] In fact, Hawaii's capital, Honolulu, currently has nearly three times as much installed solar per capita as any other city in the US.[2] But the high rate of solar adoption among Hawaiian households has also created grid complications. High levels of solar penetration can cause excess electricity to feed back into the distribution system, potentially resulting in voltage instability, asset degradation, and reliability issues.

Wind turbines on the island of Maui, Hawaii

The volume of rooftop solar and other distributed energy resources being interconnected to Hawaii's grids has not deterred the state from embracing more renewable energy. In 2015, the Hawaii Legislature set a 100 percent renewable target for the state's electricity supply by 2045, making the challenge of reliably integrating more renewable resources onto Hawaii's grids even more pressing. Indeed, in early 2017, the Hawaii Public Utilities Commission identified "the integration of renewables and [distributed energy resources] as one of the primary challenges and opportunities for electric utilities in Hawaii."[3]

Hawaiian grid operators and regulators are seizing the opportunity. In the order that framed the grid challenge, the Hawaii Public Utilities Commission determined that "a modernized grid" was "the 'backbone' necessary to… support integration of additional levels of renewables" and to "assist in both improving and ensuring system reliability and flexibility."[4] The Commission's order directed Hawaiian Electric to develop a strategy to modernize the island's grids in the territory it serves.

1 Hawaiian Electric, "2018 Saw 5% Jump in Residential Rooftop Solar Installations" (Jan. 16, 2019), *https://www.hawaiianelectric.com/2018-saw-5-jump-in-residential-rooftop-solar-installations*.

2 Mai, HJ, *Pacific Business News*, "Honolulu Leads the Nation in Installed Solar Capacity Per Capita" (Apr. 4, 2018). *https://www.bizjournals.com/pacific/news/2018/04/04/honolulu-leads-the-nation-in-installed-solar.html*.

3 Hawaii Public Utilities Commission, Order 34281 Dismissing without Prejudice and Providing Guidance for Developing a Grid Modernization Strategy – Docket No. 2016-0087 (Jan. 4, 2017), *https://www.hawaiianelectric.com/documents/about_us/investing_in_the_future/dkt_2016_0087_20170104_order_34281.pdf.*

4 Ibid.

In the near term, Hawaiian Electric's grid modernization strategy calls for the strategic deployment of advanced meters and a meter data management system, along with more extensive grid sensing and communication infrastructure to provide grid operators and customers with greater visibility, flexibility, and control. The strategy also calls for expanded reliance on energy storage, voltage management tools, and advanced inverters as well as grid-stabilizing demand response and electric vehicle charging programs.

Hawaiian Electric has also embarked on an integrated grid planning process to comprehensively identify needs across the electricity system and to help find optimized, cost-effective solutions for addressing them. The utility has already made color-coded maps of their higher-voltage primary distribution networks publicly available to allow customers and developers to see locations that may have greater capacity for more distributed energy resources to be added to the system.

In 2015, the Hawaii Legislature set a 100 percent renewable target for the state's electricity supply by 2045.

Along with their grid modernization and integrated grid planning efforts, Hawaiian Electric is pursuing large-scale, cost-efficient solar+storage projects. The company recently petitioned the Public Utilities Commission for approval for seven such projects that, if approved, will be compensated for their ability to support the grid when electricity is needed—an innovative payment structure based on net energy potential and a project's available capacity rather than solely the amount of electricity delivered to the grid.

Hawaii's other electric utility, the Kauai Island Utility Cooperative, has also been active in its pursuit of large-scale, grid-serving renewable energy projects. The Kauai Island Utility Cooperative recently completed the largest solar+storage project in the state—a 28-MW solar installation paired with a 100-MWh battery storage system—with the capability to black-start the island's grid in the event of a power outage and be able to meet up to 40 percent of the utility's peak energy demands.

Hawaii has long been a renewable energy forerunner. But as more renewable resources are added into its energy mix, the state—though grid modernization, integrated grid planning processes, and innovative project design and procurement—is leading the way in demonstrating the technical feasibility of high levels of renewable penetration. The state of Hawaii continues to welcome renewable energy to its islands. —*Nate Hausman*

Rooftop solar panels in Hawaii

CASE STUDY 6

Illinois Protects Solar Consumers as It Grows the Market

Illinois Shines customer brochures

Some states have enacted robust programs to facilitate the growth of solar. Others have adopted strong solar consumer protections to guard against scams and bad industry actors. And some states, such as Illinois, are doing both at the same time—spurring solar growth and fostering long-term market sustainability while seeking to protect and educate solar consumers and to maintain a positive public impression of the solar industry.

In December of 2016, Illinois passed the *Future Energy Jobs Act*, which remodeled parts of the state's Renewable Portfolio Standard and directed the Illinois Power Agency to develop a long-term plan for procuring Renewable Energy Credits to facilitate thousands of megawatts of new solar development. In April of 2018, the Illinois Power Agency's plan, which included an Adjustable Block Program (modeled along the lines of similar declining block programs in other states) to support distributed and community solar systems of up to 2 MW in size, was approved by the Illinois Commerce Commission. The initial phase of the Adjustable Block Program is expected to result in over 660 MW of new distributed generation and community solar capacity in the state.

The Adjustable Block Program was explicitly designed "to enable the photovoltaic market to scale up" in the state, but its design also reflected the Agency's commitment to protect Illinois solar consumers. The plan stated,

> "Installing a photovoltaic system is a significant financial commitment on behalf of that system's host (and potential owner) and a system that has been sold (or leased) to a customer using incorrect, inaccurate, or deceptive information could put the financial security of Illinois residents or businesses at risk and poison the ongoing viability of the solar market in Illinois. Ultimately, the Adjustable Block Program is a ratepayer-funded program intended to benefit the state's residents through enhanced ability to participate in the clean energy economy, and in the Agency's view, it is essential to ensure that this program produces not only project development, but also a transparent, positive experience for system hosts and subscribers."[1]

The Illinois Power Agency's plan called for common-sense solar consumer protections, including the required distribution of an informational brochure and a standardized disclosure form to all

1 Illinois Power Agency, *Long-Term Renewable Resources Procurement Plan: Final Plan* (Illinois Power Agency, August 2018), p. 124, *http://illinoisabp.com/wp-content/uploads/2018/08/Long-Term-Renewable-Resources-Procurement-Plan-8-6-18.pdf*.

customers participating in the program, whether through installation of on-site distributed generation or a subscription to a community solar project.

According to Illinois Power Agency Director Anthony Star, "Illinois is a retail choice state, and we were concerned about the ways in which some Alternative Retail Electric Suppliers have unscrupulously marketed to consumers in Illinois. We did not want those practices to take root as the Illinois solar market begins to grow. We wanted to make sure that solar development in Illinois retains strong public confidence and support."[2]

The Adjustable Block Program, which has been branded "Illinois Shines" for public-facing documents and program materials, began its rollout in late 2018. After extensive stakeholder feedback, the Agency released standardized customer-facing program brochures, robust standardized disclosure forms containing standardized savings estimates, and thorough marketing guidelines and contract requirements. The use of those documents is required for all distributed generation and community solar projects participating in the program for both direct program participants (known as "Approved Vendors") as well as their agents and designees.

The Illinois Shines brochure contains standardized information about the Adjustable Block Program, including what Renewable Energy Credits are, what materials a customer should expect to receive before signing a solar contract, what net metering is, and what rights a customer has. Versions are available to customers in English and Spanish. The precise content of the disclosure form varies depending on how a customer's contract is structured, but all forms require contact information for the solar provider and information about project specifications and costs that will be incurred by the customer.

The generation of disclosure forms is managed through an online portal, which allows the program administrator to monitor what information is provided to the customer during the sales process and compare it to the information about the system that is submitted as part of the program application. Approved Vendors must submit a copy of the customer-signed disclosure form as part of a project's application as a way to confirm that the customer has received and reviewed the important information contained on that form.

The marketing guidelines require approved vendors and their subcontractors not to make demonstrably false or misleading statements and to accurately portray the nature of solar power, Renewable Energy Credits, and the Adjustable Block Program to all customers. Those guidelines also prohibit implications that Approved Vendors are operating on behalf of the utilities or the State of Illinois in any marketing. The contract requirements include a right of rescission within three or more calendar days for projects equal to or less than 25 kW, system design specifications, responsibility for interconnection application, an allocation of system maintenance obligations, and dispute resolution procedures. All these materials are all available through the program websites: *www.illinoisabp.com* (vendor-focused) and *www.illinoisshines.com* (consumer-focused). Similar materials with additional protections were created for the Illinois Solar for All program, a separate solar program for low-income households and communities (see *www.illinoissfa.com*).

Collectively, the Illinois Adjustable Block Program vendor requirements amount to the most comprehensive solar consumer protections of any state program to date. Illinois has set the groundwork to ensure the expectations of solar consumers participating in program are met, but they have not squelched the solar industry's enthusiasm for participating in the program. —*Nate Hausman*

2 Private correspondence to author, June 6, 2019.

CASE STUDY 7

Iowa Implements a Strategy for Developing Its Bioenergy Resources

Bioenergy has long played an important role in Iowa's energy mix. The state has abundant biomass resources, including dedicated energy crops, agricultural by-products, manure, municipal wastewater plants, and landfills. Capitalizing on these resources represents a huge opportunity for Iowa.

Anaerobic digesters have played an important role in Iowa's bioenery mix.

The 2016 Iowa Energy Plan recognized biomass's potential and directed the Iowa Economic Development Authority (IEDA) to develop a Biomass Conversion Action Plan. IEDA established a committee with stakeholders from state agencies, universities, private industry, utilities, and interest groups and charged it with identifying the market opportunities, barriers, and business case for expanded biomass use. The resulting 2018 Action Plan presented nine strategies covering short- and long-term approaches:

1. Support and encourage federal policies supporting biomass, including the Farm Bill, the *Agriculture Environmental Stewardship Act*, and the Renewable Fuel Standard.
2. Streamline and consolidate permitting to facilitate construction of new systems.
3. Take advantage of the economic, energy, and ecosystem services associated with developing biomass resources. Account for the agricultural, water, and energy benefits associated with bioenergy production. Benefits related to water, air and soil quality, and economic gains are a significant consideration in developing a business model for biomass conversion facilities. This is especially important for cover crops, and Iowa should explore the development of a lifecycle cost analysis on the benefits associated with cover crops.
4. Develop a distribution strategy to access transmission, pipelines, and other networks. Work to implement uniform standards for pipeline-quality biogas and collaborate with stakeholders to ensure efficient use of biogas.
5. Identify private, state, and federal funding for research, pilot projects, and feasibility studies. Consider public-private partnerships, third-party developers, and business cooperatives. Share the advantages of various business models through case studies and outreach.
6. Create a web-based bioenergy information platform. Consider creating resources that enable stakeholders to explore the technical and financial viability of biomass projects.

7. Implement measures to overcome supply chain barriers and use resources efficiently. Consider developing a web-based tool for stakeholders to access information on the availability of biomass and to encourage private investment in biomass projects.

8. Dedicate state funding to drive the emerging bio-economy. Create a tax incentive or other support mechanism to deploy bioproduction.

9. Consolidate messaging and align with regional organizations to promote biomass. Also gauge interest in a regional Midwest Low-Carbon Fuel Standard Program.

According to IEDA Director Debi Durham, "As an agricultural powerhouse, Iowa has great potential to benefit economically and environmentally by further realizing the value-added attributes of biomass in the development of bioenergy, biofuels and biochemicals. The Biomass Conversion Action Plan is a blueprint with strategies to realize that potential."[1]

The Action Plan led to an update of the Iowa Biogas Assessment Model (IBAM), completed by Iowa State University with support from IEDA.[2] This online tool integrates geographic information system features to help entrepreneurs, policymakers, and farmers visualize the available raw biomass in the state for biogas production and to analyze the benefits of investing in anaerobic digestion (AD) and cover crops. The economic analysis includes the capital costs for relevant infrastructure such as pipelines and electricity transmission, as well as federal and state incentive programs that help defray the cost of investments in bioenergy.

With the IBAM tool, stakeholders can see the location of different types of biomass resources and available infrastructure. Users may choose from among different crop residues (corn or soy), feedlot waste/manure (e.g., horse, chicken, cattle, dairy cows), population, industrial facilities, and existing AD facilities. An accompanying economic modeling tool incorporates default parameters for the type of AD reactor, facility efficiency, annual operating expenses, investment structures and rates, federal and state income tax rates and incentives, revenue sources, and inflation rates.

A new lifecycle analysis tool—using US DOE guidelines and general assumptions related to energy resources and conversion technologies, and incorporating capital equipment costs and operating costs—calculates the profitability of a proposed bioenergy facility and the environmental and economic benefits of running the facility.[3] The tool helps investors understand the economic factors in investing in a new bioenergy facility or associated infrastructure, including crops. It helps regulators understand the energy efficiency of a proposed technology and the environmental impact of a proposed project at a specific location. More importantly, it helps policymakers understand how bioenergy development can lead to job creation and environmental benefits.

The lifecycle analysis tool highlights biogas as a means to avoid greenhouse gas emissions. Furthermore, it supports the idea that bioenergy production can help meet other agricultural and environmental goals by reducing soil erosion, improving water retention, mitigating flooding, reducing methane emissions, and reducing nutrient and sediment loading of waterways.

Iowa has taken steps to systematically analyze and develop its abundant biomass resources. In doing so, Iowa is serving as a model for other states that want to expand the use of bioenergy. —*Val Stori*

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1 Personal communication with Shelly Peterson, February 27, 2019.

2 Boyan Li, *Iowa Biogas Assessment Model Background Material* (Iowa State University, n.d.), *http://www.iowabiogasmodel.us/IBAM_Project_Documentation.pdf*.

3 Alvini Aui and Mark Mba, *Life Cycle Analysis of the Operations of Anaerobic Digesters in Iowa* (Iowa State University, n.d.,), *http://www.iowabiogasmodel.us/Anaerobic_Digestion_LCA_Final_Report.pdf*.

CASE STUDY 8

Maryland Supports Solar Parking Garages While Boosting EV Infrastructure

Construction photo of University of Maryland Regent Parking Garage solar PV canopy. MEA provided a grant of $250,000 with UMD's facilities management matching the funds to install 7,000 solar PV panels on three campus parking garages.

The Maryland Energy Administration (MEA) recently announced the opening of the seventh annual solicitation in its Parking Lot Solar PV Canopy with EV Charger Grant Program. This innovative program is designed to combine Maryland's renewable portfolio standard solar goal with its support for the development of electric vehicle charging infrastructure, which is necessary to enable the widespread adoption of electric vehicles.

The program is dedicated to the proposition that solar parking canopies can capture the unrealized solar electricity-generating potential of the state's parking lots while expanding charging opportunities for plug-in hybrid and electric vehicles. This reflects the state's broader belief in multi-purposing clean energy investments. "Investing in clean renewable energy is a huge win for Maryland because we are creating jobs, supporting economic growth and practicing good environmental stewardship," stated MEA Director Mary Beth Tung. "Things are not, and cannot, be single-use anymore. A phone is not just a phone, and Maryland parking lots can become a new, consistent site for solar energy generation."[1]

Eligible applicants must install at least 75 kW of solar PV panels on a parking lot canopy, along with at least four Level II or Level III EV charging stations. MEA expects that program participants will net meter their solar production.

1 Quote provided by Maryland Energy Administration.

In order to drive down the cost of solar canopy systems, MEA awards competitive grants of up to $400/kW, with a cap of $200,000 per project. Applications are accepted from two sectors, with the first being business and non-profits, and the second local governments and state agencies. For FY 2020, the program budget is up to $2 million. Funding comes from the Strategic Energy Investment Fund, which is in turn funded by public auctions of carbon credits through the Regional Greenhouse Gas Initiative.

"Investing in clean renewable energy is a huge win for Maryland because we are creating jobs, supporting economic growth and practicing good environmental stewardship," stated MEA Director Mary Beth Tung.

Over the history of the program, many successful projects have been completed at educational facilities such as Bowie State University, Wor-Wic Community College, Salisbury State Community College, University of Maryland Center for Environmental Studies, and the University of Maryland Institute for Bioscience and Biotechnology Research. Grants have also been awarded to large companies and medical facilities, including IKEA and Kaiser Permanente.

An example of a successful project is the Montgomery County Public Safety Headquarters, the county's primary administrative hub for a range of critical public services. This facility—the county's largest at nearly 400,000 sq. ft.—houses critical services such as transportation management resources, the Office of Emergency Management and Homeland Security, Fire and Rescue Services, and a police station.

Using grants from the MEA program, the public safety headquarters installed a 2-MW canopy-mounted solar system with four electric vehicle chargers, as well as a new 865-kW combined-heat-and-power system that replaced two existing generators providing baseload energy supply to the facility. The entire system can be disconnected from the grid to operate independently as a microgrid in the case of a grid outage. During normal operations, it can generate 11.4 million kWh annually, providing an estimated 90 to 95 percent of the facility's annual electricity consumption and reducing greenhouse gas emissions. Through its investment in this public/private partnership project, the county was able to avoid approximately $4 million in needed facility upgrades.

Such projects are readily replicable, as Maryland has thousands of acres of available parking lot space in suburban and urban neighborhoods. According to MEA, parking lots represent an exceptional opportunity to simultaneously support renewable generation and electric vehicle adoption, while providing shade and snow protection for vehicles. However, in building such structures, solar developers face the challenge of the additional cost of the canopy structure itself. It is these additional costs that the MEA program addresses through grant funding.

The ultimate goal of the program is to increase awareness and acceptance of the PV-EV model, and to encourage incorporation of these technologies when parking lots are designed.

"This program was carefully crafted to combine clean energy generation, and expand EV charging options for drivers," said MEA Director Mary Beth Tung. "The potential for this program is massive, especially in Maryland's urban areas. It solves energy access issues in a cost-effective way."[2]

— Todd Olinsky-Paul

2 "2019 Solar Canopy EV Charging Program Winners Announced," Maryland Energy Administration, November 29, 2018, *https://news.maryland.gov/mea/2018/11/29/2019-solar-canopy-ev-charging-program-winners-announced*.

CASE STUDY 9

Massachusetts Advances a Comprehensive Suite of Energy Storage Policies

As an early proponent of energy storage, Massachusetts has led the way in rolling out a comprehensive suite of energy storage policies and programs. Over a period of just a few years, the Commonwealth's Energy Storage Initiative (ESI) has achieved a combination of coordinated efforts that have included the *State of Charge* report, policy and regulatory initiatives, storage technology acceleration grants, procurement targets, a solar incentive with storage adder, investment in energy storage fire safety training and infrastructure, and most recently the inclusion of energy storage in the state's energy efficiency plan and the Green Communities technical assistance loan program.

Massachusetts first experimented with energy storage deployment grants through the Community Clean Energy Resiliency Initiative (CCERI), a grant program developed after Superstorm Sandy struck the Northeast in 2012. CCERI dedicated $40 million to resiliency grants over three rounds of funding, including 28 implementation projects (many of which included energy storage in backup power systems) and numerous feasibility studies. Grant funding also supported the development of an online resiliency tool to help municipalities assess vulnerabilities and plan for investments to increase resiliency. This grant program was followed by development of the *State of Charge* report, which was a state energy storage road mapping exercise that concluded that 1,766 MW of storage would be the optimal amount to site in Massachusetts and would produce benefits exceeding $2 billion.

A Massachusetts CCERI grant recipient, Sterling Municipal Light Department's utility-scale battery installation at the Sterling substation supports the town's police station and emergency dispatch center in case of a grid outage, and it provides cost savings during ordinary operations.

The state also developed a $20 million Advancing Commonwealth Energy Storage (ACES) grant program—administered by the Massachusetts Clean Energy Center and the Massachusetts Department of Energy Resources—to pilot innovative, broadly replicable energy storage business models and use cases with multiple value streams to catalyze the Massachusetts market and increase energy storage deployment. The projects receiving ACES awards included nine different use cases and 14 unique business models. Additionally, a separate $4.68 million grant program was awarded to support storage strategies for reducing peak demand.

"The Commonwealth's leadership in developing this industry will allow renewable energy sources to be harnessed to their full potential and increase the resiliency of the electrical grid," said MassCEC CEO Stephen Pike.

Through legislation, the Commonwealth adopted two storage procurement targets, committing first to 200 MWh by 2020, and then to 1 GW by 2025. A storage adder was included in the SMART solar incentive program, emphasizing the beneficial combination of solar and storage behind customer meters. Two rulings by the Department of Public Utilities in January 2019 allowed the use of storage by net metering customers and upheld the ability of customers to retain rights to the capacity value of behind-the-meter storage.

By concurrently advancing energy storage knowledge, policy, technology, demonstration projects, regulations and incentives, the Commonwealth has smoothed the path for developers to bring storage to scale quickly. "Our Energy Storage Initiative will lay the ground work, through a holistic approach . . . that will ensure Massachusetts becomes a national leader in the deployment and cost-effective use of energy storage," said Judith Judson, Commissioner of the Department of Energy Resources.[1]

"Investing in storage deployment and technology across the Commonwealth will help our Massachusetts-based energy storage companies tap a fast-growing market," said MassCEC CEO Stephen Pike. "The Commonwealth's leadership in developing this industry will allow renewable energy sources to be harnessed to their full potential and increase the resiliency of the electrical grid."

Massachusetts continues to advance energy storage with additional policy development, including what is anticipated to be the first state clean peak standard, a procurement standard similar to a renewable portfolio standard but that requires a percentage of electricity supplied during peak demand hours be derived from renewable or other clean sources. Because renewables such as wind and solar are variable generators and cannot be dispatched at need, this will require the use of energy storage technologies to capture renewable power when it is generated and inject it onto the grid during demand peaks, creating a large new market for storage providers.

And in a nation-leading move, Massachusetts included energy storage for the first time in its three-year energy efficiency plan for 2019-2021, making customer- and third-party-owned storage eligible for payments in return for peak demand reduction services. This program has already proved to be replicable; having developed plans for Massachusetts, the Massachusetts utilities with customers in neighboring states are now rolling out similar programs in those states.

In advancing this comprehensive suite of policies and programs, the Commonwealth has striven not only to increase deployment of energy storage, but also to attract the storage industry for job creation and economic development. *— Todd Olinsky-Paul*

1 "Baker-Polito Administration Announces $10 Million Energy Storage Initiative," Massachusetts Executive Office of Energy and Environmental Affairs, May 28, 2015, *https://www.mass.gov/news/baker-polito-administration-announces-10-million-energy-storage-initiative*.

CASE STUDY 10

Massachusetts Prepares for Offshore Wind Development

Massachusetts has a long history with offshore wind. Nearly two decades ago, Cape Wind Associates, LLC began planning for the proposed Cape Wind Project in Nantucket Sound. Although that project encountered relentless obstacles and did not come to fruition, the Massachusetts Clean Energy Center (MassCEC) has been busy laying the groundwork for a robust offshore wind industry in the Bay State, including the procurement of 800 MW of offshore wind and a plan for future solicitations.

MassCEC, the state's clean energy economic development agency, has helped to develop two important facilities supporting offshore wind—the Wind Technology Testing Center and the New Bedford Marine Commerce Terminal[1]—and it has supported a suite of workforce development initiatives to prepare for the new offshore wind industry it is working to create.

The Wind Technology Testing Center in Charlestown, MA

The Wind Technology Testing Center (WTTC) is located in Charlestown and opened in 2011. It is the largest wind turbine blade-testing center in North America, and the only one on the continent able to test utility-scale blades up to 90 meters in length. The WTTC conducts a range of certification tests, evaluating blades for strength, fatigue, and durability. Blade testing is an important component of wind turbine development and innovation, allowing both industry and investors to feel confident that blades will meet performance standards. Previously, manufacturers had to go to Europe for blade testing. The WTTC also engages in research and development partnerships, blade repairs, and workforce training.

The $40 million facility was funded with state and federal money. It has attracted wind turbine manufacturers to set up shop in North America and has helped local manufacturers by allowing them to more quickly test their designs and get them to market. The facility's strategic location on an existing deepwater port in Boston allows large blades to be shipped via water; smaller blades can be transported via roads.

1 Information about the Wind Technology Testing Center is available at *https://www.masscec.com/wind-technology-testing-center.* For Information about the New Bedford Maine Commerce Terminal is available at *https://www.masscec.com/facilities/new-bedford-marine-commerce-terminal.*

New Bedford was a major whaling and trade port in the 19th century, and it is still a major fishing and cargo port. Despite the city's rich maritime past, it is now the sixth poorest municipality in Massachusetts. With the economic development opportunities that offshore wind would bring, and with the city's strategic location and existing port infrastructure, New Bedford is a great location for a marine commerce terminal.[2]

Funded through a $113 million investment from MassCEC,[3] the New Bedford Marine Commerce Terminal is "a multi-purpose facility designed to support the construction, assembly, and deployment of offshore wind projects, as well as handle bulk, break-bulk, container shipping and large specialty marine cargo."[4] The Terminal has the largest capacity in North America and will support the transport and construction of offshore wind manufacturing components along the East Coast. The 26-acre facility was completed in 2015. It is the first of its kind in North America and is already playing an important role in the region's burgeoning offshore wind industry.

The offshore wind industry will require more than cutting-edge facilities—it will also require skilled workers. U.S. offshore wind farms commissioned between 2016 and 2030 are expected to create between 248,000 to 500,000 full time job-years through the wind farms' expected operational life through 2056.[5] To make sure that workers are prepared to meet this job demand, Massachusetts has invested in several educational and job training initiative:

In 2016, MassCEC provided $700,000 in funding to nine academic and research institutions in Massachusetts for offshore wind research projects, to expand local expertise and improve offshore wind economics.

- In 2018, MassCEC released a Massachusetts Offshore Wind Workforce Assessment, which analyzed workforce needs and job creation opportunities, and made recommendations for developing the industry.
- Later in 2018, MassCEC released a Massachusetts Offshore Wind Workforce Training and Development Solicitation, seeking proposals for projects to help develop offshore wind workforce training projects in the state.

Massachusetts has worked purposefully, strategically, and collaboratively to set the stage for offshore wind development. Thanks to these efforts, the state is well prepared to take advantage of the economic development opportunities of offshore wind, and the state's efforts are already proving to be successful.

State legislation signed in 2016 allows for the procurement of up to 1,600 MW of offshore wind energy by 2027. The Massachusetts Department of Energy Resources managed the first procurement and in May 2018 announced the selection of an 800-MW project to be developed by Vineyard Wind. In October 2019, Mayflower Wind was selected for a second 800-MW project. In December 2018, the federal Bureau of Ocean Energy Management sold three lease areas off the coast of Massachusetts for a record-breaking $405 million. This competitive interest in developing offshore wind in Massachusetts is due in large part to the state's efforts to create favorable conditions to advance a nascent industry. *— Samantha Donalds*

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2 See MassCEC's 2010 *Port and Infrastructure Analysis for Offshore Wind Development* report, which determined that New Bedford was the best location for a marine commerce terminal, *http://files.masscec.com/Port%20%26%20Infrastructure%20Report.pdf*.

3 Northeast Offshore Wind Regional Market Characterization, page 59, *https://www.cesa.org/resource-library/resource/northeast-offshore-wind-regional-market-characterization*.

4 *https://www.masscec.com/facilities/new-bedford-marine-commerce-terminal*

5 "U.S. Job Creation in Offshore Wind," by BVG Associates Limited, for CESA et al., November 2017. Page 8, *https://www.cesa.org/resource-library/resource/u-s-job-creation-in-offshore-wind*.

CASE STUDY 11

Michigan's Cherryland Community Solar Serves Rural LMI Households

The Michigan Energy Office, with assistance from the US Department of Energy, decided to create three low-income community solar pilot programs, including one at an electric coop, one at a municipal utility, and one at an investor-owned utility. The Energy Office selected Cherryland Electric Cooperative, which serves six rural counties in northern Michigan, to be its first partner. Northwest Community Action Agency (NWCAA), which administers the low-income weatherization program in that part of the state, was also part of the team.

With community solar, customers subscribe to a large off-site solar array and receive credits on their electric bills for the electricity generated. Rather than creating a community solar array from scratch, the Cherryland team decided to buy shares in an existing community solar project owned by Wolverine Power, which supplies electricity to Cherryland. The Michigan Energy Office and Cherryland paid $180,000 for subscription shares to 450 solar panels. These shares were then distributed at no cost to the 50 participating households. Participants receive a bill credit of $0.10 per kilowatt hour (kWh) generated by their shares, a benefit of about $350 per year per household.

All the participating households have incomes at or below the federal poverty level. Those who had not recently had their homes weatherized were required to have an energy audit and to have energy efficiency improvements made to their homes where possible. As part of the process, they also received educational materials about how to use less energy.

In carrying out the Cherryland community solar project, the Michigan Energy Office learned the importance of having trusted community partners, since low- and moderate-income people have often been the targets of financial scams. NWCAA had relationships with customers and was instrumental in the implementation of the program. They were also able to do weatherization intake audits. The Energy Office also learned a lot about the ownership options for community solar and about which options worked best for them as a state agency.

The Cherryland Electric Cooperative community solar array.

Even with trusted community partners, outreach was not easy. Potential participants were sometimes hard to reach by telephone, making it necessary to physically visit their homes to talk to them about the program.

The Michigan Energy Office and Cherryland paid $180,000 for subscription shares to 450 solar panels. The shares were then distributed at no cost to the 50 participating households. Participants receive a a benefit of about $350 per year per household.

In March 2018, program participants began receiving bill credits from the community solar project. The Energy Office is undertaking a follow-up survey of the participants, both to evaluate the program and to find out whether participants continue to be eligible for the program. Participants will be reevaluated every year to make sure they still qualify.

The Energy Office is in the process of finding partners for the next two pilot projects, one with a municipal utility and one with an investor-owned utility. They are discovering that the techniques that worked well for developing a partnership with Cherryland coop, a small community-based utility, may have to be adapted for larger, more complex organizations. The Energy Office continues to seek out more sources of funding and is considering requesting permission from the federal government to use weatherization funds to pay for solar.

According to Terri Novak of the Michigan Energy Office, there is considerable enthusiasm from various communities in participating in the low-income community solar pilot program, with a waiting list of communities interested in hosting community solar projects in future years. — *Diana Chace*

Cherryland Electric Cooperative's community solar array is located at its headquarters in Grawn, Michigan.

CASE STUDY 12

Minnesota Accelerates Community Solar

Solar arrays in Minnesota

Although solar has been a mainstream option for homeowners and businesses for years, some groups, including renters and building owners with shaded roofs, have had difficulty accessing solar. One solution is community solar, in which a group of customers buy, lease, or otherwise access shares in a central solar array. Participating customers receive credits on their utility bills for the electricity generated, and the solar electricity from the arrays helps to power the local electric grid. Since adopting community solar legislation, Minnesota has experienced a surge in community solar, led by Xcel Energy's Solar*Rewards Community program. As the community solar model expands across the country, other states can learn from Minnesota's vigorous and growing program.

Since Minnesota's first community solar projects (sometimes called community solar gardens) began construction in 2013, community solar arrays have been built all over Minnesota, and more are awaiting permitting or are in the design phase. In 2017, over half of the installed solar capacity in Minnesota was community solar, and by the end of that year Minnesota had one-third of all the community solar in the country. In mid-2019, there was 598 MW of community solar in Minnesota,[1] more community solar capacity than was installed in the entire US at the end of 2016. Unlike some community solar programs, Minnesota's includes no program cap. Under the current rules, if devel-opers keep building projects and customers keep signing up, the program will continue to grow. This has enabled the rapid growth of solar in Minnesota.

Minnesota's largest utility, Xcel Energy, is required by the State to offer a robust community solar program. A large majority of the community solar projects in the state are part of Xcel Energy's

1 Minnesota Department of Commerce estimate as of August 2, 2019.

program, but many other utilities in the state, including rural electric cooperatives, have also chosen to create community solar programs. In fact, cooperative utilities were the first to offer community solar to their customers in 2013. These programs have different rules than the Xcel Energy program. Customers of these other utilities often pay a premium in order to participate in community solar, whereas Xcel Energy customers have generally saved money by participating.

In Xcel Energy's service territory, community solar projects are built by private developers that contract directly with individual subscribers. The subscribers pay the developers, the developers provide electricity to Xcel Energy, and Xcel Energy credits the subscribers on their bills. Xcel Energy customers can sign up for any project that operates in their own or an adjacent county.

In mid-2019, there was 598 MW of community solar in Minnesota, more community solar capacity than was installed in the entire US at the end of 2016.

The Minnesota Department of Commerce provides "Tips About Community Solar" on its website in order to help consumers understand the program and make informed decisions.[2] The department also works with the Clean Energy Resource Teams (CERTs) who work throughout the state to provide more in-depth information and connect potential subscribers to specific projects.

Community solar in Minnesota has been popular with both commercial and residential customers. Many projects primarily serve commercial customers, while others focus on residential customers. While 92 percent of community solar customers in the state are residential, they account for only 10 percent of the overall solar capacity,[3] since their average subscription is so much smaller than the average commercial subscription.

Furthermore, Minnesota utilities, government agencies, the solar industry, and community stakeholders have implemented strategies to promote broader access to community solar. In pursuit of these strategies, the Minnesota Department of Commerce worked with the Clean Energy States Alliance to develop an initiative called Connecting Low-Income Communities through Efficiency and Renewable Sources (CLICERS). Participants in CLICERS helped shape solar-based strategies in an action plan, "Strategic Solar Actions for Income-eligible Minnesota Households," released in June 2018.[4] Part of that plan called for "expanded access to community solar gardens."

Additionally, multiple Minnesota utilities offer carve-outs and incentives to income-qualified customers and those that service them. Xcel, for example, offers upfront payments and production incentives for new solar gardens that service income-qualified customers, while Minnesota Power offers rebates to community solar garden developers serving low-income customers.

Community solar in Minnesota continues to evolve to meet the needs of subscribers, developers, electric ratepayers, and the State of Minnesota. In the early years, Xcel Energy community solar customers were compensated at the retail electricity rate for the electricity generated by the community solar arrays. For community solar applications filed after December 31, 2016, subscribers instead receive a "Value of Solar" rate, as required by legislation and approved by the Minnesota Public Utilities Commission. — *Diana Chace*

2 Minnesota Department of Commerce, "Tips About Community Solar" webpage, *https://mn.gov/commerce/consumers/your-home/energy-info/solar/tips-about-community-solar.jsp*.

3 Institute for Local Self Reliance, "Why Minnesota's Community Solar Program is the Best" webpage, accessed June 10, 2019, *https://ilsr.org/minnesotas-community-solar-program*.

4 Minnesota Department of Commerce, "Solar to Low-and Moderate-Income Communities" webpage, accessed September 12, 2019, *https://mn.gov/commerce/industries/energy/solar/solar-low-moderate-income-communities.jsp*. See also, *http://mn.gov/commerce-stat/pdfs/li-solar-action-plan.pdf*.

CASE STUDY 13

New Hampshire Incorporates Renewable Thermal Technologies into its Renewable Portfolio Standard

New Hampshire's Renewable Portfolio Standard (RPS)—like other state RPS programs—was created to increase the use of clean technologies for electricity generation. New Hampshire was the first state to include renewable thermal technologies in its RPS. Capitalizing on local energy resources and boosting local economic growth, this program extends RPS eligibility to woody biomass, geothermal, methane gas, and solar for heating and cooling.[1] Initially introduced to the legislature at a time when New Hampshire's forest-based industry was struggling from the closure of paper mills, policymakers and stakeholders saw the inclusion of wood biomass heating technologies in the RPS as an opportunity to revive the distressed industry.[2]

The landmark legislation has supported the development of 50 projects that have generated over 35 MW of electric-equivalent renewable thermal capacity.[3] The New Hampshire Public Utilities Commission (PUC) promulgated rules for Class I thermal renewable energy certificates (T-RECs), a certificate system that accounts for the generation of "useful thermal energy" from qualified thermal projects, which can then be sold and tracked on the New England Power Pool Generation Information System.

This wood chip silo is part of the John Stark High School's biomass heating facility.

RPSs and their accompanying system of renewable energy certificates (RECs) were designed to measure and account for electricity generation in one megawatt-hour (MWh) blocks. Because heat is not measured in MWh, New Hampshire measures useful thermal heat on an "electric equivalency" basis. New Hampshire became the first state to assign a REC value for thermal energy based on a BTU to MWh conversion, using a widely accepted equivalency formula: *3.412 million BTUs of useful thermal energy = 1 MWh = 1 REC.*

1 Methane gas became an eligible resource in 2018 under SB 577.

2 New Hampshire is 83 percent forested and spends 40 percent of its total energy budget on space heating. New Hampshire's milling industries' decline was the subject of a New Hampshire Public Radio series, see *https://stateimpact.npr.org/new-hampshire/2012/08/06/preview-tomorrows-installment-of-getting-by-getting-ahead-examines-working-in-the-north-countrys-fading-paper-industry.*

3 See NH PUC presentation, *https://cesa.org/assets/2018-Files/RPS-webinar-slides-11-29-2018.pdf.*

Electricity providers in New Hampshire are required to purchase a percentage of "useful thermal energy" that can be metered and that is delivered as direct heat, steam, or hot water directly to New Hampshire consumers and used for heating, cooling, humidity control, manufacturing, or other valid thermal uses. Electricity providers purchase the thermal energy as T-RECs for 1.4 percent of their load starting in 2019, reaching 2.2 percent of their load in 2023 and thereafter, or make Alternative Compliance Payments to the New Hampshire's Renewable Energy Fund.[4]

The renewable thermal provisions have had a positive impact on the forest industry.

In addition to establishing the electric equivalency for thermal energy so that T-RECs could par-ticipate in the RPS market, the NH PUC developed rules for project commissioning and monitoring, metering standards, and reporting procedures. The PUC rules differentiated metering requirements by system capacity or size threshold. Systems with capacity up to and including one million BTUs can be metered by fuel input and auger measurements, heat output, or run time combined with certified performance data, depending on technology. Larger systems require heat meters, which must be installed according to defined metering protocols and specifications.[5]

As the first comprehensive thermal RPS program in the country, New Hampshire has served as a model for other states. Massachusetts, Oregon, and Vermont, for example, have benefitted from New Hampshire's lead, incorporating lessons learned as they structure their own rules and procedures for qualifying thermal facilities in their RPS and RPS-equivalent programs.

New Hampshire's thermal RPS program has provided economic and environmental benefits for the state. Most of the participating projects are large commercial or industrial wood biomass facilities, largely in public buildings—municipal buildings, schools, and hospitals.[6] These facilities use T-REC revenue to offset the capital costs of new heating systems. They generated over 43,000 thermal RECs in 2017, earning an estimated $991,162 in gross revenue for the system owners.[7]

The renewable thermal provisions have also had a positive impact on the forest industry with the woody biomass heating projects helping sustain the low-grade wood supply market through the sale of locally-sourced wood, including wood pellets, dried and refined wood chips, and green wood chips.[8] The wood purchased by these projects in 2017 totaled an estimated $1,720,395.[9]

In addition to economic benefits, the RPS thermal provisions have helped safeguard the environment by displacing heating oil and improving air quality. The woody biomass heating projects alone displaced an estimated 1,500,851 gallons of No. 2 heating oil in 2017.[10]

"The biomass plant we installed at the Plymouth Regional High School not only eliminated our use of No. 2 heating oil but also provides us with a cash stream to support our school budget, thereby reducing local taxes," says Dan Rossner, Business Administrator in School Administrative Unit 48.[11] —*Val Stori*

4 "Useful thermal energy" is defined in RSA 362-F:2, XV-a, PUC 2500 Electric Renewable Portfolio Standard amendments, adopted rule 1-29-18.

5 Large systems are defined as over 1,000,000 BTU/hr, 83-ton equivalent.

6 Most of the projects are large commercial wood biomass facilities; two large and seven small geothermal projects are also generating T-RECs; and one facility is generating T-RECs from a biofuel project.

7 Innovative Natural Solutions LLC, unpublished analysis, June 2018.

8 Since 2015, 21 wood biomass projects have qualified for T-RECs, representing an installed boiler capacity of 22.31 MW.

9 Innovative Natural Solutions LLC, unpublished analysis, June 2018.

10 Ibid.

11 Email communication from 6 March 2019 with Dan Rossner, Business Administrator, SAU #48, Plymouth, New Hampshire.

CASE STUDY 14

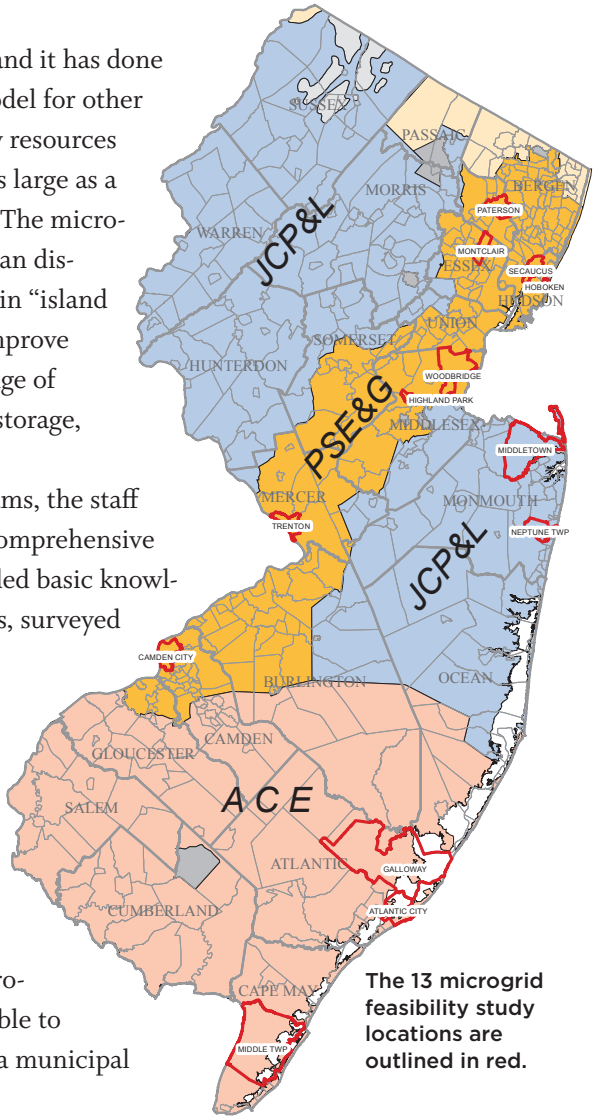
New Jersey Promotes Microgrids for Resiliency and Grid Modernization

In 2012, Superstorm Sandy impacted more than 70 percent of New Jersey's electric grid, with about five million people losing power, some for weeks. In response, the state's policymakers and energy planners acted to harden the state's infrastructure. Additional grid outages caused by storms in 2013 and 2015 intensified the desire for greater energy resiliency and underscored the need for key facilities to have continued power when the grid is unavailable.

One key solution that New Jersey has advanced is microgrids, and it has done so in a systematic, sustained manner that can serve as a useful model for other states. Microgrids connect a series of loads and distributed energy resources within a defined area that can be as small as a single building or as large as a community, although most fall in between those two parameters. The microgrid acts as a single entity in its relationship to the wider grid. It can disconnect from the wider grid when there is an outage and operate in "island mode." In addition to the resiliency advantages, microgrids can improve efficiency and provide environmental benefits. They can use a range of technologies, including combined-heat-and-power, solar, battery storage, fuel cells, and efficient natural gas generators.

To lay the groundwork for sound microgrid policies and programs, the staff of the New Jersey Board of Public Utilities (NJBPU) produced a comprehensive *Microgrid Report* that was released in late-2016.[1] The report provided basic knowledge about microgrids, described microgrid activity in other states, surveyed existing New Jersey microgrids, and identified barriers and key questions that needed to be addressed before microgrids could be implemented more widely. It found that there were already 50 microgrids in the state, some of which had been developed with incentives from New Jersey's Clean Energy Program, which NJBPU administers, although not all of them had been prepared to enter island mode in the event of a grid outage.

In early-2017, NJBPU solicited proposals from public entities across the state to conduct feasibility studies for town center microgrids.[2] The program concept was that towns and cities would be able to develop microgrids covering "a cluster of critical facilities within a municipal



The 13 microgrid feasibility study locations are outlined in red.

1 New Jersey Board of Public Utilities, *Microgrid Report* (New Jersey Board of Public Utilities, November 2016), *https://www.nj.gov/bpu/pdf/reports/20161130_microgrid_report.pdf.*

2 The official name for the program was the "Town Center Distributed

boundary that are capable of providing essential municipal services and shelter for the public during and after an emergency situation."[3] The types of facilities envisioned to be contained in these microgrids included hospitals, police headquarters, fire stations, and other critical government and private sector facilities. To help local officials and other stakeholders learn about microgrids, NJBPU funded the New Jersey Institute of Technology (NJIT) to establish an online Community Microgrids Learning Academy. NJBPU also worked with NJIT to map out 24 potential microgrids across the nine counties that were hit hardest by Hurricane Sandy.

The increased attention that NJBPU has given to microgrids has contributed to heightened interest in the concept among various parties in New Jersey.

Although NJBPU initially set aside $1 million for the feasibility studies, it ultimately awarded slightly more than twice that amount and 13 feasibility studies were produced. NJBPU is currently preparing for a second round of funding, with a budget of at least $4 million to help some of the municipalities that completed studies turn their plans into reality.

With the 13 feasibility studies posted on NJBPU website, other stakeholders are learning about the microgrid potential. NJBPU, NJIT, and Rutgers University are also working on a microgrid financing study under a grant from the US Department of Energy that will feature a financing tool for microgrid developers.

In June, New Jersey issued a *Draft 2019 New Jersey Energy Master Plan*, with microgrids included under "Modernize the Grid and Utility Infrastructure," one of the seven strategies in the plan. The plan, which was prepared by five state agencies with NJBPU leading, is an initial roadmap toward meeting the state's goal of 100 percent clean energy by 2050.[4] The plan points out that the microgrid financing study currently underway in the state will inform the final 2019 Energy Master Plan, as well as its implementation roadmap and the plan for the state's Global Warming Response Act.[5]

The increased attention that NJBPU has given to microgrids has contributed to heightened interest in the concept among various parties in New Jersey. As one example, this year Montclair State University became a campus-wide microgrid with the ability to continue to operate if the grid goes down elsewhere and with technologies that will save $4 million annually in energy costs.

3 New Jersey Board of Public Utilities, Town Center Microgrid Feasibility Study Application, (New Jersey Board of Public Utilities, 2017), p. 1, *https://www.nj.gov/bpu/pdf/commercial/TC%20DER%20Microgrid%20Feasibility%20Study%20Application.pdf.*

4 State of New Jersey, Draft 2019 New Jersey Energy Plan: Policy Vision to 2050 (State of New Jersey, June 2019), *https://nj.gov/emp/pdf/Draft%202019%20EMP%20Final.pdf.*

5 Ibid., p. 102.

CASE STUDY 15

New Mexico's "PV on a Pole™" Brings Solar to Manufactured Homes

In New Mexico, many people in rural areas and on Native American reservations live in manufactured homes that are poorly insulated, difficult to retrofit, and reliant on electricity for heating as well as cooling, resulting in high utility bills for their occupants. Seventeen percent of New Mexicans live in manufactured housing, which is the second highest rate in the country. The staff of the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) realized that they had to address this market if solar is to benefit all income and ethnic groups in the state.

Nambe Pueblo PV on a Pole™ with system recipient Victor Perez, along with Carmen Campbell of Jemez Mountains Coop, and Ken Hughes and Mark Gaiser of EMNRD

Installing solar panels can help manufactured home residents reduce their utility costs. However, a major obstacle is that the roofs of manufactured homes are often not able to support the extra weight of solar panels.

Mark Gaiser, an EMNRD engineer, had an idea. Rather than trying to install solar on a roof that wasn't designed for it, why not put the solar panels on a pole and place it in the ground beside the home? And rather than taking the time and trouble to mount the pole in concrete, why not make it screw-mounted? And rather than individually designing a system for each home, why not standardize and mass-produce the arrays, and then quickly assemble them on-site?

Gaiser and his colleagues developed a new solar product, "PV on a Pole™," which has four solar panels totaling 1.32 kW mounted atop a pole with a tracker. The pole can be installed with a soil drill mounted on a truck. While PV on a Pole™ was designed with manufactured homes in mind, it can be used at any home.

After several delays in deploying a prototype, EMNRD began working with Jemez Mountains Electric Cooperative in Espanola and with Nambe Pueblo, which is served by the Cooperative. A philanthropic foundation, Cornerstone, which has an interest in providing solar to tribal communities, donated $10,000 to the Pueblo for installation of two prototypes. Leaders of the Pueblo chose

PV on a Pole™ in Nambe Pueblo, with system recipient Victor Perez

Gaiser and his colleagues developed a new solar product, "PV on a Pole™," which has four solar panels totaling 1.32 kW mounted atop a pole with a tracker. The pole can be installed with a soil drill mounted on a truck. While PV on a Pole™ was designed with manufactured homes in mind, it can be used at any home.

the two homes where the prototypes would be installed. When none of the local solar companies were available to help with the installation, Jemez Mountain Electric Coop offered to have its own workers assist. A test installation at Jemez Mountain headquarters went well, and the two poles were successfully installed in late November 2018.

While Gaiser was building prototypes, his EMNRD colleague Ken Hughes began cultivating interest and exploring financing options across New Mexico, talking with mobile home residents, dealers, and managers, rural electric coops, municipalities and municipal utilities, tribal representatives, community colleges, legislators, and foundations. One financing possibility is for electric utilities, including coops, to provide on-bill financing. Another possibility is that mobile home dealers could include PV on a Pole™ in the home loan.

Now that prototypes have been installed, next steps for the project include monitoring the performance of the prototypes, refining the design, finding a way to scale up manufacturing, establishing financing mechanisms, and continuing to spread the word about PV on a Pole™.

Hughes says the department is committed to seeing PV on a Pole™ implemented widely across the state. Housing agencies and state energy officials in other parts of the country have also shown interest in deploying PV on a Pole™ as a way to bring solar to the many Americans who live in manufactured housing.

—Diana Chace

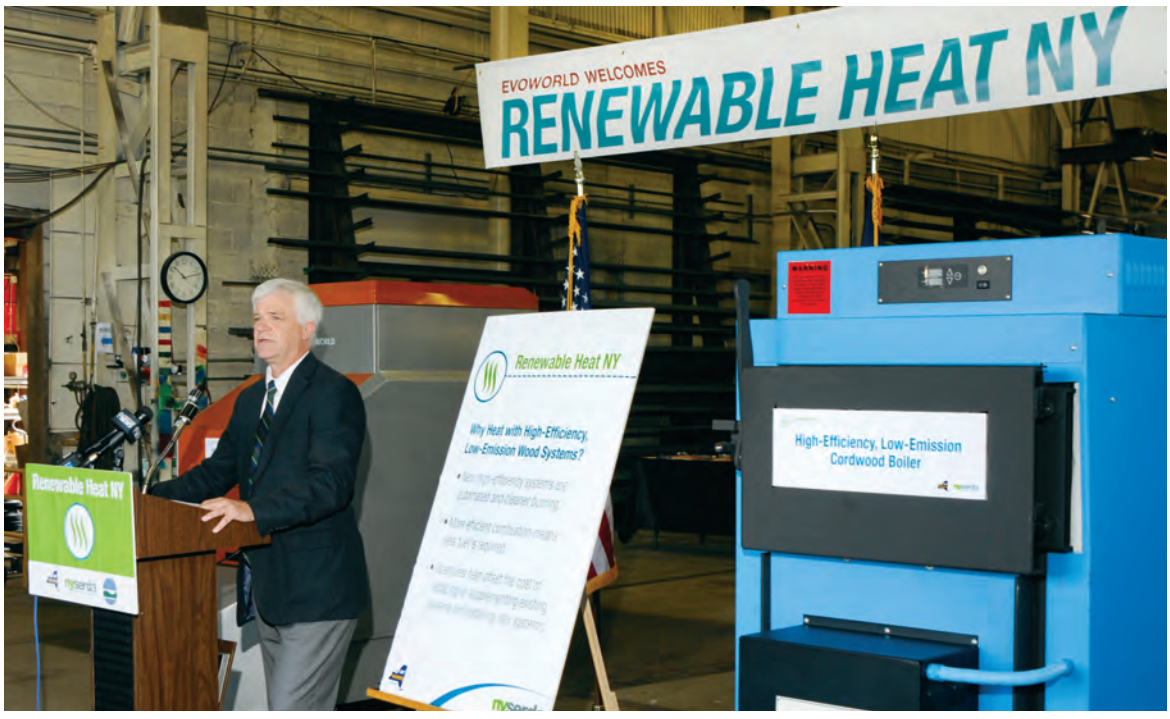
CASE STUDY 16

New York Opens the Door to Clean Heating and Cooling for Its Communities

The heating and cooling of buildings is responsible for 27 percent of all greenhouse gas emissions in New York State. In support of Governor Andrew Cuomo's Green New Deal and the state's *Climate Leadership and Community Protection Act* calling for an 85 percent reduction in greenhouse gas emissions from 1990 levels by 2050, the New York State Energy Research and Development Authority (NYSERDA) has developed a comprehensive, long-term policy approach to addressing emissions from the heating and cooling sector.

To increase the use of clean heating and cooling systems in buildings, NYSERDA announced its Clean Heating and Cooling Community Campaign (CHCC) initiative in 2017. Based on the proven Solarize model, which pioneered community campaigns and group purchasing for solar photovoltaics, CHCC uses the concept of aggregated purchases to obtain discounts for a group of buyers.[1] It is also designed to educate and increase the awareness and knowledge of clean heating and cooling technologies among consumers. It is an ambitious initiative to jump-start the market for these technologies and make it self-sustaining.

In November 2017, NYSERDA launched its first round of CHCC, seeking proposals from organizations to administer the community campaigns. A scoring committee reviewed the proposals and,



New York Department of Environmental Conservation Commissioner at Evoworld, Inc. in Troy, NY

1 Solarize originated in Portland, Oregon in 2009 and is now widespread throughout the United States.

in August 2018, eight organizations across the state were named to manage local clean heating and cooling campaigns. Three of the organizations also applied for and received additional funding for workforce development, and one received funding to test methods of how best to engage low-to-moderate income (LMI) customers in this initiative.

In 2019, NYSERDA gave awards to an additional six organizations to run campaigns, with three of the new organizations receiving additional funds to support workforce development and one to increase LMI participation. Overall, $4 million was made available for the first two rounds to support 14 organizations that are executing clean heating and cooling community campaigns throughout the state. Predictably, the communities that showed the most interest in the CHCC program were predominantly heating with oil and propane and had demonstrated a prior clean energy commitment, such as being designated a Clean Energy Community.[2]

Four million dollars was made available for the first two rounds to support 14 organizations that are executing clean heating and cooling community campaigns throughout the state.

All participating organizations chose one or more clean heating and cooling technologies to use in their campaigns and are required to use a NYSERDA-provided Request for Proposals template for choosing the installers who will participate in the program.[3] These installers then work collaboratively with the organizations to design and implement a marketing and outreach campaign.

The participating organizations are also required to conduct outreach, marketing, and education efforts. Potential customers are informed of community "launch events" through media, email invitations, social media, and press releases. These events provide information about clean heating and cooling technologies and introduce contractors to customers in a pleasant, fun environment.

For each community campaign, the organizations track enrollee information such as basic building/customer information, installer bids, contracting, and installation and inspection dates. They also provide monthly campaign activity reports to NYSERDA. Homeowners can enroll in the program without making a firm commitment; they can simply indicate their desire to learn more from an installer. After an evaluation by the installer, the homeowner will review the options available and sign a contract if she/he wishes to participate.

NYSERDA also helped the organizations by recruiting teams of expert consultants to provide technical assistance for community campaigns. The teams help with the installer selection process and assist with marketing and outreach. Because "lessons learned" are key to the program's future success, teams conduct debriefings, analyze the successes and failures of a campaign, and submit quarterly enrollment data and metrics to NYSERDA.

NYSERDA is using an artificial intelligence tool to target customers with a high propensity to adopt clean heating and cooling technologies. Using data gathered from public records, this tool identifies customers who would benefit from clean heating and cooling. NYSERDA is paying for at least 200 of the CHCC program's participating installers to subscribe to this service for up to two years.

Although the CHCC program is relatively new, NYSERDA has already announced funding for a third round of campaigns, which are expected to launch within the year. — *Georgena Terry*

2 NYSERDA, Designated Clean Energy Communities, *https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Communities/Designated-Clean-Energy-Communities* (accessed Jan 11, 2019).

3 HeatSmart Southern Tier Year 1 Request for Proposals, *http://heatsmartsoutherntier.org/wp-content/uploads/2018/10/HeatSmart-Southern-Tier-CHC-Communities-RFP.pdf*.

CASE STUDY 17

New York Pioneers Non-Wires Alternatives

Faced with increasing electric demand that could strain the capacity of the existing distribution system to provide reliable service to customers, electric utilities and regulators have two options: 1) construct new grid infrastructure to accommodate increased demand, or 2) look for so-called "non-wires alternatives" (NWAs)—technologies and distribution system management measures that provide flexibility without upgrading infrastructure.

In 2014, Con Edison, the electric utility serving New York City, confronted precisely this choice. Increased electric demand in certain fast-growing areas of Brooklyn and Queens threatened to overload the capacity of area electric feeder lines.

Rather than build a new substation and distribution feeders for approximately $1.2 billion, Con Edison petitioned the New York Public Service Commission to implement a collection of programs, including demand response, distributed generation, additional energy efficiency, and energy storage to relieve electric demand in the area. All told, Con Edison's proposal, dubbed the Brooklyn/Queens Demand Management Program, included 52 MW of non-traditional utility-side and customer-side solutions for an original investment of $200 million.

The Brooklyn-Queens Neighborhood Program included energy-efficient lighting upgrades

When the New York Public Service Commission took up the Brooklyn-Queens Neighborhood Program proposal in 2014, New York Governor Andrew Cuomo had recently launched the Reforming the Energy Vision (REV) initiative to shift the state's utility regulation to meet the needs of a cleaner, more distributed, and resilient energy future with affordable and reliable customer-focused electric service. The Con Edison proposal fits well with the Public Service Commission's commitment under REV to facilitate an affordable, clean, and efficient energy system for the state.

Not only did the program remain under its $200 million budget, but it successfully deferred the need for a substation upgrade that would have cost $1.2 billion.

On December 12, 2014, the New York Public Service Commission approved the Brooklyn-Queens Neighborhood Program. The order noted: "By encouraging deployment of distributed energy resources according to grid needs, offering increased clean energy solutions for customers, and promoting innovation through competition, this proposal is consistent with the vision set forth in the Reforming the Energy Vision (REV). By this Order, the Commission is making a significant step forward toward a regulatory paradigm where utilities incorporate alternatives to traditional infrastructure investment when considering how to meet their planning and reliability needs."[1]

The package of Brooklyn-Queens Neighborhood Program measures implemented to date consists of approximately 34 MW of non-traditional customer-side NWAs and 18 MW of non-traditional utility-side NWAs to achieve the 52 MWs planned load relief. The customer-side measures included energy efficiency programs for residential, small business, and commercial buildings. The structures include New York City Housing Authority developments and other multifamily buildings. Con Edison also held a dynamic resource auction for demand response and incentivized combined-heat-and-power and fuel cells. The utility-side measures included voltage optimization and energy storage.

Not only did the program remain under its $200 million budget, but it successfully deferred the need for a substation upgrade that would have cost $1.2 billion. Con Edison originally hoped the Brooklyn-Queens Neighborhood Program would be able to put off the substation upgrade until 2019, but it now believes the program has contributed to deferring the substation beyond the utility's planning horizon. Con Edison also received regulatory approval to continue implementing the program beyond 2018, utilizing its existing budget; and it is seeking additional load relief solutions.

The success of the Brooklyn-Queens Neighborhood Program has not gone unnoticed. It has been called the "veritable grandfather of NWAs."[2] "This is something that can be replicated in every location of the country," Richard Kauffman, Chair of the NYSERDA Board, said about the project, "It's not only an evolution of processes, thinking and culture, it's also a gradual change in business models, evolving away from 'programs' to these activities being integral to the business itself."[3]

— Nate Hausman

1 New York Public Service Commission, Order Establishing Brooklyn/Queens Demand Management Program, Case 14-E-0302—Petition of Consolidated Edison Company of New York, Inc. for Approval of Brooklyn Queens Demand Management Program (Dec. 12, 2014), *http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B83594C1C-51E2-4A1A-9DBB-5F15BCA613A2%7D*.

2 Walton, Robert, Utility Dive, "The Non-Wire Alternative: ConEd's Brooklyn-Queens Pilot Rejects Traditional Grid Upgrades" (Aug. 3, 2016), *https://www.utilitydive.com/news/the-non-wire-alternative-coneds-brooklyn-queens-pilot-rejects-traditional/423525*.

3 Spiegel, Jan Ellen, *InsideClimate News*, "Another $1.2 Billion Substation? No Thanks, Says Utility, We'll Find a Better Way" (Apr. 4, 2016), *https://insideclimatenews.org/news/04042016/coned-brooklyn-queens-energy-demand-management-project-solar-fuel-cells-climate-change*.

CASE STUDY 18

Oregon Helps Farmers while Generating Energy and Conserving Water

Irrigation water delivery infrastructure in much of the West is inefficient, old, and deteriorating with age. Energy Trust of Oregon, in cooperation with the nonprofit Farmers Conservation Alliance (FCA), developed an ambitious and comprehensive program to help Oregon irrigation districts and the farmers they serve transition to modern water delivery systems. These systems will reduce energy consumption, generate renewable electricity, increase agricultural production, and reduce water use. The program is working with more than 25 irrigation districts, representing about 30 percent of the state's irrigated agricultural land. It is demonstrating that modern agricultural water management can mitigate the impacts of long-term droughts and other serious environmental and agricultural challenges.

(Left to Right) Ron Cochran (Tumalo Irrigation District Board Chair), NRCS Chief Matt Lohr, Ken Rieck (Tumalo Irrigation District Manager), and Senator Jeff Merkley celebrating the modernization (piping) of the Tumalo Irrigation District

Oregon's farms typically receive irrigation water from open canals owned by irrigation districts. These canals deliver more than 480 billion gallons of water annually. Because of seepage and evaporation, 20 to 50 percent of the water diverted into these canals never makes it to a farm. Many irrigation systems are failing and have become operational liabilities.

One approach to modernizing an irrigation system starts with replacing open, earthen canals with pipes, thereby eliminating water losses from evaporation and seepage into the ground. Gravity pressurizes water delivered through the pipes, allowing farmers to reduce or eliminate pumping energy and related costs. In some places there is sufficient excess water pressure in the pipes to add hydroelectric power generators to produce electricity. But despite the important benefits of modernization, the significant complexity and expense of modernization and limited public awareness meant that few districts considered it before the start of the Energy Trust program.

Energy Trust's early involvement with hydropower projects for a few irrigation districts, most notably a 700-kW hydropower turbine for the Three Sisters Irrigation District, made it apparent that a larger irrigation modernization initiative was desirable. To implement a comprehensive approach, Energy Trust contracted with FCA, whose mission is to develop resource solutions for rural communities. With funding and staff support from Energy Trust, FCA created a methodology for developing individual irrigation district modernization strategies and built a large coalition of public- and private-sector partners.

FCA and Energy Trust offer the districts assistance to assess the benefits of modernization, develop plans for modernization, and pursue permitting and financing. As of August 2019, 20 irrigation districts —including all eight in the Deschutes River basin, one of Oregon's largest irrigated areas—had signed up to participate in the program. About five to seven additional districts are expected to join the program each year. Energy Trust has provided up to $200,000 per irrigation district for assessment studies.

For nine of the initial irrigation districts participating in the program, implementing modernized systems could lead to saving an average of more than 350 million gallons of water per day. Nearly 60,000 MWh of electricity could be conserved each year from avoiding pumping and related uses.

When Oregon Senator Jeff Merkley learned about the program, he quickly understood its substantial potential. As he noted, "These investments in irrigation systems are also investments in the future resiliency, competitiveness and livability of Oregon's rural economies."[1] Working with the US Department of Agriculture (USDA), he recognized that one of the initiatives under the rubric of the National Resource Conservation Service (NRCS) had not been funded for many years, and he worked to have funding for it included in the 2018 Farm Bill. As a result, there will now be at least $100 million a year for irrigation modernization implementation and related efforts, not just in Oregon but across the country.

Some Oregon irrigation districts are now ready to begin implementing their plans and two of them have started to install piping. In September 2018, USDA awarded the Tumalo Irrigation District nearly $30 million dollars "to improve water conservation, water delivery reliability, and public safety on more than 68 miles of its canals and laterals."[2] The federal award required 25 percent in matching funding from state and local sources. Energy Trust and FCA worked with the district to identify possible sources for the match. As Energy Trust Program Manager Dave Modal notes, "Every step of the way, we have had tremendous support at the state and federal levels for the irrigation modernization initiative."[3]

FCA calculates that, for nine of the initial irrigation districts participating in the program, implementing modernized systems could lead to saving an average of more than 350 million gallons of water per day. Nearly 60,000 MWh of electricity could be conserved each year from avoided pumping and related uses. Hydropower projects totaling 38 MW could be installed. The affected communities will receive considerable economic development benefits from the investment, short-term construction jobs, and reduced ongoing costs.[4]

Many other states have the potential to do similar irrigation modernization projects. FCA intends to provide advice and assistance to projects in other states. Energy Trust has received a grant from the US DOE through Idaho National Laboratory to write up two project case studies so that others can learn about and consider replicating Oregon's impressive model. — *Warren Leon*

1 Jeff Merkley, quoted in Energy Trust of Oregon, "Oregon Program Receives 2016 National Award for Helping Farms, Irrigation Districts Save Water," press release, June 15, 2016, *https://www.energytrust.org/2016/06/15/oregon-program-receives-2016-national-award-helping-farms-irrigation-districts-save-water*.

2 Office of Senator Jeff Merkley, "Merkley Announces Funding for Major Irrigation Project," press release, September 52, 2018, *https://www.merkley.senate.gov/news/press-releases/merkley-announces-funding-for-major-irrigation-project*.

3 Interview with author, January 17. 2019.

4 Farmers Conservation Alliance, "Projected Impact," web page, accessed January 22, 2019, *https://fcasolutions.org/impact*.

CASE STUDY 19

Rhode Island's Ocean SAMP Lays the Groundwork for the Nation's First Offshore Wind Farm

Rhode Island's ocean area is almost as large as the state itself. Its active uses include commercial and recreational fishing, transportation, recreation, and military activities. An equally diverse range of stakeholders are impacted by the environmental health and the potential development of this ocean area, from tribal communities, to historic preservationists, to the residents and tourists who enjoy Rhode Island's beautiful beaches during the summer. Rhode Island's Ocean Special Areas Management Plan (SAMP)[1] seeks to balance a diversity of ocean uses, including the development of offshore wind, through careful and collaborative consideration of the unique social, recreational, ecological, and economic attributes of the ocean area.

As early as 2007, Rhode Island policymakers began to discuss how to develop offshore wind power in order to meet the state's renewable energy goals. It soon became clear that a comprehensive study was needed to determine if and how renewable energy development could be balanced with various social, economic, and environmental considerations.

In 2008, the Rhode Island Coastal Resources Management Council (CRMC)[2] was charged with an ambitious task: creating a plan (what would become the Ocean SAMP) for how the state's offshore waters should be developed with offshore wind. The process needed to allow for the input of all impacted stakeholders; to capture the scope of all current uses, by both people and wildlife; to determine where

Block Island Offshore Wind Farm

1 RI Coastal Resources Management Council, Ocean SAMP, *http://www.crmc.ri.gov/samp_ocean.html.*

2 About the CRMC: *http://www.crmc.ri.gov/aboutcrmc.html.*

renewable energy projects could be sited; and to develop regulations to minimize conflict between current and potential uses.

The CRMC is an independent state regulatory agency responsible for balancing economic considerations with environmental protections in making decisions that concern how the coastal resources of the state are managed. It plays a leadership role in coordinating, developing, and implementing resource plans and policies. The CRMC is comprised of 16 Governor-appointed members serving three-year terms. Members include diverse stakeholders: representatives from coastal communities, state and local governments, and the general public, as well as the Director of the Department of Environmental Management.

Development of the Ocean SAMP took two years and involved a significant amount of research, as well as more than 100 public meetings. The CRMC collaborated with the University of Rhode Island and other academic institutions; state agencies within Rhode Island and from neighboring states; federal agencies; and impacted stakeholders, including commercial fishermen, tribal communities, representatives from the tourism and recreation sectors; and many others.

The Rhode Island Coastal Resources Management Council (CRMC) was charged with an ambitious task: developing a plan (what would become the Ocean SAMP) for how the state's offshore waters should be developed with offshore wind.

The CRMC released the Ocean SAMP in 2010. The National Ocean and Atmospheric Association approved the SAMP in 2011. It is now a model regulatory tool for coastal management that incorporates the best available science and marine spatial planning tools. As a living document—a unique feature of the Ocean SAMP—it is regularly updated through the work of stakeholder advisory panels and through stakeholder participation in plan implementation.

Through an open and collaborative two-year process, the Ocean SAMP was able to:

- Increase ecological protection in 54 percent of the area studied.
- Identify a 13-square mile "renewable energy zone" where offshore wind development was optimal, with the least conflict between potential development and existing uses such as fishing and recreation, and environmental concerns.
- Streamline the regulatory process for offshore wind development while minimizing both the ecological impacts and the impacts on commercial and recreational fishing.

Furthermore, federal agencies including the Bureau of Ocean Energy Management (BOEM) are required to use the Ocean SAMP in all planning decisions related to offshore wind development off the coast of Rhode Island. This gives Rhode Islanders more input on these federal decisions than they would otherwise have. BOEM has recognized Rhode Island's Ocean SAMP as a model that other states could emulate in the responsible development of offshore wind resources.

It is no accident that Rhode Island became the first state with a commercial offshore wind farm.

The Block Island Offshore Wind Farm began generating power in December 2016, but the groundwork was laid many years earlier. The wind farm consists of five turbines totaling 30 MW and is four miles off the coast of Block Island. The achievement of being first-in-the-nation, and of jump-starting a brand-new industry and economic development force, owes recognition to many people and organizations. For states that wish to emulate this success, Rhode Island's CRMC and its Ocean SAMP offer an excellent model. —*Samantha Donalds*

CASE STUDY 20

Vermont Implements Strategy to Support Advanced Wood Heating

Forests are vital to the health and economic prosperity of Vermont's rural communities. The Green Mountain State is 80 percent forested and its forest products industry brings an annual revenue of $1.4 billion. However, like other states in the northern reaches of the Northeast, Vermont experienced the collapse of its low-grade wood market as Maine's pulp mills began closing their doors. Prior to the collapse of this low-grade wood market, nearly one million tons of pulpwood was leaving Vermont for Maine.

Wood chips make their way on a series of conveyer belts to Montpelier's biomass district heating system. The system provides heat to 21 buildings including the Capitol Complex, city buildings, school buildings, and private customers. The 10 MMBtu/hr project was funded with support from the Vermont Clean Energy Development Fund.

To manage Vermont's forests and help the local economy, several Vermont agencies have worked together to support Vermont's advanced wood heating industry. Unlike burning wood for electricity, which only has a 23 percent efficiency, advanced wood heating can achieve efficiency ratings over 80 percent. New equipment designs and the use of wood pellets can significantly reduce air emissions compared to older wood heating boilers, furnaces, and stoves. Advanced wood heating has the potential to displace a significant amount of fossil fuels, while keeping heating dollars in state. Thus, the Vermont Clean Energy Development Fund (CEDF), the Department of Environmental Conservation, the Department of Forests, Parks, and Recreation (FPR), and the Agency of Commerce and Community Development (ACCD) are working together to promote it.

The state's 2016 Comprehensive Energy Plan (CEP) and Tier III of the 2015 Renewable Energy Standard (RES) laid out targets for advanced wood heating to both contribute to the renewable heating of buildings and revitalize low-grade timber markets. The CEP established renewable energy goals and greenhouse gas emissions reduction goals for the state, identifying advanced wood heating technologies as a primary means for meeting these goals, coupled with growing a local wood pellet market. It envisions having as much as one third of Vermont's buildings heated with renewable

energy, including woody biomass sustainably sourced from Vermont forests.[1] The Plan emphasizes sustainable harvesting to ensure the health and viability of Vermont's forests.

The RES, which took effect on January 1, 2017, allows Vermont's electric distribution utilities to meet their portfolio requirements by investing in projects that reduce fossil fuel consumption by their customers. Advanced wood heating projects qualify, though the wood must comply with renewability standards. These standards, which have yet to be finalized, must be approved and adopted by the Commissioner of FPR, which currently has voluntary harvesting guidelines to improve forest sustainability.[2]

Several Vermont agencies have worked together to support Vermont's advanced wood heating industry. Unlike burning wood for electricity, which only has a 23 percent efficiency, advanced wood heating can achieve efficiency ratings over 80 percent.

FPR has a long history of promoting wood heat. Since the 1990s, the Department has positioned a staff member at the Department of Public Service (DPS), the state's energy office, to help promote and manage a woods-for-schools initiative, which installed automated woodchip and pellet boilers in Vermont schools. In 2016, FPR, along with CEDF, ACCD, and DPS, co-funded a new State Wood Energy Coordinator position to help implement the CEP and meet the Plan's goal of doubling the amount of wood heat used in buildings by 2035. The coordinator works from the FPR office and is tasked with providing information and outreach to potential advanced wood heat consumers.

The State Wood Energy Team is a public-private partnership that provides technical support and outreach to Vermont schools and affordable housing providers on advanced wood heating systems. The Wood Energy Coordinator now manages this team, which, in 2017, released a five-year advanced wood heat plan. The plan aims to achieve 35 percent of Vermont's heating needs by 2030, displace 40 million gallons of fossil fuels, and bring the state $120 million in fuel savings annually. The plan encapsulates the multi-disciplinary nature of advanced wood heating in that it promotes opportunities for economic development, renewable energy development, energy savings, cost reductions, and healthy, working forests.

As a result of the five-year plan's recommendations, Governor Phil Scott supported and signed legislation eliminating the sales tax on advanced wood heating systems. FPR tracks the data from equipment sales to assess the advanced wood heating sector's impact on forests. In addition to this sales tax exemption, the plan promoted continued funding for the Clean Energy Development Fund. CEDF offers a $3,000 incentive on new, qualified advanced wood heating systems.[3] Lastly, the plan highlighted the opportunity for workforce training to increase the number of qualified installers. ACCD now offers grants for tradesmen to participate in advance wood heat vendor trainings.

Vermont's strategic focus on advanced wood heating across state government is building support for wood heat throughout disparate governmental departments. Together, these agencies and departments are presenting a unified vision for the sustainable development of a long-term market that will support clean energy, forest health, economic development, and improved air quality. Vermont's coordinated approach can be a good model for other states. — *Val Stori*

1 Vermont's Comprehensive Energy Plan, *https://outside.vermont.gov/sov/webservices/Shared%20Documents/2016CEP_Final.pdf* (page 50).

2 FPR adopted the voluntary guidelines on Jan. 15, 2015 pursuant to Act 24 of 10 V.S.A. § 2750 (2013), *https://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Voluntary_Harvesting_Guidelines/VHG_FINAL.pdf* (Accessed 31 Jan. 2019).

3 In addition to the CEDF incentive, Efficiency Vermont offers a $3,000 incentive for new, qualified advanced wood boilers, *https://www.efficiencyvermont.com/rebates/list/central-wood-pellet-furnaces-boilers-residential.*

CASE STUDY 21

Washington State Grants Advance Grid Modernization

Established under the state's Clean Energy Fund, the Washington Grid Modernization program is now in its third year of grantmaking. The program, administered by the Washington State Department of Commerce, is intended to position Washington as a global leader in clean energy technology and market transformation. It is based on the idea that clean energy market transformation requires strategic intervention in business, government, programs and communities to create lasting change in market behavior.

The program provides grants to public and private electric utilities for projects that advance a range of grid modernization approaches, including clean energy technologies and transmission and distribution control systems; integration of renewable energy sources, deployment of distributed energy resources, and sustainable microgrids; and increased utility customer choice in energy sources, efficiency, equipment and utility services. Project data and business case analyses from these projects are meant to transform how utilities and communities view energy systems and resiliency.

An aerial view of the Orcas Power and Light 504 kW Microgrid and Community Solar Array on Decatur Island. With assistance from a Clean Energy Fund grant, Orcas Power and Light Cooperative will procure an additional 500 kW/2.0 MWh energy storage system and controls to support multiple use cases and allow the system to operate as an islandable microgrid capable of sustained operation during system outages.

Since its inception, the fund has supported numerous groundbreaking projects, many of which include energy storage, resiliency and islandable microgrid systems that can disconnect from the grid when there is a power outage. Project proposals are vetted and scored by an advisory panel that has included members of the Clean Energy States Alliance and Sandia National Laboratories. Grants may fund no more than 50 percent of the costs associated with obtaining eligible assets.

In its first round of grantmaking (CEF1), the Grid Modernization program awarded $14.3 million in three grants to three electric utilities, for four projects focused on a diverse set of energy storage systems. The projects selected demonstrated both lithium-ion and vanadium redox flow battery systems in a wide range of use cases. All these systems have been installed, commissioned and tested, and are undergoing evaluation by the Pacific Northwest National Lab.

"Washington's leading utilities, along with their technology partners and customers, are transforming the nation's electric grid.... [O]ur state Clean Energy Fund helps them move the industry closer to a low-carbon future," said Governor Jay Inslee.

In round two (CEF2), the program awarded $12.5 million in grants to five projects. Most of these included a focus on microgrids combining solar with storage and load controls to provide resiliency benefits. The projects explored many of the use cases for battery energy storage that were demonstrated in CEF1. These projects are expected to be deployed in 2019 and 2020.

Round three grantmaking (CEF3) is now underway. The program is negotiating the Scopes of Work to award up to $10.6 million in grants to four public and private utilities. The amount of the individual grants will be between $1.0 million and $3.0 million.

The Department of Commerce believes these projects have helped the state's utilities respond to aging infrastructure, changing customer needs, a growing population, and an increasing number of renewable energy assets coming online. The state's commitment to an ongoing grant program has helped it become a test bed for advanced clean energy technology and policy.

"Washington's leading utilities, along with their technology partners and customers, are transforming the nation's electric grid…. [O]ur state Clean Energy Fund helps them move the industry closer to a low-carbon future," said Governor Jay Inslee.[1]

Director of the Department of Commerce Lisa Brown observes, "Clean Energy Fund investments create business opportunities and jobs, strengthening communities all across the state. These grants are instrumental in advancing technology and systems that will ultimately make our grid more efficient, flexible and economical to operate, more reliable and resilient in emergencies."[2]

— Todd Olinsky-Paul

1 "Commerce announces $10.6 million in state Clean Energy Fund grants for grid modernization," Washington Department of Commerce, April 16, 2019, *https://www.commerce.wa.gov/news-releases/community-grants/commerce-announces-10-6-million-in-state-clean-energy-fund-grants-for-grid-modernization.*

2 Ibid.

ENDNOTES

Introduction

1 Warren Leon et al, *Clean Energy Champions: The Importance of State Programs and Policies,* (Clean Energy States Alliance, June 2015), available at *https://www.cesa.org/assets/2015-Files/Clean-Energy-Champions-LR.pdf.*

Chapter 1

2 Galen Barbose, *U.S. Renewables Portfolio Standards: 2019 Annual Status Report* (Lawrence Berkeley National Laboratory, July 2019), slides 15-18, *http://eta-publications.lbl.gov/sites/default/files/rps_annual_status_update-2019_edition.pdf.*

3 Quoted in Riley Snyder and Michelle Rindels, "Sisolak Signs 'Milestone' Bill Increasing Renewable Portfolio Standard to 50 Percent by 2030," *Nevada Independent*, April 22, 2019, *https://thenevadaindependent.com/article/sisolak-signs-milestone-bill-increasing-renewable-portfolio-standard-to-50-percent-by-2030.*

4 For information about the Massachusetts Clean Peak Standard, see the Massachusetts Department of Energy Resources' Clean Peak Standard webpage, *https://www.mass.gov/service-details/clean-peak-energy-standard.*

5 Assembly Appropriations Committee, "Statement to Assembly, No. 3723, State of New Jersey," April 5, 2018, *https://www.njleg.state.nj.us/2018/Bills/A4000/3723_S1.HTM.*

6 Jonathan Sundby et al., *Renewables on the Rise 2019: A Decade of Progress Toward a Clean Energy Future* (Environment America, August 2019), pp. 8, 12, *https://environmentamerica.org/sites/environment/files/reports/Renewables-On-The-Rise/FRG-AME_Renewables-On-The-Rise_2019_v1a.pdf.*

7 Barbose, *U.S. Renewables Portfolio Standards*, slide 20. That slide includes a map showing which non-RPS states have had renewable energy capacity additions linked to RPSs in other states.

Chapter 2

8 US Department of Energy and US Department of Interior, *National Offshore Wind Strategy: Facilitating of the Offshore Wind Industry in the United States* (US Department of Energy and US Department of Interior, 2016), pp. 7, 9, *https://www.energy.gov/sites/prod/files/2016/09/f33/National-Offshore-Wind-Strategy-report-09082016.pdf.*

9 The North Carolina Clean Energy Technology Center publishes a quarterly report, *50 States of Electric Vehicles*, that tracks state activities, including state studies, financial incentives, regulations, utility rate design, and deployment. See *https://nccleantech.ncsu.edu/2019/05/08/the-50-states-of-electric-vehicles-q1-2019-update-report-nearly-every-state-addressed-electric-vehicles-during-q1-2019.*

10 California Energy Commission, "California Energy Commission Works to Replace State's Oldest, Most Polluting School Buses," California Energy Commission Official Blog, July 24, 2018, *https://calenergycommission.blogspot.com/2018/07/california-energy-commission-works-to.html.*

11 Jacqueline Toth, "For Widespread Adoption of Electric Vehicles, Many Roadblocks Ahead," Morning Consult, May 22, 2019, *https://morningconsult.com/2019/05/22/for-widespread-adoption-of-electric-vehicles-many-roadblocks-ahead.*

12 Matt Casale and Brendan Mahoney, *Volkswagen Settlement State Scorecard* (US PIRG and Environment America, May 2019), p. 9-10, *https://uspirg.org/sites/pirg/files/reports/USP%20VW%20Scorecard%20May19.pdf.*

13 Ibid., p. 2.

14 Wood Mackenzie Power & Renewables and Energy Storage Association *U.S. Energy Storage Monitor: Q2 2019 Executive Summary* (Wood Mackenzie Power & Renewables and Energy Storage Association, June 2019), p. 4, *https://www.woodmac.com/research/products/power-and-renewables/us-energy-storage-monitor.*

15 Autumn Proudlove et al., *50 States of Grid Modernization: Q2 2019 Quarterly Report, Executive Summary* (NC Clean Energy Technology Center, June 2019), p. 6, *https://static1.squarespace.com/static/5ac5143f9d5abb8923a86849/t/5d40d21dec492200019b4a24/1564529189675/Q22019_gridmod_exec_final.pdf.*

16 For an explanation of the Massachusetts policy and why it is an important development for the future of energy storage, see Todd Olinsky-Paul, *Energy Storage: The New Efficiency—How States Can Use Efficiency Funds to Support Battery Storage and Flatten Costly Demand Peaks* (Clean Energy Group, April 2019), *https://www.cleanegroup.org/ceg-resources/resource/energy-storage-the-new-efficiency*.

17 See California Energy Commission's project database at *http://innovation.energy.ca.gov/SearchResults.aspx?cat=Topics&subj=Smart%20Grid&subSubj=Microgrids*.

18 To learn about the projects funded by the California Energy Commission, see its webpage on "Highlighting Energy Innovation by the Numbers," *http://innovation.energy.ca.gov/SearchHome.aspx?ti=636954999843975851*.

19 Massachusetts Clean Energy Center, InnovateMass web page, accessed June 7, 2019, *https://www.masscec.com/innovatemass*.

20 NYSERDA, Clean Energy Incubators webpage, accessed June 7, 2019, *https://www.nyserda.ny.gov/Partners-and-Investors/Clean-Energy-Startups/NYSERDA-Supports-Growth-Essentials/Clean-Energy-Incubators*.

Chapter 3

21 GridWise Alliance and E9 Insight, *Grid Modernization 2018* (GridWise Alliance, December 2018), p. 8, *https://gridwise.org/grid-modernization-index*.

22 Ibid., pp. 8-9.

23 Ibid., pp. 9, 21, 10, 11, 16.

24 Hawaii Public Utilities Commission, Order 34281 Dismissing without Prejudice and Providing Guidance for Developing a Grid Modernization Strategy—Docket No. 2016-0087 (Jan. 4, 2017), *https://www.hawaiianelectric.com/documents/about_us/investing_in_the_future/dkt_2016_0087_20170104_order_34281.pdf*.

25 Jan Rosenow and David Farnsworth, *Decarbonising Heat in Buildings—A Comparison of Policies in Germany and New England* (Regulatory Assistance Project, May 2019), p. 13, *https://www.raponline.org/wp-content/uploads/2019/05/rap-rosenow-farnsworth-ee-heat-buildings-2019-may-8.pdf*.

26 Weston Berg, "Building Energy Efficiency Policies," in Weston Berg et al., *The 2018 State Energy Efficiency Scorecard* (American Council for an Energy-Efficiency Economy, October 2018), pp. 70-89, *https://aceee.org/sites/default/files/publications/researchreports/u1808.pdf*.

27 Ibid., p. 71.

28 Ibid., p. 87.

29 NEEP, *Building Energy Codes for a Carbon Constrained Era: A Toolkit of Strategies and Example* (Northeast Energy Efficiency Partnerships, December 2017), pp. 26, 28, *https://neep.org/sites/default/files/resources/Building%20Energy%20Codes%20for%20a%20Carbon%20Constrained%20Era%20-%20A%20Toolkit%20of%20Strategies%20and%20Examples.pdf*.

30 Energy Trust of Oregon, "Oregon's Home Energy Scoring Program," web page, accessed June 4, 2019, *https://blog.energytrust.org/oregons-home-energy-scoring-program*.

31 NYSERDA, *Renewable Heating and Cooling Policy Framework: Options to Advance Industry Growth and Markets in New York* (NYSERDA, February 2017), *https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/NYSERDA/RHC-Framework.pdf*.

Chapter 4

32 CESA provides descriptions of 40 programs and policies in, *A Directory of State Clean Energy Programs and Policies for Low- and Moderate-Income Residents* (CESA, rev. ed., Dec. 2018), *https://www.cesa.org/projects/low-income-clean-energy/resources/resource/directory-of-state-clean-energy-programs-and-policies-for-low-and-moderate-income-residents*.

33 California Public Utilities Commission, *Energy and Social Justice Action Plan* (California Public Utilities Commission, February 2019), *https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/Infrastructure/DC/Env%20and%20Social%20Justice%20ActionPlan_%202019-02-21.docx.pdf*.

34 For an overview of resiliency efforts for LMI communities and information about projects across the country, see the webpage of Clean Energy Group's Resilient Power Project, *https://www.cleanegroup.org/ceg-projects/resilient-power-project*.

35 Maryland Energy Administration, Resiliency Hub web page, accessed June 11, 2019, *https://energy.maryland.gov/Pages/Resiliency-Hub.aspx*.

36 Clean Energy Group, Maycroft Apartments web page, accessed August 21, 2019, *https://www.cleanegroup.org/ceg-projects/resilient-power-project/featured-installations/maycroft-apartments*.

37 Massachusetts Department of Energy Resources Community Clean Energy Resiliency Initiative web page, accessed August 12, 2019, *https://www.mass.gov/service-details/community-clean-energy-resiliency-initiative-cceri-round-3-grant-awards*.

38 Maryland Energy Administration, Community Solar web page, accessed August 1, 2019, *https://energy.maryland.gov/residential/Pages/Community-Solar.aspx*.

39 For the DC guide, see *http://www.opc-dc.gov/images/pdf/brochure/cesa-rptDCguide2.pdf*. For the Maryland guide, see *https://energy.maryland.gov/Reports/A%20Maryland%20Consumers%20Guide%20to%20Solar.pdf*. For the Massachusetts guide, see *http://files.masscec.com/solar-loan/SolarElectricityResidentialGuide.pdf*. For the Mississippi guide, see *http://www.ago.state.ms.us/wp-content/uploads/2017/04/SolarPower_MSConsumerGuide-digital-version.pdf*. For the Rhode Island guide, see *http://www.energy.ri.gov/documents/solar/Guide-to-Going-Solar.pdf*. For the South Carolina guide, see *http://energy.sc.gov/files/SolarGuideHomeowners.pdf*. For the Vermont guide, see *https://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/Vt%20Guide%20to%20Residential%20Solar%202016.pdf*.

40 For the Massachusetts guide, see *https://www.mass.gov/files/documents/2016/12/pm/ma-homeowners-guide-to-solar-financing-final.pdf*. For the New Mexico guide, see *http://www.emnrd.state.nm.us/ECMD/RenewableEnergy/documents/NMGuidetoSolarFinancing.pdf*. For the New York guide, see *https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwiC09WkmfHiAhUCT98KHZyMCsYQFjAAegQIABAC&url=https%3A%2F%2Fwww.nyserda.ny.gov%2F-%2Fmedia%2FNYSun%2Ffiles%2FHomeowners-Guide-Solar-Lease-Loan-Power-Purchase-Agreements.pdf&usg=AOvVaw01hFg1WeDFPZHE5V-BDLef*.

41 For the Connecticut Green Bank's GosolarCT website, see *http://www.gosolarct.com*.

42 The Minnesota advice is at *https://mn.gov/commerce/consumers/your-home/energy-info/solar/tips-about-community-solar.jsp and https://www.cleanenergyresourceteams.org/solargardens*.

43 For a survey of the various states' solar contract disclosure requirements, see Nate Hausman et al., *State Solar Contract Disclosure Requirements* (CESA, August 2018), *https://www.cesa.org/assets/2018-Files/State-Solar-Contract-Disclosure-Requirements.pdf*.

44 HF. 729, 88th Session. Chapter 216B Minnesota Statistics §2168B.1641 e(5) (2013).

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