RESILIENT POWER

What States Should Do:

A Guide to Resilient Power Programs and Policy

CleanEnergyGroup
Innovation in Finance, Technology & Policy

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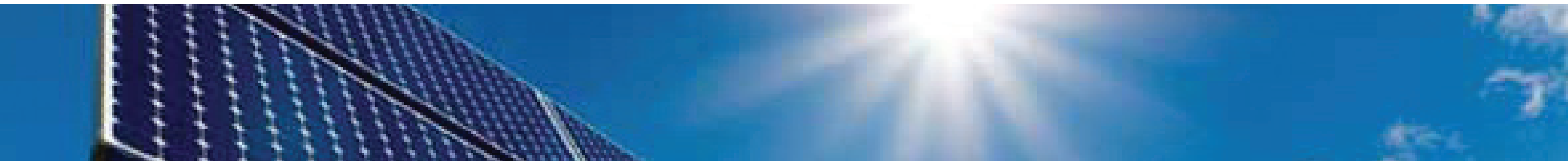

ABSTRACT

States are making important progress in deploying clean, resilient power technologies that can keep the power on at critical facilities during grid outages caused by extreme weather events. In a first-of-its-kind report, *What States Should Do: A Guide to Resilient Power Planning*, Clean Energy Group profiles the leading state programs and makes recommendations for what other states can do to support the deployment of clean, resilient power systems. New resilient power technologies such as solar PV combined with energy storage can provide electricity during outages as well as valuable grid services year-round. This guidebook is intended to help states establish new policies and support new markets to advance clean resilient power nationwide.

ACKNOWLEDGEMENTS

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A Project of Clean Energy Group

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Key Take-Aways from this Report

In addition to specific recommendations for state decision-makers, this report reveals a burgeoning movement at the state level to promote and support resilient power deployment. The resilient power planning, programs, and investment that started in the Northeast are quickly spreading to other regions, and competitive solicitations are beginning to give way to financing and incentives, as states adjust their programs to take advantage of emerging markets for distributed energy and energy storage. These overarching take-aways tell the story of the resilient power movement to date:

- In the two-and-a-half years since Superstorm Sandy, some $400 million in new state-managed funds have been dedicated to resilient power efforts in the Northeast alone, leveraging hundreds of millions more in private funds.
- More than 90 critical facilities in the Northeast – including emergency shelters, wastewater treatment plants, firehouses and other first responder facilities – will have resilient electrical systems in place to improve emergency response in the next year, and to protect neighborhoods in the next power outage.
- States first addressed resilient power through heavily subsidized demonstration projects, but have quickly evolved toward more permanent, cost-effective and market-oriented solutions that provide financing and leverage emerging energy services markets.
- Resilient power has proved that it not only provides clean backup power during grid outages, it can also reduce costs and provide additional income streams to the host facility or owner year-round.
- Natural disasters are not confined to the Northeast, and resilient power is a concept that is quickly taking hold throughout the country.

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EXECUTIVE SUMMARY

This report is the first comprehensive survey of state resilient power programs, policies and funding efforts put in place since Superstorm Sandy devastated the Northeast United States in October 2012, disrupting electric service to more than eight million people in 17 states. In a rare example of a positive outcome from a natural disaster, a number of these states have embarked on new and ambitious resilient power programs, aimed at protecting critical facilities and vulnerable populations from the worst impacts of future disasters. In the first two years following the storm, more than $400 million in new state funds have been dedicated to resilient power efforts in the northeast alone, and this money has leveraged many more millions in private funds.

We believe this trend represents a promising new path for clean energy programs across the country. The state efforts showcased in this report demonstrate that, when installed in combination and designed properly, renewables and energy storage offer not only environmental and economic benefits, but can also save lives and protect vulnerable populations.

This report describes the actions of leading states in the new arena of resilient power, here defined as clean, distributed energy and storage resources sited at critical facilities, configured to provide power continuously, and able to island and continue to provide electricity in case of a grid outage. The report summarizes what early adopter states have done to support the deployment of clean resilient power technologies, and their results so far. It presents policy and program tools that these states have used, and it suggests others that could be employed by states. And it makes recommendations based on lessons learned over the first year of resilient power programs in several key states.

Although backup power for grid outages has traditionally been provided by diesel generators, resilient power differs from diesel generators in several important respects.

First, it is cleaner, employing renewables, energy storage, and high-efficiency, low-emissions technologies such as combined heat and power (CHP) and fuel cells. Second, it runs year-round, providing daily benefits to the host facility, whereas diesel generators sit idle 99 percent of the time. Third, because it is designed for daily use, resilient power is more reliable than diesel backup generators, which have a high incidence of failure, in part because they are seldom used. Fourth, resilient power does not rely on deliveries of liquid fuel, which may be difficult or impossible during a disaster. And fifth, in some places, resilient power technologies can produce income for their owner/operators by allowing them to bid into electric services markets such as the frequency regulation and demand response markets, as well as reducing electricity costs through peak shifting and reduction of electricity demand charges for the host facility.

Superstorm Sandy was not the first storm to wreak such havoc on the grid, but it was the first to move the affected states to enact new policies and initiatives to promote resilient power programs employing clean energy technologies. Northeastern governors declared such storms the "new normal" and called for immediate action to prepare their states before the next disaster. Legislatures passed bills and allocated funds. And, led by Connecticut, New Jersey, Massachusetts, and New York, the Resilient Power movement was born.

Throughout the aftermath of Sandy and the emergence of the resilient power movement in the Northeast, Clean Energy Group has offered support to states, municipalities, developers and others engaged in this important work, in the form of direct policy and program support, stakeholder outreach and knowledge sharing, and a technical assistance fund to help support project deployment in low-income neighborhoods. This report is part of our ongoing effort to promote and support clean, resilient power deployment, in the Northeast and across the country.

Key Findings

This report examines resilient power programs in the above-mentioned Northeastern states, as well as related actions in other states, such as Florida and California. Because many of these programs are new or still developing, final conclusions cannot yet be drawn; but the report does make recommendations based on lessons-learned during the first year of monitoring state resilient power activities.

Based on early results and the experiences of state energy officials and staff, this report recommends that future state resilient power efforts incorporate these elements:

- Engage in a thorough pre-program stakeholder process that includes municipalities, utilities and other stakeholders; involve vendors, developers and service providers when developing resilient power programs
- Assess specific resilient power needs and target funding to meet those needs
- Consider the needs of low-income and vulnerable communities
- Create a flexible program that allows communities to design systems to meet local needs
- Market the program to municipalities
- Provide pre-application technical assistance to municipalities and other applicants
- Provide financing assistance and information to applicants, including:
    - Information on municipal financing options, such as municipal bonds
    - Minimally restricted program funds that can be used for a wide variety of purposes, including paying for equipment, engineering and design, construction, etc.
    - A variety of funding and finance tools including loans, grants, and credit enhancement
- Allow resilient power projects to access available value streams, for example by engaging in sales of electricity market services or electricity arbitrage, so long as the system can provide the required resiliency benefit when called upon to do so
- Conduct rigorous evaluations of proposed financing for projects
- Require performance monitoring and evaluation

This report also discusses policy tools and incentives, which may be used by states in supporting resilient power deployment, and gives examples of their use. These tools include:

- Solicitations/RFPs
- Renewable Portfolio Standards and Stand-Alone Mandates
- Adders, multipliers and carve-outs
- Prescriptive rebates
- Integrating resilient power into longer-term state policy

In addition to the traditional policy tools listed above, the report also discusses emerging role of green banks and energy resilience banks, and it addresses the important role of third-party service providers, an emerging industry offering energy storage benefits and relying on new electricity services markets supported by Federal Energy Regulatory Commission (FERC) rulings. These providers and the electricity markets that support them are rapidly becoming vital to resilient power programs in some states, as evidenced by New Jersey's $3 million Renewable Electric Storage Incentive program, which has made awards to 13 solar+storage projects at critical infrastructure facilities. All 13 projects base their *pro formas* on sales of frequency regulation services into the PJM Interconnection, a regional transmission organization serving all or parts of Delaware, the District of Columbia, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

As similar electric service markets develop in other regions of the country, more states should be able to incentivize private solar+storage firms to co-locate at critical facilities, where they can provide resilient power benefits while selling needed services to the grid on a daily basis. Clean Energy Group believes the development of these markets will be essential to the cost-effective deployment of resilient power technologies going forward.

At this writing, most active state resilient power programs are concentrated in the Northeast. Massachusetts has implemented a $40 million program, New Jersey has implemented a $3 million resilient energy storage program and a $200 million Energy Resilience Bank—the first such institution in the nation—Connecticut has implemented a $48 million microgrid program, New York has a $40 million microgrid program underway, Rhode Island has drafted a solicitation for a resilient power study, and Maryland has established a task force and produced a report, and is planning a solicitation. Vermont has supported a $12.5 million resilient power, solar+storage microgrid project with additional U.S. Department of Energy (DOE) funding. These programs have largely been funded by system benefit charges, alternative compliance payments from utilities, and supportive federal solicitations and disaster relief funds.

In addition, a few states have begun working with utilities and regulators to modernize electric grids and markets, replace retiring generation plants, improve resilience and reliability, and increase clean and distributed energy resources. An example is New York, with its Reforming the Energy Vision (REV) process. As a small part of this overarching grid modernization plan, ConEdison has allocated $66 million to CHP deployment in its service territory, expanding NYSERDA's existing CHP program, which has already supported the deployment of more than 140 CHP systems, all capable of islanding in case of a grid outage.

Because of these state programs, 40 municipalities in the Northeast now have resilient power projects underway, which will support more than 90 critical facilities, at a likely capital cost of several hundred million dollars. In other words, larger resiliency goals have now been translated into real, on-the-ground community projects protecting communities and their vulnerable populations.

We are at the start of a revolution—creating a new field of clean energy: resilient power. States and communities are coming around to the notion that we can provide reliable, resilient power to critical facilities and communities by using clean, distributed generation, such as solar and energy storage. This is both climate change mitigation (as it reduces carbon fuel use) and climate adaptation (as it protects people from climate impacts).

The technology has arrived, and it is increasingly affordable. What is needed are supportive policies, innovative financing, and information-sharing efforts about the benefits—which could be demonstrated by multiple resilient power projects in all regions of the country, to get these systems deployed widely.

INTRODUCTION

Across the nation, the frequency of power outages is on the rise, and they are increasingly costly. Over the past two decades, each five-year period has seen more numerous and more severe power outages than the preceding five-year period. According to the U.S. Energy Information Administration, the number of U.S. power outages affecting 50,000 or more consumers increased from 149 during 2000-2004 to 349 during 2005-2009.[1]

Today, U.S. electric grids suffer blackouts 285 percent more often than in 1984, when the government began collecting data on such events.[2] The cost to U.S. businesses is as much as $100 billion per year, and that doesn't count the cost of human suffering.[3]

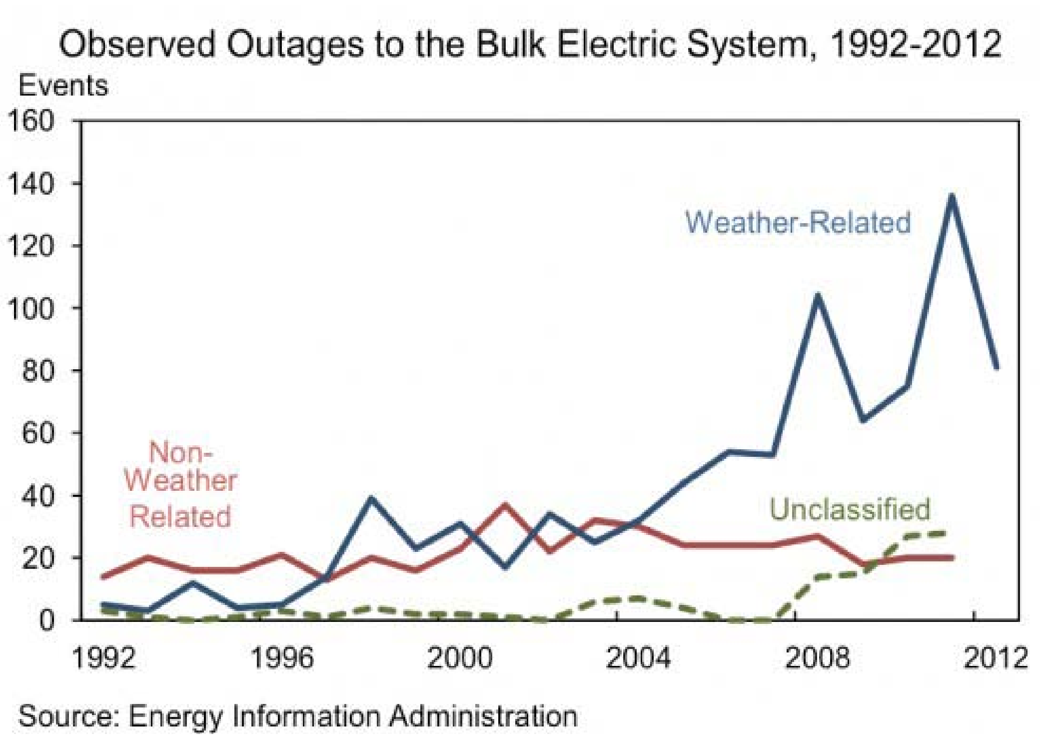
As shown in Figure 1, the vast majority of grid outages are weather related. Hurricanes, derechos, ice storms, floods, droughts, wildfires, and tornadoes can contribute to challenges to the electric grid. Not surprisingly, the number and severity of extreme weather events has also increased in recent years (see Figure 2), and scientists predict that this trend will continue.[4]

Extreme weather events and the electric outages they cause illustrate one simple fact: our aging electric grids, relying on centralized generation and millions of miles of above-ground power lines, are simply too vulnerable. The hard fact is that when communities are devastated by natural disasters, the power systems that serve those communities are too prone to failure. In fact, the U.S. power grid experiences more blackouts than any other developed nation.[5]

Resilient Power Solutions: Distributed Generation with Battery Storage

When the electric grid goes down during a disaster, it is imperative that critical facilities—first responders, public shelters and the like—are able to self-supply electrical power, so they can continue to serve their communities. Traditionally, facilities that require backup power have relied on diesel generators. But diesel generators are notoriously unreliable, and their duration of service is limited by the amount of fuel that can be stored on-site or trucked in during a disaster.

Figure 1 Weather-related power outages, 1992-2012



Diesel Generators: Not the Solution

Diesel generators require fuel, which can be difficult to obtain during a disaster. Even when fuel is available, diesels often fail when they are most needed. For example, during Superstorm Sandy, some 300 patients had to be evacuated from New York University's Langone Medical Center when flood water shorted out fuel pumps located in the basement, rendering both of its rooftop generators useless. At Bellevue Hospital Center in Manhattan, National Guard troops carried diesel fuel up 13 flights of stairs for hours to power rooftop generators, which also eventually failed, prompting the evacuation of 725 patients. By some estimates, up to 60 percent of the diesel generators relied on by medical centers, first responders, and other critical facilities failed during Sandy, and similar stories have been repeated across the nation.

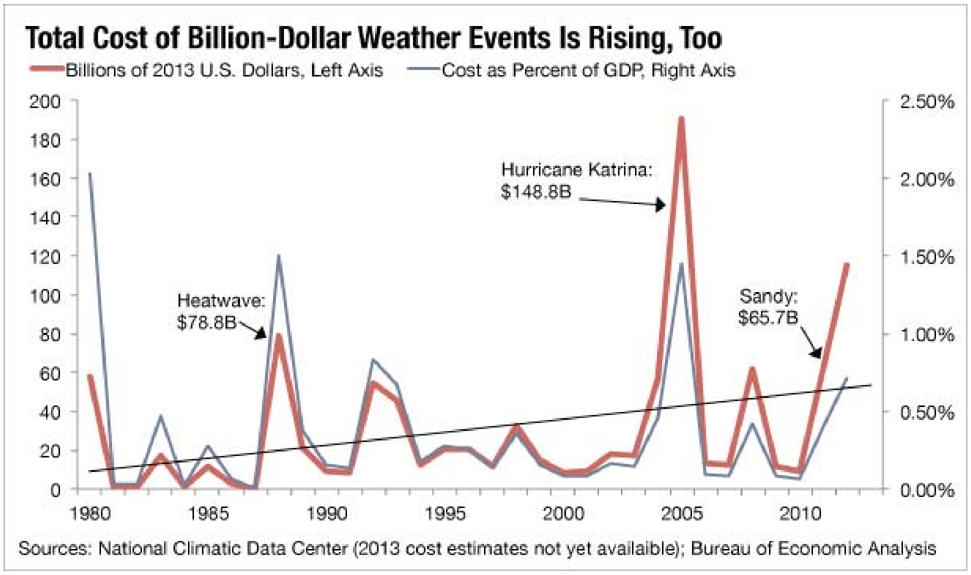
The alternative to diesel generator backup power is resilient power, defined as clean, on-site, distributed generation that runs 24 x 7, 365 days a year and can be islanded (isolated from the grid, see figure 3) to provide uninterrupted power to the host facility in the event of a grid outage.

Typically, resilient power systems are sited at critical facilities most needed for emergency response and relief efforts during a disaster, including hospitals, fire houses, communications facilities, fueling stations, public shelters, transportation facilities, and water and wastewater treatment plants. Resilient power may also be sited at multi-unit housing facilities, to allow elderly or disabled residents to shelter in place and avoid dangerous and difficult evacuations.

Regardless of the technology used, clean resilient power differs from diesel backup generators in several important respects. First, it is non-polluting or minimally polluting. Second, it provides electric power continuously, not just during emergencies. Third, because it is in constant use, resilient power is more reliable than diesel backup generators, which have a high incidence of failure in part because they are seldom used. Fourth, resilient power does not rely on deliveries of liquid fuel, which may be difficult or impossible during a disaster. And fifth, resilient power and storage technologies produce real value for customers by reducing electricity costs and demand charges, improving power quality, and providing the potential for revenues from the sale of grid services such as frequency regulation and demand response.

Technologies for clean resilient power include on-site renewables, such as solar photovoltaic (PV) systems paired with energy storage devices such as batteries; high-efficiency generators such as fuel cells and CHP systems; microgrids, which can incorporate various types of generators along with energy storage, to support multiple loads; and supporting technologies such as inverters, islanding switches, and black-start equipment. For more information on solar+storage, a new resilient power technology that is non-polluting, scales well, and is fast approaching grid parity in many parts of the country, see the Clean Energy Group report, Solar + Storage 101: An Introductory Guide to Resilient Solar Power Systems.[6]

Figure 2 Billions of dollars in damages from extreme weather events (1980-2012) (Source: NOAA)



To further the resilient power efforts of states and municipalities, Clean Energy Group launched its Resilient Power Project as a foundation-funded effort to support states, municipalities, and others in developing and deploying resilient power policy, programs, and systems. This guidebook is intended to help states establish new policies to advance clean resilient power markets. It will be updated as new policy strategies emerge, as the technologies develop, and as markets grow and change.

For more information about resilient power and Clean Energy Group's work with states, see our report, Resilient Power: Evolution of a New Clean Energy Strategy to Meet Severe Weather Threats.[7]

Figure 3 Islanding from the Grid

LEADING BY EXAMPLE: STATE RESILIENT POWER PROGRAMS

Some states have initiated programs to help communities address their resilient power needs, while others have conducted studies or established task forces. Here we examine the actions taken by states that are leaders in resilient power deployment. More information about these and other state efforts may be found at Clean Energy Group's Resilient Power Project webpage (www.resilient-power.org) and in our collection of resilient power case studies, linked from that page.

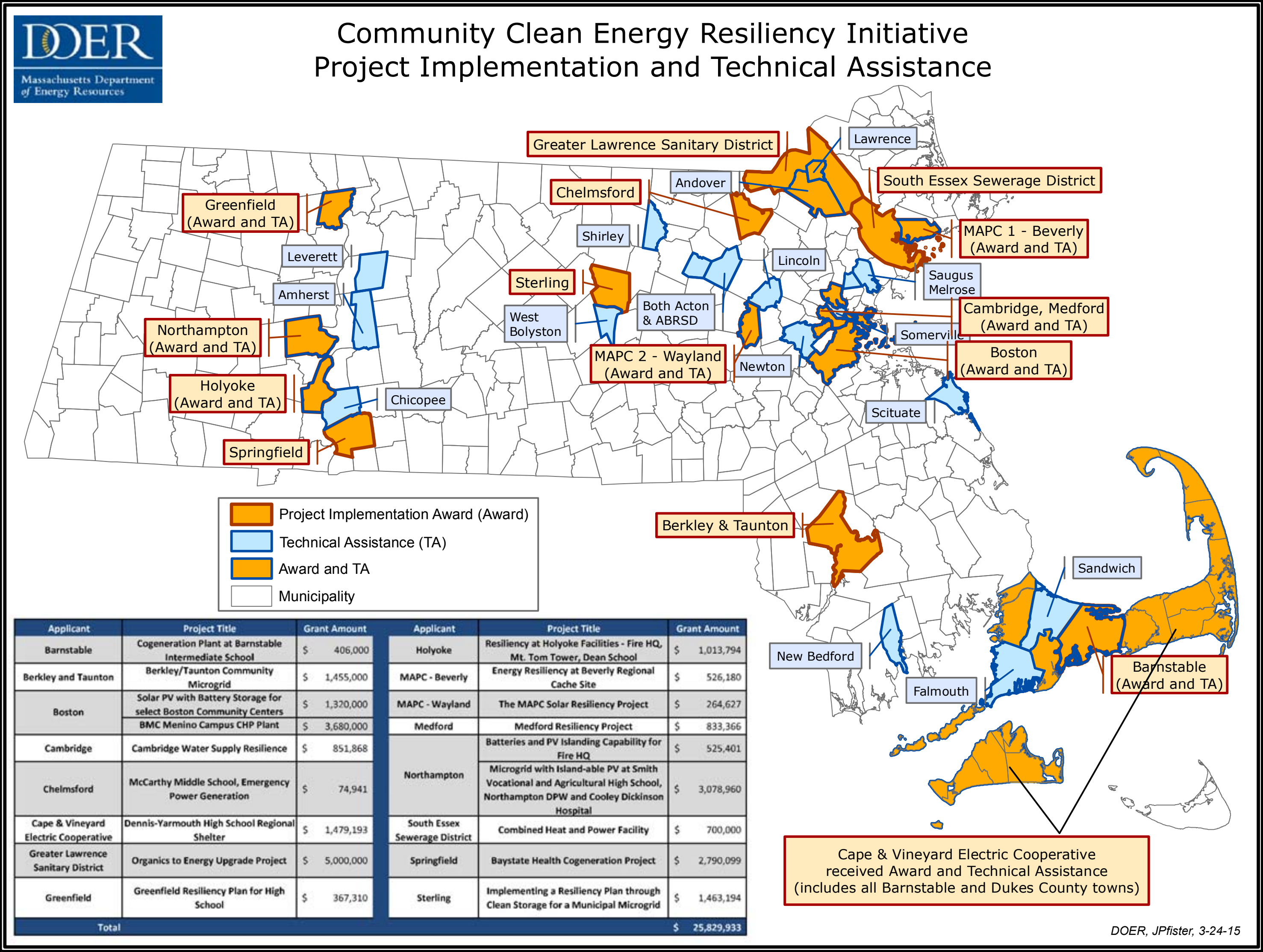
Massachusetts Community Clean Energy Resiliency Initiative

The Massachusetts Department of Energy Resources (DOER) has supported 18 municipal resilient power projects, and awarded 27 technical assistance grants, over two rounds of funding through its $40 million Community Clean Energy Resiliency Initiative[8] (Figure 3). The Massachusetts program incorporated a number of significant innovations that resulted in a wide range of high-quality projects receiving awards.

Program eligibility requirements included:

- Awards were available to municipalities and other public entities such as school, water and sewage districts, and regional planning agencies. Public-private partnerships were eligible so long as the public entity was the lead applicant.
- Eligible facilities were defined as those where "loss of electrical service would result in disruption of a critical public safety life sustaining function" and included first responder, medical, wastewater treatment, communications, shelter, food supply, fuel supply, transportation, shelter and multi-family housing facilities. Privately owned facilities were required to enter into a memorandum of understanding (MOU) stating that they would provide critical public functions in case of an emergency.
- Projects were required to be able to operate in island mode continuously for at least 3 days, with longer duration projects receiving higher scores. Eligible technologies included renewable electric and thermal generation; high-efficiency CHP (65 percent efficient) and fuel cells (50 percent efficient); energy storage (electric or thermal); energy management systems (controls, switches, software); islanding technology; and microgrids. New or retrofit systems were eligible. Conventional technologies, such as diesel generators, were not eligible.
- Project deployment grants were capped at $5 million.
- Project deployment proposals were judged on the basis of geographic diversity, proposal content, finances, and technical details.

Figure 4 MA DOER Community Resiliency Initiative Awards and Technical Assistance - 2014



Applicant	Project Title	Grant Amount
Barnstable	Cogeneration Plant at Barnstable Intermediate School	$ 406,000
Berkley and Taunton	Berkley/Taunton Community Microgrid	$ 1,455,000
Boston	Solar PV with Battery Storage for select Boston Community Centers	$ 1,320,000
	BMC Menino Campus CHP Plant	$ 3,680,000
Cambridge	Cambridge Water Supply Resilience	$ 851,868
Chelmsford	McCarthy Middle School, Emergency Power Generation	$ 74,941
Cape & Vineyard Electric Cooperative	Dennis-Yarmouth High School Regional Shelter	$ 1,479,193
Greater Lawrence Sanitary District	Organics to Energy Upgrade Project	$ 5,000,000
Greenfield	Greenfield Resiliency Plan for High School	$ 367,310

Applicant	Project Title	Grant Amount
Holyoke	Resiliency at Holyoke Facilities - Fire HQ, Mt. Tom Tower, Dean School	$ 1,013,794
MAPC - Beverly	Energy Resiliency at Beverly Regional Cache Site	$ 526,180
MAPC - Wayland	The MAPC Solar Resiliency Project	$ 264,627
Medford	Medford Resiliency Project	$ 833,366
Northampton	Batteries and PV Islanding Capability for Fire HQ	$ 525,401
	Microgrid with Island-able PV at Smith Vocational and Agricultural High School, Northampton DPW and Cooley Dickinson Hospital	$ 3,078,960
South Essex Sewerage District	Combined Heat and Power Facility	$ 700,000
Springfield	Baystate Health Cogeneration Project	$ 2,790,099
Sterling	Implementing a Resiliency Plan through Clean Storage for a Municipal Microgrid	$ 1,463,194
Total		**$ 25,829,933**

The DOER program was groundbreaking in a number of ways, detailed below.

Technical Assistance (TA)

Notably, this was the first state program to offer a technical assistance fund to help municipalities define their needs and design project proposals. This addressed the problem of municipalities not having in-house expertise in advanced energy systems, and not being able to afford the up-front engineering expertise required to craft a project proposal. DOER hired consultants to form a technical assistance team and encouraged municipalities to apply for a technical assistance grant in Round 1 of the solicitation. Those who were awarded TA grants in Round 1 were eligible to apply for project implementation funds in Round 2. This helped both to encourage proposals from municipalities that might not otherwise have participated and to secure higher quality proposals. (See Figure 4.)

DOER made 27 technical assistance grants[9] at a total cost of $224,194. Each grantee received a technical analysis of the proposed project site, including conceptual design information, indicative economic information, and a detailed project plan. These technical assistance reports are available in full at the DOER program website.[10]

Bottom-up project design

The DOER program refrained from restricting proposals to a specific technology or project size and made both publicly and privately owned critical facilities eligible through the program (private facilities were required to enter into an MOU stating that they would provide critical public benefits in case of a disaster). By casting a wide net, DOER allowed municipalities in Massachusetts to propose the type and size system that fit their needs— from small, single-facility systems to microgrids— and to include the critical facilities that would best serve the community. This allowed each project to be tailored to the needs of the municipality that proposed it and to the facility or facilities it would support.

Support for low-income communities

DOER broke new ground in offering variable levels of support for community resilient power projects, based in part on the wealth of the host community. Project implementation grants were calculated using a formula that included the population and per capita income of the municipality, with the result that low-income communities received additional support. To help municipalities secure matching funds, DOER provided a list of financial resources, including state and federal incentive programs and other non-governmental programs. DOER attempted to make awards geographically diverse, funding projects in all regions of the state.

The DOER program posted impressive results in only one year, awarding $26 million over two rounds of funding to 18 municipal projects. Of these 18 projects, 16 included solar+storage technologies. Because many of the projects served two or more separate facilities, a total of 31 critical facilities will be provided with solar+storage systems in all, making this the first significant state effort to deploy solar+storage for critical facility power resilience.

DOER continues to support the deployment of resilient power systems from its 2014 solicitation with technical assistance. DOER has $12 million left over from its 2014 program for additional resilience work. In addition, DOER has committed $10 million in ACP funds to the deployment of energy storage systems in the state; and, in collaboration with Massachusetts Clean Energy Center, DOER has commissioned a two-part study to make recommendations for the future role of energy storage in the state.

For more information on the Massachusetts Community Clean Energy Resiliency Initiative, see http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/resiliency/resiliency-initiative.html.

New Jersey Energy Resilience Bank and Renewable Electric Storage Incentive

The New Jersey Board of Public Utilities (BPU) has formed the nation's first Energy Resilience Bank,[11] capitalized with $200 million in federal disaster relief funds, for the explicit purpose of supporting critical infrastructure resiliency projects with grants and loans. In partnership with the New Jersey Economic Development Authority (EDA). The BPU has also issued the $3 million New Jersey Renewable Electric Storage Incentive,[12] which prioritizes energy storage paired with renewable generation to support critical infrastructure.

Energy Resilience Bank

The NJ BPU, together with the NJ EDA, created the nation's first Energy Resilience Bank (ERB) in 2014, capitalized with $200 million in federal Community Development Block Grant-Disaster Recovery (CDBG-DR) funds. Based on the increasingly popular Green Bank model, this is the first state institution dedicated to ongoing support of clean resilient power projects using a combination of grants and loans. The NJ ERB is jointly administered by the BPU and the EDA.

Prior to creating the ERB, NJ BPU examined the benefits and challenges of resilient power technologies, engaging the support of U.S. Department of Energy (DOE), Sandia National Laboratories, the National Renewable Energy Laboratory, the Federal Emergency Management Agency, universities and other stakeholders.

The BPU concluded that for purposes of resilience, distributed energy resources (defined as renewables, CHP and fuel cells) are less reliant on liquid fuel deliveries, offer longer continuous run times, have less environmental impacts, and are generally more cost-effective over time than diesel generators.

However, they found that these resilient power technologies also require greater up-front investment, and for this reason, many facilities in the past have chosen to install diesel generators. Even retrofits of islanding and black-start equipment at existing distributed energy resources, which would allow them to operate independently of the grid, tend to be quite expensive. To address this problem, the ERB was created to assist eligible facilities in installing clean and renewable technologies by providing financial assistance to reduce first costs.

ERB support includes both grants (for costs incurred early in project development, including feasibility studies, if the first project milestone is met) and longer term, low-interest loans. A portion of these loans may be forgivable if funded projects meet annual operational performance requirements. Funding and financing will be made available through a series of solicitations, with each targeting a specific facility type.

The first round of ERB funding dedicated $65 million for resilient power projects at water and wastewater treatment plants. This focus is in part due to the extreme effect Superstorm Sandy had on these facilities in New Jersey: Sandy caused power losses and flooding in 94 wastewater treatment plants, destroying equipment and allowing between three and five billion gallons of untreated wastewater to flow into the state's waterways. In addition, 267 drinking water treatment facilities lost power, and 37 were forced to issue boil advisories. Future solicitations are planned for other types of critical facilities, including hospitals and long-term care facilities, colleges, prisons, multi-family housing, schools and other facilities serving as shelters, municipal buildings, and transportation infrastructure.

Applications to the ERB are accepted on a rolling basis, with the application window remaining open until all funds are allocated. There is no overall per-project cap, but there is an overall $5 million cap on energy storage equipment funding, and a $500,000 per-project cap for energy storage equipment. The ERB will fund 100 percent of a qualifying project's unmet need; 60 percent in the form of an amortizing loan, 20 percent in the form of a forgivable loan (loan forgiveness is based on projects meeting performance standards), and 20 percent in the form of a grant.

Details of eligibility and program requirements for the NJ Energy Resilience Bank include:

- Eligibility is limited to public facilities, not-for-profit entities, and for-profit entities that meet the U.S. Small Business Administration definition of a "small business." Privately owned utilities are not eligible

- Due to federal funding requirements, only facilities directly or indirectly impacted by Superstorm Sandy or another qualifying disaster are eligible. Direct impact means there was physical damage to the facility. At this writing, only water and wastewater treatment plants may qualify as indirectly impacted facilities (meaning they were unable to process water or wastewater due to loss of electric service and/or flooding)

- Priority is placed on projects that serve low- and moderate-income communities or which create low- or moderate-income (LMI) employment, as per federal LMI National Objectives[13]

- A portion of ERB funding is set aside for qualifying facilities located in the most-impacted counties in New Jersey

- Projects must be operational within two years of the awards. Two six-month extensions are available to projects that can show that significant progress is being made

- All projects must comply with federal and state requirements, including federal NEPA environmental reviews

- Eligible technologies include resilient distributed energy systems installed on the customer side of the meter. Microgrids are also eligible

- In order to qualify for funding, CHP systems must achieve a LHV efficiency of 65 percent, and fuel cells without heat capture must achieve 50 percent efficiency. For all applications, the ERB will consider whether the project meets 15 percent energy savings goals set by other New Jersey energy programs

- Eligible systems must be able to island and operate independently during a grid outage, and must have black start capability

- Eligible systems must be able to support facility critical loads in islanded mode for seven days without fuel deliveries

- Eligible systems must meet a cost-benefit requirement using a cost-benefit model developed by Rutgers University[14]

- Eligible systems, except for solar+storage systems, may be sized larger than the host facility's electric and thermal loads, providing the project has customers for any additional electricity and heat generated

- Host facilities must be flood-hardened as per New Jersey's Comprehensive Risk Analysis and detailed in its CDBG-DR Action Plan

- ERB financing may not be used for costs associated with emergency generators, fossil fuel storage tanks, diesel or propane systems, used equipment, demonstration or pilot equipment, or solar PV panels (but inverter and storage costs are eligible)

- Prior to applying, each project must have an energy audit. Applicants are strongly encouraged to meet with permitting and environmental review staff, and with their distribution utility, prior to applying

- Proposals are evaluated based on criticality, resilience, technical feasibility, cost effectiveness, impacted communities served, readiness to proceed, and meeting the HUD low- to moderate-income national objective. There are also point bonuses for energy efficiency and microgrids

In addition to the above, any major infrastructure project must be reviewed by HUD before ERB funding is approved. Major infrastructure projects are those located in two or more counties, or having a total cost of at least $50 million, with at least $10 million in CDBG-DR funding.

Renewable Electric Storage Incentive Program

The NJ BPU initiated a multi-year competitive solicitation to support projects pairing energy storage technologies with renewable generation at critical infrastructure. In its first year, the program expended $3 million on 13 awards (Table 1), largely to schools serving as emergency shelters and to wastewater treatment plants. All 13 awarded projects employed solar+storage, and importantly, all 13 proposed to sell frequency regulation services into the PJM electricity services markets. New Jersey BPU has proposed increasing its funding to $6 million for the second year of the program.

The New Jersey Renewable Electric Storage Incentive program was originally intended to support the large amount of solar PV being installed in the state, due in large part to the state's successful SREC (solar renewable energy certificate) program. Energy storage was anticipated to address two goals related to the integration of large quantities of solar-generated electricity: 1) peak shifting (storing electricity generated during hours of low demand for release during hours of high demand), and 2) frequency regulation (smoothing the variable output of solar PV). A 2012 study by Navigant estimated the technical potential for storage associated with solar PV in New Jersey to be 500 MW of peak shifting and 45 MW of frequency regulation.[15]

Two months after the Navigant study was concluded, Superstorm Sandy hit New Jersey with devastating effect, knocking out electric power to millions of residents and businesses for two weeks or more. In response, the electric storage program was adapted to include a third goal: providing resilient power to "public and critical" infrastructure. While the program does not limit funding to projects that support critical facilities, it does prioritize these projects.

Program requirements include:

- Each energy storage system must be connected to a behind-the-meter, net metered Class 1 renewable generator (solar, wind, geothermal, wave/tidal, renewables-fueled fuel cell, or methane), sized to produce no more than 100 percent of the host facility's historic annual electric consumption

- Energy storage systems may only be charged by the renewable generator at the host's site, not by electricity imported from the grid or by fossil fueled generators (with the exception of minimal charging necessary to provide ancillary services to the grid operator)

- There is no minimum amount of time that critical loads must be supported, but applicants must specify how long these loads will be supported by the proposed system

- Project designs must be replicable at other sites
- Storage systems must be installed within one year of receiving an award; one six-month extension may be granted due to unforeseen or extenuating circumstances, but in this case the project will forfeit 10 percent of the award amount
- Project proposals are judged on four criteria: cost effectiveness, project readiness, technical feasibility, and resiliency
- Project performance data must be reported quarterly to the New Jersey BPU, for use in evaluating the program and making program revisions for future rounds of funding

The first round of funding was capitalized at $3 million, with individual awards capped at $500,000 or 30 percent of installed costs. The program was oversubscribed, receiving 22 proposals seeking more than $4.6 million. Thirteen awards were announced, with funded projects ranging from 250 kW to 1.5 MW, and the duration of islanded operation ranging from 2 to 10 hours. Total storage capacity to be installed is 8,750 kW.

For its second round of funding, the NJ BPU is considering moving from a competitive solicitation to a prescriptive rebate program. This would reduce the administrative burden and streamline the program for participants. The BPU is also considering opening the program to private facilities that serve a public good; requiring minimum warranties and doubling the program funding from $3 million to $6 million. And the BPU is deciding how to handle public information requests for data from private firms, and which tracking metrics to use in monitoring project performance.

The New Jersey energy storage program is unique and innovative in a number of ways:

- It relies on the energy services markets to support project finances, with a relatively small state incentive ($230,000 per project on average) to compensate developers for locating systems at critical public facilities and providing islanding capacity
- It relies on private developers to deploy resilient power systems at public facilities, and contemplates the future eligibility of private facilities serving public purposes

Table 1 New Jersey Renewable Electric Storage Incentive Program Awards

Rank	Project Location	Storage Capacity (kW)	INCENTIVE REQUEST	PROJECT COST
1	Monmouth County Bayshore Outfall Authority	500	$175,000	$705,000
2	Lawrenceville School	1,000	$468,708	$1,562,360
3	Atlantic City Utility Authority	1,000	$417,096	$1,390,320
4	Toms River Municipal Authority	250	$120,000	$400,000
5	Cumberland County Utilities Authority	1,500	$500,000	$1,855,000
6	Franklin Township Board of Education	500	$145,000	$675,000
7	Borough of Buena Municipal Utilities Authority	750	$300,000	$1,000,000
8	Rice Elementary School	500	$130,000	$741,510
9	Paramus High School	250	$123,000	$410,000
10	Marlton Middle School	500	$130,000	$741,262
11	Jersey City Municipal Services Complex	1,250	$200,000	$1,585,000
12	Demasi Middle School	250	$70,000	$330,766
13	East Amwell School Board of Education	500	$130,000	$740,531

- It contemplates a move away from competitive solicitations and toward a prescriptive rebate program, which would simplify project administration and speed application turnaround times
- It funds renewables paired with energy storage systems exclusively

The energy storage effort was originally planned as a four-year program, with additional capitalization expected in future years. New Jersey BPU has proposed increasing its funding to $6 million for the second year of the program.

California Demonstration of Low-Carbon Microgrids for Critical Facilities

In 2014, the California Energy Commission (CEC) issued a $26.5 million microgrids solicitation resulting in a recommendation of more than $31 million in funding for 8 microgrids, four of which are designated to support critical infrastructure.[16]

Program Opportunity Notice (PON) 14-301, Demonstrating Secure, Reliable Microgrids and Grid-Linked Electric Vehicles to Build Resilient, Low-Carbon Facilities and Communities, was open to project applications in three categories:

- Group 1: Demonstration of Low-Carbon-Based Microgrids for Critical Facilities
- Group 2: Demonstration of High-Penetration, Renewable-Based Microgrids
- Group 3: Demonstration of Advanced Smart and Bidirectional Vehicle Charging

Of the $26.5 million total, $20.5 million was allocated for microgrids, while $6 million was allocated for vehicle charging projects. Microgrids proposals were subject to a funding cap of $5 million per project, with a minimum of $500,000. Applicants were required to provide at least 25 percent in matching funds, with larger match amounts receiving preferential scoring. No more than 30 percent of awarded funds could be used to purchase renewable generation. The program was funded through an electric ratepayer surcharge established by the California Public Utilities Commission. The solicitation was open to all entities with the exception of publicly-owned utilities, and projects were required to be located in investor-owned utility service territories.

Program requirements for Group 1 projects include:

- Microgrids proposed to support critical facilities must provide energy and cost savings and environmental benefits, as well as supporting critical facilities with resilient power
- Critical facilities may be either public or private, but applicants must explain what critical public services are provided by the facilities supported
- Microgrids may serve a single facility or multiple facilities
- Microgrids must be able to support critical loads in islanded mode for at least 3 hours
- In keeping with the program's goals of replicability and advancement of technology toward large-scale deployment, microgrid technologies must be capable of being made commercially available at the end of the project
- Microgrids must meet or exceed 2020 goals set forth in the U.S. Department of Energy's 2011 *Microgrid Workshop Report*,[17] meaning they must reduce the outage time of required loads by more than 98 percent at lowest cost, while reducing emissions by more than 20 percent compared to a diesel backup generator
- Generation within microgrids must be provided by renewable resources integrated with electric storage and demand response, "to the extent feasible and cost effective." Preferred generation types include solar, wind and CHP
- CEC Electric Progam Investment Charge funds may only be used for activities on the customer side of the meter

The CEC has recommended funding for four microgrids supporting critical infrastructure, at a total cost to the state of $16.6 million. The microgrids recommended for funding will provide resilient power to three fire stations in the city of Fremont; the Laguna Wastewater Treatment Plant in Santa Rosa; Blue Lake Rancheria in Blue Lake, which includes a public shelter, emergency operation center, fire station, fueling stations, supermarket, critical municipal buildings and other facilities; and a hospital in Walnut Creek.

Connecticut Microgrid Grant and Loan Pilot Program

The Connecticut Department of Energy and Environmental Protection (CT DEEP) has funded 13 resilient power microgrids in the first two rounds of its $48 million, three-year Microgrid Grant and Loan Pilot Program.[18] A third round of funding is planned for 2015.

CT DEEP launched its Microgrid Grant and Loan Pilot Program in 2012[20], committing $48 million over three years for the purpose of incentivizing microgrids, with an emphasis on clean, renewable generation, that would support critical infrastructure and create islands of resilient power. This represented the first significant state-administered resilient power solicitation. The program was designed in response to a directive from the Connecticut governor's office, and was a direct result of the disastrous impacts of Superstorm Sandy on the Northeastern states. The program was primarily marketed to municipalities, and required a legislative amendment to allow municipal microgrids to transmit electricity across rights of way without violating the utility franchise. Grants were capped at $3 million per project, and eligible uses included design, engineering and interconnection costs. Generation and storage were not eligible uses. The Connecticut Green Bank (formerly CEFIA) has supported the program by offering assistance to municipalities to help finance balance-of-system costs.

In its first two rounds of funding, the program made awards to 11 resilient microgrid projects. Round 1 was fully subscribed, with nine awards, but Round 2 was undersubscribed, with only two awards. (See Table 2.)

CT DEEP program requirements in Round 1 included the following:

- Microgrids must serve two or more physically separated critical facilities
- Microgrids must have black start capability and be able to operate continuously in island mode for at least four weeks
- Microgrids requiring fossil fuels must have access to uninterruptable fuel resources for a minimum of two weeks, and a plan to secure additional fuel resources beyond two weeks
- Microgrids must provide clean, economically justified on-site power in both grid connected and island mode for a minimum of 7,000 hours annually (80 percent minimum availability)
- Fuel cells, natural gas or propane fueled generators, and class 1 renewables are eligible
- Critical facilities and generation cannot be located in a flood plain or hurricane flood zone unless mitigation measures are in place
- Proposed generation must be able to follow system load and maintain system voltage within ANSI c84-1 standards when islanded
- Proposed generation capacity must exceed anticipated critical facility loads by at least 20 percent
- Five years annual performance reporting is required

Project proposals were judged on the basis of a cost/benefit analysis, project financing, cost-effectiveness on a $/kW basis, contribution to public need, inclusion of a mix of public and private facilities, and projected performance and reliability. Preference was given to projects that incorporated renewable generation, and for geographic diversity, as well as for the financial and managerial experience and capability of the applicant and developer.

CT DEEP stated that it was seeking a "diverse portfolio of projects with varying geographic locations, generation types, and community circumstances."[19]

Table 2 CT DEEP Microgrid Grant and Loan Pilot Program Winners – Rounds 1and 2

CT DEEP AWARD WINNERS			
ROUND 1			
Project	**Facilities**	**Generation**	**Grant Amount**
UConn Depot Campus/Storms	Campus buildings	400 kW fuel cell, 6.6 kW PV	$2,144,234
City of Bridgeport-City Hall/ Bridgeport	City hall, police station, senior center	(3) 600 kW natural gas mircoturbines	$2,975,000
Wesleyan/Middletown	Campus, athletic center (public shelter)	(1) 2.4 MW and (1) 676 kW natural gas CHP reciprocating engine	$693,819
University of Hartford-St. Francis/Hartford	Dorms, campus center, operation building	1.9 MW diesel (existing), 250 kW diesel, 150 kW diesel	$2,270,333
SUBASE/Groton	Various buildings and piers	5 MW cogen turbine, 1.5 MW diesel	$3,000,000
Town of Windham/Windham	2 schools (various public purposes)	130 kW natural gas, 400 kW fuel cell	$639,950
Town of Woodbridge/ Woodbridge	Police stations, fire station, Dept. of Public Works, Town Hall, high school, library	1.6 MW natural gas, 400 kW fuel cell	$3,000,000
City of Hartford-Parkville Cluster/Hartford	School, senior center, library, supermarket, gas station	600 kW natural gas	$2,063,000
Town of Fairfield-Public Saftey/Fairfield	Police station, emergency operations center, cell tower, fire HQ, shelter	50 kW natural gas recip. engine, 250 kW natural gas recip. engine, 47 kW PV	$1,167,659
ROUND 2			
City of Milford	Parsons complex, middle school, senior center, senior apartments, city hall	(2) 148 kW natural gas CHP units,120 kW PV, 100 kW battery storage	$2,909,341
University of Bridgeport	Dining hall, rec center, student center, 2 residential buildings as shelters, police station	1.4 MW fuel cell	$2,180,898

For its Round 1 solicitation, CT DEEP allocated $15 million, of which up to $1.5 million could be used to fund project development costs, with a maximum of $60,000 per project for this purpose. The remaining $13.5 million was allocated for project implementation, including eligible design, engineering, and interconnection infrastructure costs, with a per-project cap of $3 million. Program grants could not be used for generation or storage, or for infrastructure, design, and engineering for non-critical facilities. Implementation grants were to be disbursed when the project became operational. Projects were expected to become operational within a year, but most Round 1 projects have not met that deadline.

Program staff have assessed and reevaluated the program after each round with the goal of continual improvement. For Round 2, CT DEEP made a number of changes including:

- Proposal scoring weighted to favor microgrids incorporating renewable generation and energy storage
- Solar and wind generators must be paired with energy storage in order to count toward islanded system capacity
- Diesel generation limited to no more than 25 percent of capacity for any project[20]
- Milestone payment schedule adopted
- Projects to be operational within three years
- Project development cost reimbursement cap lowered to $50,000 (and restricted to municipal applicants)

In addition, in Round 2 CT DEEP coordinated with the Connecticut Green Bank to help applicants obtain financing for balance of system costs not eligible for grant funds (primarily generation and storage equipment). The Green Bank was available as a financing agent for applicants, using its relationships with investors as well as its existing programs including C-PACE, Lead by Example, the CHP Program, and the Anaerobic Digester Program. Applicants were encouraged to contact the Green Bank but were also free to seek third party financing.

A number of additional program revisions are under consideration for Round 3. These include:

- A legislative amendment allowing grant funds to be used to purchase renewable generation and storage assets
- Making more high-level pre-application technical and financing assistance available to municipalities on request
- Offering rolling application deadlines to allow a better fit with related incentives, such as REC auctions
- Providing a vendor list through the CT Department of Administrative Services to help municipalities build project teams
- Modifying grant amounts based on project-specific variables
- Moving to a two-track application process:
    - Track one would allow rolling applications with a set of pass/fail requirements and minimum scores required to move ahead
    - Track two would be for municipalities proposing to create microgrids by adding renewable generation and energy storage to existing emergency generators. The rationale for this proposed change is that existing emergency generators are already approved and in place. By incorporating renewables and storage in a microgrid configuration, existing fossil fueled generators will run less, and could be operated more efficiently when they do run. CT DEEP may also require modifications to older generators to bring them up to current air emissions specifications. Systems approved under this track would not be required to run year-round.

Other State Efforts

In addition to the state programs discussed above, numerous states have initiated studies, issued reports, or are planning resilient power programs. We briefly summarize those efforts here.

California

In addition to its microgrids program, California has adopted an energy storage portfolio standard that applies to three of the state's largest utilities, with a total goal of 1.325 GW of energy storage by 2020; a State energy storage roadmap; a State Energy Assurance Plan; and has engaged in California Local Energy Assurance Planning (CaLEAP).

Maryland

The Maryland Energy Administration's (MEA) Game Changer Competitive Grant Program has supported several innovative energy projects, notably the Konterra solar + storage microgrid; MEA has also produced the state's Resiliency through Microgrids Task Force Report.

Massachusetts

In addition to DOER's community resiliency program, the Massachusetts Clean Energy Center is collaborating with DOER to produce a state energy storage roadmap, with resilient power a prominent use. DOER has also committed $10 million to fund energy storage deployment in the state.

Minnesota

The Minnesota Department of Commerce has produced a report titled *Minnesota Microgrids - Barriers, Opportunities and Pathways toward Energy Assurance*.

New York

New York State Energy Research and Development Authority (NYSERDA) is administering the $40 million New York Prize to support construction of 4-5 new microgrids across the state, plus a number of feasibility studies. Recently, NYSERDA announced the first five $100,000 awards under the program, for feasibility studies. Once the studies are complete, awardees will be eligible to apply for project development funds. Funded projects must serve multiple customers, including at least one critical facility, and must be integrated into the utility grid. New York has also allocated another $20 million in a competition to create two new microgrids in Nassau and Suffolk counties.

In addition to its microgrids programs, NYSERDA also administers solicitations for fuel cells and CHP systems at critical infrastructure facilities, and has supported the installation of over 140 resilient CHP systems. And NYSERDA has announced extra incentives for commercial/industrial solar PV projects that include an energy storage component under its NY-Sun Commercial/Industrial Incentive Program, so long as the system reduces energy-use intensity at the customer's site by at least 15 percent. Projects located at "utility identified strategic locations" are eligible for additional incentives.

NYSERDA has also issued a report, The Contribution of CHP to Infrastructure Resiliency in New York State and the City University of New York - NYSolar Smart Distributed Generation Hub has announced a Resilient Solar Project to create a roadmap for the integration and tracking of resilient solar systems (under development).

Oregon

Oregon Department of Energy has announced an energy storage solicitation and produced a State Energy Assurance Plan. In addition, the state has adopted an energy storage mandate that will require utilities to procure at least 5 MWh of energy storage by 2020.

Photo credit: Maryland Energy Administration

Resilient solar+storage system at Desoto Elementary School, Arcadia, Florida
Photo Credit: Florida Solar Energy Center

Florida Solar Energy Center SunSmart E-Shelter Program

Beginning in 2012, in an effort coordinated by University of Central Florida's (UCF's) Florida Solar Energy Center in collaboration with the Florida Office of Energy, Florida's SunSmart E-Shelter Program equipped more than 115 schools with small PV systems and batteries, which are sufficient to keep lights and electrical outlets operating during a grid-disrupting natural disaster. This enables these schools to serve as self-powered places of refuge. Because the state took a "cookie cutter" approach and kept the systems small – a typical system consisted of a 10 kW solar PV array, with a 48 kW battery – these systems were relatively inexpensive: installed costs ranged from $74,000 to $90,000 per school, and might have been even lower were it not for a requirement that all components be US-made (the program was ARRA-funded). The state was also able to negotiate a volume discount by using a single installer for the entire state. School received the systems at no cost, and program staff calculated that each school would save around $1,500-$1,600 per year on electricity costs.

In general, schools make excellent resilient shelters, as they are centrally located, can accommodate many people, and typically have large, flat roofs and open spaces where PV panels can be installed (and many schools across the nation have existing PV). In the case of the Florida program, the state had designated selected schools as hurricane shelters, with interior spaces retrofitted as hardened "enhanced hurricane protection areas." This provided a pre-determined set of critical loads that would be supported by the resilient power solar+storage systems.

However, working with schools presented challenges as well as opportunities. Decisions ultimately rested with local school administrators and school boards, meaning that E-Shelter Program staff had to sell the idea to each school board. Because school administrations tend to turn over rapidly, systems generally had to be completely installed within a year. Due to time constraints, the program was unable to educate numerous solar installers about the program, so they ended up with a single installer serving the entire state, rather than one installer for each of seven state emergency management regions, as they had planned; this added travel time and made maintenance visits difficult to schedule.

For more information about the Florida E-Shelter Program, see http://www.fsec.ucf.edu/en/education/sunsmart/index.html.

Photo Credit: Green Mountain Power

Vermont DPS Electrical Energy Storage Demonstration Program

With support from U.S. DOE Office of Electricity, Sandia National Laboratories, and the Clean Energy States Alliance, the Vermont Department of Public Service awarded a $300,000 combined federal/state grant to a solar powered microgrid project in 2014. This utility-owned project incorporates 250 kW of solar PV (7,700 panels) plus 4 MW of battery storage to create the nation's first microgrid on a utility distribution system powered exclusively by solar PV. The microgrid provides resilient power to a public school that is a designated emergency shelter; it will also allow the operating utility to incorporate more solar PV in the area. Because it is built on a closed landfill, the project also qualifies as brownfield redevelopment. Additional solar panels, batteries, electric vechicle charging stations and critical facilities will be added to this system in a planned expansion.

The Vermont solicitation was developed with the primary purpose of stimulating deployment of an energy storage demonstration project that would support the integration of renewable energy, in line with the state's renewable energy development goals. Because Vermont is a regulated state with regard to electric utilities, the solicitation was open to utilities, which are vertically integrated and can own generation and storage. Vermont was able to achieve significant leveraging of its money, with the resulting project coming in at around $12.5 million, on a $50,000 investment by the state. This model worked so well that it is now being adopted by other states, notably Oregon and Massachusetts.

The developer, Green Mountain Power, plans to use the microgrid for many purposes on its distribution system in Rutland, VT, including the integration of significant amounts of solar (the utility has announced its intention to make Rutland the "solar capital of New England"). Because the resiliency benefit is merely one of many uses for the microgrid, the microgrid is oversized with respect to the school it will support as a resilient shelter, and this allows it to provide unlimited islanding capacity with solar and batteries alone. In addition, the utility was able to rate-base much of the cost of the microgrid, showing the advantages of utility-owned resilient power systems in those states where utility ownership is possible.

For more information about the Vermont Electrical Energy Storage Demonstration Program, see http://www.vermontbusinessregistry.com/bidAttachments/10128/CEDF_Storage_RFP_Final.pdf and http://www.cleanegroup.org/blog/solar-energy-storage-resilient-power-in-vermont#.VNdS_PnF-WU.

HOW TO PROMOTE RESILIENT POWER SOLUTIONS IN YOUR STATE

Although many state resilient power programs are emerging, recently launched, or ongoing, there are some lessons to be learned from early results. Based on the Resilient Power Project's work with states and monitoring of state programs, here are some insights that might be applied by states developing new resilient power programs.

Engage in a thorough pre-program stakeholder process

Regardless of the target audience for the program, a variety of stakeholders (including utilities, municipalities, developers, regulators and others) will need to be engaged. Doing this early in the program design process can be useful both in gathering information and marketing the program, and may help to avoid problems down the road. One way to engage with stakeholders is to hold a workshop, as was done in Vermont and Oregon, for utilities, industry representatives, NGOs and others. In Connecticut, an informational workshop was held specifically for municipal officials. Many states disseminate program information about their programs via their websites and through a series of webinars. Clean Energy Group has hosted numerous webinars on state resilient power programs, which are archived and may be viewed at http://www.cleanegroup.org/ceg-projects/resilient-power-project/webinars/. For an example of stakeholder engagement, see the Oregon Department of Energy's energy storage webpage.[22]

Assess needs and target funding

Resiliency program funds and incentives can be targeted to meet specific needs for powering critical infrastructure. For example, during Superstorm Sandy, billions of gallons of sewage was spilled into waterways in New Jersey due to power outages and flooding at municipal wastewater treatment plants, and drinking water treatment plants were forced to issue boil advisories. To address this, the New Jersey Energy Resilience Bank dedicated its first tranche of $65 million to supporting resiliency projects at water and wastewater treatment plants. In Florida, where communities need resilient shelters during hurricanes, schools designated as hurricane shelters were selected for solar+storage systems, with the resilient power systems supporting critical loads in specially-designed enhanced hurricane protection areas within each school. States can assess which types of critical facilities need resilient power solutions most urgently, or can support municipalities in doing so.

Consider the needs of low-income and vulnerable communities

States may wish to make a special effort to develop and market specific resiliency programs for low-income and vulnerable communities, via Community Development Corporations, Community Development Finance Institutions, and other NGO advocacy groups. As noted earlier in this report, low-income, elderly and disabled populations are often the most vulnerable to disasters and accompanying power outages, having fewer resources with which to weather the disaster and to rebuild afterwards, yet it is harder for these communities to attract resilient power project developers or financing.[23] By comparison, wealthier communities and businesses are able to be early adopters of resilient power technologies to keep their interests safe when the grid goes down. To address this imbalance, states can target resilient power programs toward low- to medium-income communities, or include per-capita income in resilient power award calculations, as Massachusetts DOER did in its Community Clean Energy Resiliency Initiative.

Create a flexible program that allows communities to design systems to meet local needs

Some state programs have adopted narrow eligibility standards when it comes to the types of technologies they will fund; for example, funding only microgrids or only systems that are 100 percent renewable. The best results have come from programs that define eligible systems more broadly, allowing communities the flexibility to build systems that best match their needs and resources. For an example of a program that allows communities flexibility in project design, see the Massachusetts DOER Community Clean Energy Resiliency Initiative.[24]

Market the program to municipalities

Because resilient power may be a new concept in many communities, state resiliency programs should be marketed to municipalities to ensure that local officials receive the information and support they need to participate in state programs. In-person meetings, webinars, conference calls, and other forms of outreach can be effective, and groups such as municipal planning organizations and associations of municipal governments may be able to help in marketing the program. States should prepare and distribute information about the importance of resilient power for critical facilities, help communities identify where resilient power systems would be most beneficial, and inform municipal officials about financial resources available to help defray the costs of resilient power systems.

Provide pre-application technical assistance to applicants

Because resilient power uses new combinations of commercially available clean energy technologies with battery storage, resilient power systems may include custom-engineered rather than off-the-shelf components, and custom engineering may be required for system design. For this reason, the burden upon applicants to produce a detailed project proposal that satisfies the state's application requirements can be substantial. Programs that provide assistance for conducting initial feasibility studies and system design can help applicants overcome this barrier and may also benefit from greater program interest and higher-quality project applications. This approach has been used with excellent results by the Massachusetts Department of Energy Resources, which funded 27 pre-application municipal technical assistance reports in its Community Clean Energy Resiliency Initiative (see http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/resiliency/resiliency-initiative.html). A similar approach was taken by NYSERDA in the design of its New York Prize microgrids competition, which has announced funding for five feasibility studies (see http://www.nyserda.ny.gov/All-Programs/Programs/NY-Prize/Competition-Structure).

Provide financing assistance and information to applicants

A primary barrier to resilient power deployment is high up-front costs that must be borne by the developer/system owner. Even in cases where state grants pay for a significant portion of the resilient power system, the burden of financing balance-of-system costs can pose a significant cost barrier, especially with regard to new technologies that may not be familiar to banks and financiers. To help applicants with financing, states can provide information resources and/or low-cost loans, credit enhancement, and other financing. Attributes of effective finance programs include:

- **Provide information on municipal financing options, such as municipal bonds.** Municipalities may have more resources for financing resilient power projects than they realize. State green banks and economic development commissions may be helpful in providing information on potential finance mechanisms that could be applied. For example, the Connecticut Green Bank has provided information on financing for municipalities interested in applying to the CT DEEP Microgrid Grant and Loan Program (see http://www.energizect.com/government-municipalities/programs/microgrid_financing). Another good resource for municipalities is the Clean Energy Group publication, *Financing for Clean, Resilient Power Solutions*, which can be downloaded at http://www.cleanegroup.org/assets/Uploads/CEG-Financing-for-Resilient-Power.pdf.

- **Allow awarded funds to be used for a wide variety of purposes**, including paying for equipment, engineering and design, construction, and other purposes. This allows award recipients the maximum flexibility to structure financing as the project requires. Note that states may wish to restrict eligible equipment to that not covered by other state rebates or incentives, for example, program funds may not be used to purchase PV panels if the state has another program that provides PV rebates, to avoid double-dipping. The Massachusetts DOER Community Clean Energy Resiliency Initiative[25] is a program that addresses this concern.

- **Provide a variety of finance tools** including loans, grants, and credit enhancement. Some programs have made loans entirely or partially forgivable, provided that projects are completed on schedule and meet performance criteria. For an example of this type of loan structure, see http://www.njeda.com/web/pdf/ERBProgramGuide.pdf. [26]

- **Allow resilient power projects to access available value streams**, so long as the system can provide the required resiliency benefit when called upon to do so. Often, developers must design a resilient power system to access multiple value streams (a practice known as value stacking) to make the system financially viable. This might mean using the system for peak shifting and demand charge reduction, selling ancillary services to the grid operator, and engaging in electricity arbitrage. Some programs limit the ability of projects to engage in these types of activity. But value stacking can help the economics of a project, and this in turn can help applicants obtain financing. Note that developers should be able to show that the system will remain ready and able to provide resiliency benefits at any time, even while providing other energy services.

- **Conduct in-depth evaluations of proposed financing for projects.** This will help to ensure that awarded program funds will not be tied up in projects that face difficulty in financing balance-of-system costs.

Require performance monitoring and evaluation

Project performance should be monitored and assessed, both to ensure that public money is well-spent, and to provide data to developers of future resilient power programs and projects. One year of operational data collection at minimum is recommended. Metrics for evaluating the performance of energy storage systems have been developed and published by Pacific Northwest National Laboratory and Sandia National Laboratories.[27] In addition, the New Jersey BPU is developing performance metrics for solar+storage systems.

Provide additional support and incentives for resilient power projects serving low- to moderate-income communities.

States can help to level the playing field for low-income and vulnerable populations, so that they are not left behind yet again. For example, when designing its community resilience initiative, Massachusetts DOER included the per capita income of the community in its grant-making formula, thus making more money available for projects in low-income areas. Other approaches could include adders, carve-outs, weighted evaluation criteria, low-cost financing and other targeted assistance. For more information on how the state can help to ensure that low-income communities can participate in resiliency programs, see the box on "Protecting vulnerable populations."

Photo Credit: Cupertino Electric, Inc., featuring Hawkeye Photography

Protecting vulnerable populations

It is important to acknowledge the disproportionate impact that prolonged power outages have on disadvantaged communities, such as the elderly and the disabled. These communities and low-income communities can have more difficulty recovering from extreme weather events and related power outages due to lack of discretionary income, little or no savings, poor access to communication channels and information, physical vulnerability, and lack of insurance. Populations with mobility contraints can be especially hard-hit by power outages due to their reliance on electric-powered medical and mobility devices, and may be unable to access storm shelters, due to the lack of electric power to run elevators or lack of functioning public transportation. And if shelters can be accessed, vulnerable populations need shelters with reliable electric power due to the need for refrigeration for medicine, charging points for powered medical devices, and other needed services that require electritity.

In November 2013, a federal court ruled that New York City violated the Americans with Disabilities Act by not adequately protecting its disabled residents during Superstorm Sandy. The decision held the City liable for failing to make sure the blind, deaf and physically disabled were provided access to post-disaster services, like emergency shelters and transportation, which were available to the able-bodied. Resilient power at shelters can provide such access, and resilient power in multi-family housing can allow vulnerable populations to shelter in place, avoiding difficult and dangerous evacuations.

When developing resilient power policy and programs, states should consider the resilient power needs of these vulnerable communities. Here are some strategies for ensuring that state programs result in actual protections for these populations:

- Clearly define the need. To address the needs of low-income populations, for example, it will be important to inform project developers as to the meaning of "low-income" as it pertains to the program. It is also helpful to identify specific communities that would qualify, or eligible facilities, such as nursing homes or affordable housing units.

- Provide "matchmaking opportunities" where developers can meet representatives of organizations serving low-income and vulnerable populations. This can help prospective applicants form project teams.

- Include addressing the needs of low income and vulnerable populations among a set of weighted criteria to be used in reviewing project proposals, clearly defining its value.

- Include a carve-out or set-aside for project proposals that serve a defined population or community.

- Provide additional financial support for project proposals that serve a defined population or community. There are many ways to approach this, including offering an adder or multiplier for qualifying proposals, requiring a smaller funding match, providing lower cost loans, allowing more time for repayment of loans, offering credit enhancement, and providing more grant funding up front (as opposed to after the project is commissioned). States may also wish to include municipal per capita income in grant-making calculations.

Photo Credit: © Bigstock Photos

STATE POLICY TOOLS FOR RESILIENT POWER DEPLOYMENT

States use various types of programs and incentives to encourage the deployment of clean energy resilient power projects that provide public goods and economic development benefits. This section of the report reviews programs and incentives that have been used by some states to support resilient power deployment, as well as some broader policy approaches that go beyond a single program or a limited round of funding.

Solicitations/RFPs

Many states have used resilient power solicitations or RFPs to support the development of resilient power projects. This is a good way for the state to get multiple competitive project proposals, from which it can choose the best or lowest-cost projects to fund. It is also a good way for the state to gain experience and knowledge about new technologies and applications. Solicitations are often used to support demonstration projects when technologies are new, markets are under-developed, and when the state lacks experience with the type of technology being solicited.

Solicitations generally include a number of important elements, including eligibility requirements that define who may apply and what types of projects the state is interested in supporting; requirements for financial matching; definitions of key terms such as "resilient" or "microgrid;" a timetable for funding and construction of projects; performance standards for proposed projects; and other guidelines for applicants. If the goal of the solicitation is to produce demonstration projects, the RFP should define the specific technologies and applications the state would like to see demonstrated.

When defining eligible project types and sizes, it may be helpful to consider the differing needs of the applicants or participating communities. For example, a microgrid may be the perfect solution for one community, while smaller single-facility solar+storage systems may be a better fit for another. Similarly, not every critical facility will need to be able to run in "islanded mode" around the clock, or for weeks at a time. Allowing applicants to show how the proposed system will meet their needs is a good way to make sure the solicitation is flexible enough to accommodate a wide variety of solutions, while upholding strong standards for the provision of resiliency services. At the same time, it is important to verify claims made in project proposals.

Here are some questions to consider when developing resilient power solicitation:

- How long should resilient power systems be required to be able to run in their islanded state? Weeks? Days? Hours?
- How many hours per day do critical loads need to be supported at various types of facilities?
- Who will decide which loads are "critical?"
- What types of facilities will be eligible?
- How can the state ensure that needed sectors or communities are served?
- What factors should be considered when defining eligible technologies? Energy efficiency? Cost-effectiveness? Eligibility for clean energy credits/programs?

In drafting a solicitation, it may be helpful to examine successful resilient power solicitations from other states. Examples include the Connecticut Microgrids Grant and Loan Pilot Program,[28] Round 1 of the New Jersey Renewable Electric Storage Competitive Solicitation,[29] and the Massachusetts Community Clean Energy Resiliency Initiative. [30]

Renewable Portfolio Standards and Stand-Alone Mandates

Resilient power mandates may be incorporated into existing renewable portfolio standards (RPS), or they may take the form of stand-alone mandates, such as California's energy storage mandate and Puerto Rico's energy storage requirements for new renewable generators.

Renewable Portfolio Standards

Resilient power can be incentivized within a state RPS. While there are few existing examples of this, there is ample precedent for the use of RPS to promote goals beyond the simple deployment of renewable energy. Generally, incorporating resiliency within an RPS requires defining the desired systems and components (batteries, fuel cells, CHP systems, microgrids) as eligible technologies, and then crafting incentives or mandates to promote deployment of these technologies within islandable systems at critical facilities.

Incentives can take the form of higher capacity caps, accelerated incentive payments, incentive adders or multipliers, or carve-outs similar to SRECs (renewable energy credits specifically for solar PV). These incentives could be offered within the customer-side tier of a tiered RPS, within the main (utility) tier, or both.

Mandates would require utilities to procure resilient power capacity up to a set target or a defined percentage of the utility's portfolio. This approach would follow the more traditional RPS approach of goals and deadlines, with a system of non-compliance payments that could be used to fund additional resilient power projects within a state's clean energy fund.

Examples of two existing programs follow.

New York Large Fuel Cell Program

NYSERDA administers New York's clean energy fund and its RPS. Within the RPS, NYSERDA's large fuel cell program offers an additional incentive of $500 per kW (up to $100,000 per project site) for systems that provide resilient power "at sites of Essential Public Services, such as police stations and hospitals, or where the fuel cell system will be an integral part of a documented and verifiable 'facility of refuge'."

NYSERDA also lists a number of essential public service facilities that may qualify for the incentive, including emergency services, health care services, communication services, food distribution/retail, and fuel distribution/ retail. Determination of host site eligibility is at NYSERDA's discretion. NYSERDA additionally offers other incentives for critical infrastructure resilient power outside of the RPS, including a small fuel cell program and two CHP programs with critical facility adders.

Pennsylvania Alternative Energy Portfolio Standards Act

The Pennsylvania Alternative Energy Portfolio Standards Act raises the capacity cap for "customer-generators" from 3 MW to 5 MW "for customers … who make their systems available to operate in parallel with the electric utility during grid emergencies as defined by the regional transmission organization or where a microgrid is in place for the primary or secondary purpose of maintaining critical infrastructure, such as homeland security assignments, emergency services facilities, hospitals, traffic signals, wastewater treatment plants or telecommunications facilities" (DSIRE.org).

Clean Energy Group and its sister organization, Clean Energy States Alliance, have produced two recent papers on the topic of using RPS to support critical infrastructure resilient power deployment: Using State RPSs To Promote Resilient Power,[31] and Does Energy Storage Fit in an RPS?[32] This topic is dealt with in greater detail in these two publications.

Stand-Alone Mandates

Stand-alone mandates may be applied in the form of separate resilient power portfolio standards or on a per-project basis.

An example of a separate resilient power RPS is provided by a straw proposal issued by the New Jersey Board of Public Utilities (BPU) in 2013.[33] The BPU proposed a "smart" (market-responsive) CHP portfolio standard that would include financing for a "CHP storm response program for critical public facilities," which were defined as public shelters that could self-supply electricity during a grid outage. The new portfolio standard was to be established outside of the state's existing RPS, deriving its authority instead from the state's Energy Efficiency Portfolio Standard, which obligates the state's natural gas utilities.

Resilient Power Banks/ Green Banks

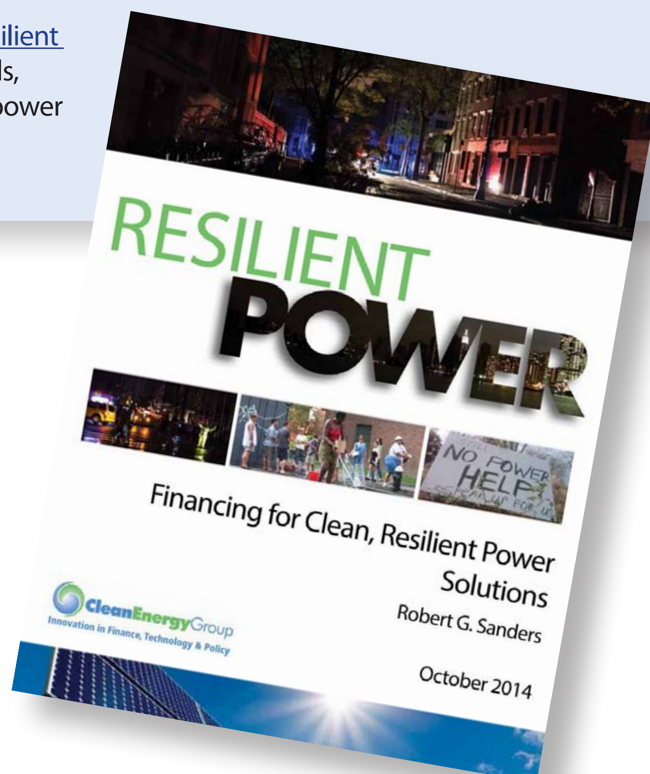
Increasingly, states are creating green banks to support clean energy and energy efficiency deployment. Green banks are publicly funded institutions that provide low-cost financing for qualifying projects. Green banks and similar financial institutions can be useful to support resilient power deployment if resilient power technologies are included as qualifying technologies.

In July 2014, New Jersey formally approved the creation of the first-in-the-nation Energy Resilience Bank (ERB). This innovative institution was funded with $200 million of New Jersey's federal Community Development Block Grant-Disaster Recovery allocation. The New Jersey Board of Public Utilities approved a sub-recipient agreement with the New Jersey Economic Development Authority to work jointly in the establishment and operation of the ERB. The ERB will make direct loans and grants for resilient power deployment at critical facilities, but it can also provide credit enhancement for bond issuances and other private financing participations. More information about the NJ ERB can be found at http://www.state.nj.us/bpu/commercial/erb/. Other green banks that have supported resilient power programs or technologies include the CT Green Bank, formerly CEFIA (http://www.ctcleanenergy.com/) and the NY Green Bank (http://greenbank.ny.gov/). More information about green banks in general can be found at http://www.coalitionforgreencapital.com/whats-a-green-bank.html.

Business models and financing for Resilient Power Solutions

Because resilient power represents a relatively new suite of technologies for which markets and financing structures are just beginning to emerge, it can be helpful for states to provide informational support in the areas of business and ownership models and financing. Financing in particular has proved to be challenging for municipal-led project teams; yet, municipalities hold many financing tools, including many options for issuing bonds.

The Clean Energy Group publication Financing for Clean, Resilient Power Solutions describes in detail various ownership models, bonding options and other resources for financing resilient power systems, such as credit warehousing and resiliency banks.



The proposed financing method was on-bill financing, with natural gas utilities loaning money to CHP project developers (other potential sources of funding, such as the state's systems benefit charge and bond financing, were also considered). A portion of the loans was to be paid back to the utilities and ratepayers from CHP energy savings, and another portion would be forgiven based on system performance over time.

The BPU proposed to regulate the market, mandating more or less CHP procurement from year to year as appropriate under prevailing market conditions. This dynamic portfolio standard management was intended to "minimize or eliminate the vertical demand curve that impacts the RPS competitive markets in New Jersey." [34] At this writing, the NJ BPU has not adopted the proposal, moving instead to an Energy Resiliency Bank model as federal disaster recovery funds became available.

A second example is the stand-alone energy storage portfolio standard enacted in California, where the state's Public Utilities Commission required that three major investor-owned California utilities procure a total of 1.325 GW of energy storage by 2020. The program is primarily intended to aid in the integration of renewables and to push the advancement of new energy storage technologies (the most commonly used and fully developed storage technology, pumped hydro, is not allowed under the mandate). However, requirements for customer- and distribution grid-sited storage, plus requirements for municipal utilities and utility districts, should result in a significant number of smaller scale projects capable of offering resilient power benefits (although there is no requirement for islandable systems at critical facilities within the program). For more information about the California energy storage mandate, see http://www.cpuc.ca.gov/PUC/energy/electric/storage.htm.

Adders, multipliers, and carve-outs

Adders, multipliers, and carve-outs may be applied as part of various types of incentive programs, either within or outside an RPS, to provide an extra boost to a particular kind of technology or application. Adders and multipliers boost an existing incentive for the desired technology; carve-outs, sometimes called set-asides, make a portion of the existing incentive applicable only to the desired technology.

As an example, New York uses adders to incentivize critical facility resiliency projects within its two CHP programs, administered by NYSERDA: The CHP Acceleration Program, and the CHP Performance Program. For these programs, the critical facility bonus payments are additional to the base incentive, not merely an acceleration of payments as in the large fuel cell program. The CHP Acceleration Program offers a "Critical Facility Incentive Bonus" of 10 percent for small CHP systems placed at critical facilities, including public shelters. The incentive is capped at $1.5 million per project. The CHP Performance Program for large CHP systems offers a similar bonus incentive of up to 10 percent (on a base incentive capped at $2,000,000) for projects serving critical infrastructure, including facilities of refuge (see NYSERDA PON 2701).

Prescriptive rebates

As resilient power technology becomes more commercially successful, and supportive markets for distributed generation and storage develop, states may move from solicitations and mandates to prescriptive rebate programs. A prescriptive rebate program includes requirements as to how the technology must be used to qualify for the rebate (to support specific types of facilities in islanded mode, for example). This type of program lends itself well to simple, single-facility systems such as solar+storage, but less well to large, complicated systems like microgrids, which are individually engineered and for which some components, such as microgrid controllers, are still not readily commercially available.

The prescriptive rebate model is being considered by the New Jersey BPU in its Renewable Electric Storage program, which offered a competitive solicitation in its first round of funding, but may move toward a rebate program for subsequent rounds. The BPU is considering this in part because all 13 projects receiving awards are planning to sell services into PJM's frequency regulation market, indicating market support for future projects. From an administrative perspective, BPU staff feel that a prescriptive rebate program would be simpler to administer, would allow for faster turnaround times in processing applications, and would be equally effective.

A second example is New York's $450 million NY-Sun Commercial/Industrial Incentive Program, a PV rebate program that offers extra incentives for solar projects that include an energy storage component, so long as the system reduces energy-use intensity at the customer's site by at least 15 percent. Projects located at "utility identified strategic locations" and including energy efficiency upgrades are eligible for additional incentives. In this program, the energy storage "rebate" is an adder to an existing PV rebate; the additional incentive for solar+storage systems at specific locations illustrates how a resilient power prescriptive rebate could be structured using a series of tiered incentives. More information about the NY-Sun program is available at http://ny-sun.ny.gov/Get-Solar/Commercial-and-Industrial.

Typically, rebate programs rely on the availability of reliable, vetted off-the-shelf technology that meets program requirements. This can present a problem for resilient power systems, because while some components such as solar panels, CHP systems and fuel cells have established track records, other components, such as batteries, "smart" inverters, and microgrid controllers are newer technologies that lack a record of performance. For this reason, states may wish to consider requiring warranties for rebate-eligible equipment, as is under consideration in New Jersey. In addition, state rebate programs should incorporate a well-defined set of performance standards that must be met in order to qualify for the rebate. The state may also wish to provide a list of certified installers, to help ensure that equipment is installed correctly and will meet performance standards.

It makes sense for states to begin with a resilient power solicitation, in order to support demonstration projects that will help the state gain experience and knowledge about markets, technologies and the appetite for resilient power development among municipalities and businesses. With the benefit of this knowledge, states may feel more comfortable moving to a prescriptive rebate or RPS model, especially if markets emerge to support the technologies and applications. As markets continue to develop, rebates or REC values can be adjusted downward.

Integrating resilient power into longer-term state policy

Some states have taken steps toward embedding resilient power policy into other, more permanent state policies, via state energy plans, disaster preparedness plans, and policy guidance documents, such as roadmaps. These policy documents can provide an overarching strategy for the state and lay the groundwork for greater continuity of effort, as explained below.

State disaster preparedness/recovery plans

State emergency management plans have traditionally given little attention to assuring electrical service at critical facilities. However, this situation is beginning to change, in part due to concerns about the changing climate and the frequency and severity of power loss due to recent storms. In many states, planners are becoming more aware that the critical services needed for emergency response—telecommunications, computers, lighting, fuel pumps, water pumps, elevators, traffic signals, medical services, etc.—depend on electricity and will not function properly during a disaster without resilient power.

Typically, addressing resilient power within an emergency management plan begins with identifying critical facilities and services. State planners may wish to defer to municipal officials in identifying many critical facilities, as they will often be in the best position to know what facilities are most important for their communities, and can engage in local stakeholder processes. A list of critical facilities typically includes medical and first responder facilities, shelters, public transportation, telecommunications facilities, water and wastewater treatment plants, and prisons. It is also important to consider multi-unit housing facilities, including retirement homes and affordable housing, where residents are more vulnerable to the impacts of natural disasters and power outages, and may be safer sheltering in place than attempting to evacuate.

Often, such exercises result in hundreds of critical facilities being identified, and it is important to winnow the list down to a manageable size. Once a priority list of critical facilities is created, municipalities will often need help in taking the next step from planning to action, and this is where state policy can support municipal efforts by offering funding and financing support for resilient power project deployment.

State energy plans

As with emergency management plans, state energy policy documents have not traditionally addressed resilient power for critical facilities. However, it is state energy officials that have been most active thus far in developing resilient power policy and programs, and the provision for "islands of power" during a widespread outage is clearly of interest to many state energy officials. As such, resilient power will likely need to be incorporated into state energy plans.

Generally, resilient power provisions in an energy plan should reflect the plan's overarching priorities. Thus, if the state has made a commitment to expanding its use of renewable energy and reducing its reliance on fossil fuels, it would make sense for any resilient power provisions to reflect this.

Because resilient power requires elements of both emergency management and energy planning, a joint effort between emergency management and energy officials may be very helpful.

State Energy Assurance Plans, Roadmaps and Task Force Reports

A number of states have developed plans, roadmaps and reports that address, at least in part, the idea of resilient power. Typically these are the product of work groups or task forces assembled for the purpose, often by the state legislature or an executive committee. Such efforts can be very helpful in laying the groundwork for state policy. Often they will include a risk analysis, an assessment of the current state of the electricity grid and fuel systems, a look at markets and opportunities, and some recommendations for moving toward the state's goals.

Example documents include the State of California Energy Assurance Plan;[35] the Oregon State Energy Assurance Plan;[36] Minnesota Microgrids - Barriers, Opportunities and Pathways Toward Energy Assurance;[37] the Oklahoma Energy Assurance Plan;[38] the Texas Energy Assurance Plan;[39] and the Maryland Resiliency Through Microgrids Task Force Report.[40] For an example of state planning processes and methodology, see the California Local Energy Assurance Planning (CaLEAP) website.[41]

Resilient Power and the EPA Clean Power Plan

The U.S. Environmental Protection Agency's Clean Power Plan aims to achieve 30 percent CO_2 reductions from the power sector by 2030, against a baseline level set in 2005. To do this, the plan relies on states to play a primary role. The plan recognizes the history of state leadership in clean energy and gives states broad flexibility in deciding how to meet the goals of the plan.

While the plan does not directly address resilient power issues, it does offer support for resilient power technologies, including renewable generation and energy storage. To the extent that resilient power projects are more efficient and less polluting than traditional fossil fueled power plants, they can contribute to state emissions reduction efforts. More broadly, resilient power fits into a larger category of distributed energy resources that can provide power more efficiently, make the electricity grid more flexible, and reduce the need for over-investment in "peaker plants" that exist only to meet peak demand and sit idle much of the time.

Different states will choose to meet Clean Power Plan goals differently. States interested in deploying resilient power should incorporate resilient power incentives into their Clean Power Plan emissions reductions programs. The EPA provides resources for state clean power planning, at http://www2.epa.gov/cleanpowerplantoolbox.

The Role of Utilities in State Resilient Power Planning

As previously mentioned it is important to include utilities in program and policy development, but what about the role of utilities as project developers?

In states with vertically integrated utilities, utility ownership can be a powerful tool to get resilient power technologies like solar+storage deployed. This is the model followed in Vermont, where Green Mountain Power was able to rate-base a $12.5 million solar+storage microgrid (see Case Study).

This would not have worked in deregulated states, where utilities cannot generally own generation, and may not be able to own energy storage. Although storage does not actually generate electricity, and acts as a load as much as a supplier of power, it has not been specifically defined in most states, meaning that it is likely to be lumped in with generation for regulatory purposes, rather than considered a transmission or distribution system asset, which could allow utility ownership.

As states begin to look at resilient power and grid modernization, and as new technologies and technology hybrids such as microgrids and solar+storage enter the market, it is becoming more important to accurately define these new technologies, who can or cannot own them, and how costs and benefits are allocated.

An example of this is the current New York Reforming the Energy Vision (REV) process, a grid modernization effort being undertaken by the NY Public Service Commission (PSC). Thus far, the PSC has determined that "utility ownership [broadly defined as owning, leasing, contracting or other direct sponsorship of DER (distributed energy resources), which includes distributed generation and storage) will only be allowed under the following circumstances: 1) procurement of DER has been solicited to meet a system need, and a utility has demonstrated that competitive alternatives proposed by non-utility parties are clearly inadequate or more costly than a traditional utility infrastructure alternative; 2) a project consists of energy storage integrated into distribution system architecture; 3) a project will enable low or moderate income residential customers to benefit from DER where markets are not likely to satisfy the need; or 4) a project is being sponsored for demonstration purposes."[42]

The PSC has stated that utility affiliates, such as ESCOs, will be able to own distributed energy resources, but the PSC is developing oversight measures to guard against abuses of market power.[43] Such rules maintain the separation of generation and transmission ownership on a large scale, but allow utilities to petition for an exception to the rules when markets fail to meet customer or system needs in specific cases.

Grid modernization efforts such as NY REV have just begun in a handful of states, but are likely to spread. As resilient power is increasingly recognized as a needed customer-sited asset that benefits entire communities, it will be important that resiliency discussions are included in these overarching revisioning efforts.

The Role of Third-party Service Providers in State Resilient Power Planning

New markets for energy storage to provide ancillary services have emerged due to recent FERC rules that reduce barriers to market entry and mandate equitable pay-for-performance from grid operators. These emerging markets have led to the rise of a new class of third-party storage suppliers, whose business model involves co-locating with a renewable generator, selling ancillary services such as frequency regulation to the grid operator, engaging in electricity arbitrage and other profitable practices where possible, and providing the use of the battery and inverter at no charge to the renewable generator or host facility. Markets for ancillary services are inconsistent across different electricity service territories; currently, PJM has the best frequency regulation market, whereas the New York and California ISOs have the best markets for demand response. However, all FERC-regulated territories have come into compliance with FERC's market-opening rules, and some non-FERC territories, such as ERCOT, are considering similar rules to level the field for small distributed service providers. Nevertheless, markets remain fragmented and highly locationally specific.

It should be possible for states to leverage these new markets by providing an incentive for third-party storage suppliers to locate near critical facilities, and to provide a resilient power benefit to those facilities when the grid is down (they cannot sell grid services at such times in any case). In fact, this is what recently happened in New Jersey, when the BPU funded 13 solar+storage projects at critical facilities. All 13 projects plan to sell frequency regulation services to the grid operator , with the result that New Jersey was able to provide a relatively low incentive rate, averaging about $230,000 per project.

This raises the issue of private third-party ownership, rather than municipalities or regulated utilities owning and operating resilient power systems funded by a state resiliency program. Although most early state resilient power programs have relied on municipal and/or utility ownership of systems, private third-party service provision should be an equally viable model. In this model, the resiliency benefit would be provided as a service by the private, third party under a contractual relationship with the state, the municipality, or the owner of the facility receiving the service. Provision of resilient power during grid outages does not conflict with the sale of grid services at other times, since grid services cannot be sold during an outage in any case. However, contracts governing privately owned systems engaging in sales of services will need to specify that sufficient storage capacity reserves must be maintained at all times, so that the system is able to provide the resiliency benefit when called upon to do so. This is in fact what has occurred in New Jersey, where a state program funded private developers providing resilient power to public critical facilities.

Energy services markets are complicated, and different ISOs operate differently despite FERC oversight. Clean Energy Group is preparing a white paper on the FERC rules that impact energy storage technologies; it will be posted as a resource at www.resilient-power.org.

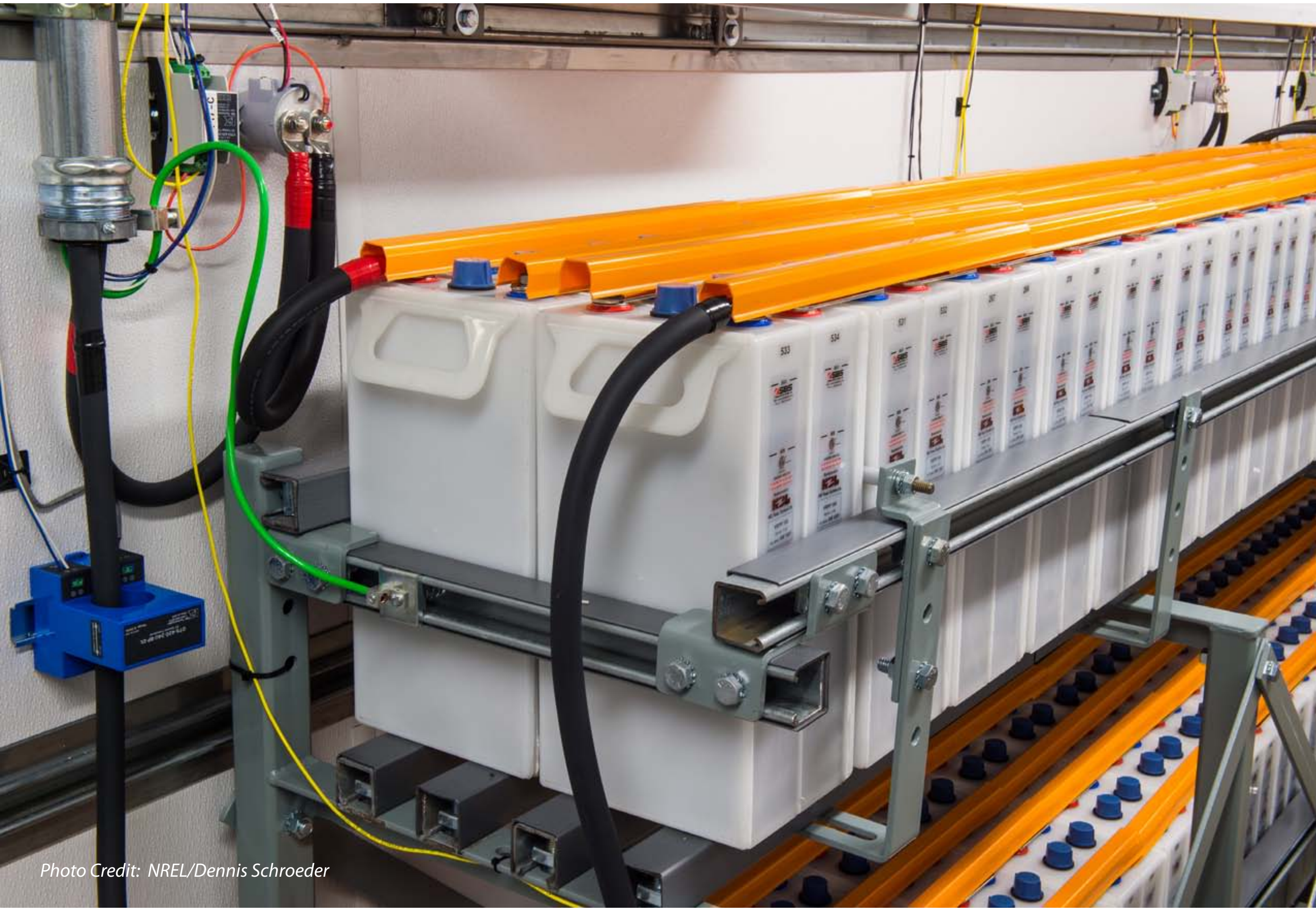


Photo Credit: NREL/Dennis Schroeder

CONCLUSION

As awareness of grid vulnerabilities and outages grows, the cost of resilient power solutions comes down, and markets for distributed energy resources develop, more and more states are considering what they can do to implement policy and programs in support of resilient power deployment.

As we have shown in this report, state actions can take many forms, from one-off demonstration projects to multi-year grant programs to financing institutions and market support. Each state will have to choose the approach that fits its unique needs and circumstances; but whatever that approach is, it can benefit from information, examples, and lessons learned from other states engaged in similar activities.

To date, state resilient power efforts have been concentrated in the Northeast. Massachusetts has implemented a $40 million program, New Jersey has implemented a $3 million resilient energy storage program and a $200 million Energy Resilience Bank—the first such institution in the nation—Connecticut has implemented a $48 million microgrid program, New York has a $40 million program underway, Rhode Island has drafted a solicitation for a resilient power study, and Maryland has established a microgrids task force and produced a report, and is planning a solicitation. Vermont has supported a $12.5 million resilient power, solar+storage microgrid project with additional DOE funding.

Because of these state programs, numerous municipalities in the Northeast now have resilient power projects underway. These projects will provide critical emergency services at a likely capital cost of several hundred million dollars. In other words, larger resiliency goals have now been translated into real, on-the-ground community projects protecting communities and their vulnerable populations.

We are at the start of a new clean, resilient power revolution—creating a new field of clean energy: resilient power. States and communities are coming around to the notion that we can provide reliable, resilient power to critical facilities and communities by using clean, distributed generation, such as solar and energy storage. This is both climate change mitigation (as it reduces carbon fuel use) and adaptation (as it protects people from climate change impacts).

The technology has arrived, and it is increasingly affordable. What are needed are supportive policy, innovative financing, and information-sharing efforts about the benefits—which could be demonstrated by multiple resilient power projects in all regions of the country, to get these systems deployed widely.

Clean Energy Group's Resilient Power Project provides a platform for this knowledge-sharing, and provides free policy, program, and technical support to state agencies pursuing resilient power deployment. Thanks to our funders, there is no cost to engage with our staff for technical assistance and information sharing activities. Simply contact us and indicate that you would like to be placed on our email distribution list. You will be notified about conference calls, webinars, new research and reports, and you will receive our free monthly resilient power newsletter by email. You can also search our online library of publications and webinar archive for useful information. To join the Resilient Power Project, go to our webpage at www.resilient-power.org.

RESOURCES FOR FURTHER READING

2015

Solar + Storage 101: An Introductory Guide to Resilient Solar Power Systems, by Seth Mullendore and Lewis Milford, Clean Energy Group. This guide provides a basic technical background and understanding of solar+storage systems. It is meant as a starting point for project developers, building owners, facility managers, and state and municipal planners to become familiar with solar+storage technologies, how they work, and what's involved in getting a new project off the ground. March 2015.

What Cities Should Do: A Guide to Resilient Power Planning, by Robert G. Sanders and Lew Milford, Clean Energy Group. This paper describes a plan of action for cities to become more "power resilient" using new technologies like solar and battery storage, which can be more reliable than diesel generators to protect vulnerable populations from harm due to harmful power outages in severe weather. March 2015.

Distributed Energy Storage: A Case for National and International Collaboration, by Lewis Milford, Seth Mullendore and Todd Olinsky-Paul. In this concept note, Clean Energy Group proposes the creation of national and international networks around the next generation of clean energy innovation: combining energy storage with small-scale clean energy generation at the customer level. February 2015.

Ramp Up Resilient Power Finance: Bundle Project Loans Through a Warehouse Facility to Achieve Scale, by Robert G. Sanders, Senior Finance Director, Clean Energy Group. This report outlines a new clean energy finance model for many resilient power systems to protect vulnerable communities and critical infrastructure from severe weather events. January 2015.

2014

Financing for Clean, Resilient Power Solutions, by Robert G. Sanders, Senior Finance Director, Clean Energy Group. This paper describes a broad range of financing mechanisms that are either just beginning to be used or that have a strong potential for providing low-cost, long-term financing for solar with energy storage (solar + storage). The goal is to identify financing tools that can be used to implement projects and that will attract private capital on highly favorable terms, thereby reducing the cost of solar and resilient power installations. October 2014.

Resilient Power: Evolution of a New Clean Energy Strategy to Meet Severe Weather Threats, by Clean Energy Group. This paper describes the progress of "resilient power" efforts since the New York City blackouts in 1999 to Superstorm Sandy. The paper outlines the dangers that power outages can pose to our most vulnerable populations, the failures of traditional backup power sources, and the opportunities to develop distributed energy systems with clean and dependable energy technologies. The paper goes on to announce the launch of the Resilient Power Project and describes the importance of new technologies like solar PV with energy storage to provide resilient power as weather patterns become increasingly volatile and longer power outages become more frequent. September 2014.

Clean Energy for Resilient Communities, by Robert G. Sanders and Lewis Milford. In the first blueprint of how a city could become more "power resilient," this report shows how Baltimore and other cities could use clean energy to create a more reliable electric system that protects vulnerable citizens during power blackouts. (A report **Summary** is also available.) The report was written by Clean Energy Group for The Abell Foundation, a leading private foundation in Baltimore. February 2014.

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Endnotes

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