

# State Governance, Planning, and Financing to Enhance Energy Resilience



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**About National Association of State Energy Officials**

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

**About the National Governors Association Center for Best Practices**

The National Governors Association (NGA) Center for Best Practices is a 501(c)(3) nonprofit that develops innovative solutions to today’s most pressing public policy challenges and is the only policy research and development group that directly serves the nation’s Governors. The NGA Center is organized into multiple policy areas prioritized by Governors. By covering an extensive range of policy topics, such as workforce development, cybersecurity, public health and infrastructure, our team is ready to assist Governors on any number of policy issues and challenges. Through the NGA Center, Governors and their advisors learn what works and what lessons can be learned from other states facing similar challenges.

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## Introduction

From 2011 to 2020, the United States faced an average of 14 distinct billion-dollar disasters annually at an average cost of \$93 billion.<sup>1</sup> Beyond impacting lives and livelihoods, major natural disasters can devastate energy systems and require expensive repairs and improvements. For this guide, NGA and NASEO are defining resilience as the ability to withstand disasters better, respond effectively, and recover more quickly and to a more improved state.

Threats to energy infrastructure are not just physical. Cyber-attacks cost U. S. businesses \$3.5 billion in 2019.<sup>2</sup> Energy companies are the third most frequent target of cybercriminals, just behind the manufacturing and finance/insurance sectors, experiencing 11.1% of known cyberattacks in 2020.<sup>3</sup> Through planning or luck, many of those attacks did not affect energy supply or delivery; yet, the 2021 Colonial

Pipeline ransomware attack, which limited the fuel supply for millions on the East Coast, underscores the potential severity of the cyber risks to the energy sector.

The costs and impacts of disasters affecting energy infrastructure and supply are not felt evenly across an economy or population. Communities of color, lower-income communities, and communities on the front lines of climate change tend to bear a disproportionate burden in terms of costs, time and resources needed to return to normalcy, health impacts, and lives lost. As natural disasters and malicious attacks become more frequent and costly, particularly to already-disadvantaged communities and people, states are shifting attention to pre-hazard mitigation – investing in system resilience in advance of an incident. Energy resilience planning activities yield high savings potentials, as investing in hazard mitigation saves six dollars for every dollar spent.<sup>4</sup>

### **How to Use This Guide**

To help Governors and State Energy Offices strengthen state preparedness, this guide describes the range of resilience governance structures, plans, and funding mechanisms that states are leveraging to enhance energy resilience. The report is underscored by descriptive examples and case studies throughout. There is no single “best” approach to energy resilience and the path taken will likely depend on multiple factors. As a result, many of the practices highlighted in this paper can be implemented in parallel. But as state leaders continue to shift focus to pre-disaster mitigation, this report illustrates how energy, can be included as a core facet to those efforts.

## **Governance Approaches to Enhancing State Resilience**

Governors and State Energy Offices are establishing new roles and mechanisms to defend infrastructure against a wide range of threats in their states. Efforts include appointing resilience leads (often with a title of “Chief Resilience Officer”), establishing cross-cutting task forces, tasking state agencies with developing state resilience plans, and engaging stakeholders. Energy resilience is a core focus for these efforts due to its interdependencies with public health, transportation, safety, and the economy. As the leads for energy resilience planning, State Energy Offices are further expanding these efforts through policy and program development, grant programs, and support for local government, the private sector, and households. This section highlights relevant best practices for states to consider and implement.

### Appoint a state-wide, multi-agency resilience lead

At least 11 states have positions for resilience officers. These positions are housed in various agencies from state to state. In **Oregon**, the state resilience officer sits directly in the Governor's office. The Governors in **Colorado** and **North Carolina** established dedicated resilience offices working at the direction of a Chief Resilience Officer. In **Colorado**, the Chief Resilience Officer coordinates activities among state agencies and local governments, provides technical assistance to state and local partners, and supports community recovery efforts.<sup>5</sup> In other states, such as **Florida, Louisiana, New Jersey, Rhode Island, South Carolina, Virginia, Washington, West Virginia**, and **Wyoming**, the state's Chief Resilience Officer is housed within established state agencies or also working as an agency director

“Through proper coordination, cooperation and collaboration, the South Carolina Office of Resilience can ensure that the state is maximizing the effectiveness of all available resources to best protect the lives and property of our citizens.” Ben Duncan, South Carolina Resilience Officer

By designating a Chief Resilience Officer, Governors can signal the importance of resilience planning and cross-agency planning and collaboration. Appointed state resilience leads have been instrumental in leading interagency working groups, developing cross-cutting state resilience plans – often with energy as a core focus – and coordinating resource deployment.<sup>6</sup>

### Develop a state resilience plan

State resilience planning is a relatively new yet important tool for states to assess threats and identify policies and investments to improve mitigation. Distinct from energy security plans and state hazard mitigation plans, state resilience plans are generally led by the Chief Resilience Officer or a designated state agency, in collaboration with State Energy Offices and other partner agencies and organizations from across the state.

While they vary in focus and approach, state resilience plans often address the following actions:

- Assessing vulnerabilities
- Planning for critical infrastructure protection including but not limited to:
  - Energy
  - Transportation
  - Water and wastewater
  - Communications
  - Emergency services
  - Healthcare delivery
- Engaging local communities
- Leveraging federal, state and private funds to mitigate economic impacts
- Identifying nature-based solutions and services
- Boosting environmental justice and equitable outcomes

Many states develop their resilience plans based on the need to prepare for a particular hazard that they deal with regularly, such as coastal flooding, wildfires, or earthquakes. For example, *The Oregon Resilience Plan* addresses preparedness needs for a Cascadia subduction zone seismic event and tsunamis. The plan details seismic vulnerabilities in critical infrastructure systems, preparedness measures that can be implemented by those sectors, including energy providers, and fuel delivery security. To further these energy priorities, the state resilience officer and Oregon Department of Energy were part of an NGA-facilitated team that worked with utility leaders across the state to develop the *Oregon Guidebook for Local Energy Resilience*.<sup>7</sup> This guidebook helps small utilities strengthen business continuity planning, identify funding and financing sources for distributed energy resources that can bolster resilience, and provides guidance on operational resilience.

Other plans, such as the *North Carolina Climate Risk Assessment and Resilience Plan*, focus more broadly on the threats posed by climate change. North Carolina's plan includes assessments of 11 key sectors, with the energy assessment led by the state Department of Environmental Quality. In the energy section, the plan assesses the energy systems' vulnerabilities to multiple climate-oriented threats, including heavy precipitation and flooding, sea level rise and coastal storms, and increased temperature and drought. Non-climate stressors such as population growth, aging infrastructure, supply chain interruptions, and critical interdependencies are also included. The analysis identifies multiple acute vulnerabilities in the energy sector along with metrics to measure possible impacts and potential solutions the state could adopt.<sup>8</sup>

The *New Jersey Climate Change Resilience Strategy* also explores solutions to prepare for climate-related threats. Released in October 2021 at the direction of Governor Phil Murphy's Executive Order. The plan outlines actions such as retrofitting buildings to withstand natural hazards, encouraging clean energy in new developments, and prioritizing state agency funding for resilient infrastructure. Energy-adjacent and governance actions include prioritizing engagement with and investment in underserved communities, establishing resilience leadership across all state agencies, and proactively engaging with local government partners. The plan builds on existing gubernatorial goals to develop the clean energy sector and expand energy storage.<sup>9</sup>

While energy may not always be the core focus of a state resilience plan, it is often interwoven throughout. *Virginia's Coastal Adaptation & Resilience Master Planning Framework* was created in 2020 in response to former Governor Ralph Northam's 2018 Executive Order 24, Increasing Virginia's Resilience to Sea Level Rise and Natural Hazards.<sup>10</sup> It highlights the roles that energy efficiency and clean energy can play in mitigation efforts and identifies mechanisms to fund/finance those upgrades (such as Commercial Property Assessed Clean Energy (C-PACE) and Green Banks). Notably, the commonwealth's C-PACE programs were expanded by the General Assembly in 2020 to better support hazard mitigation efforts. The *Colorado Resiliency Framework* includes a section on the infrastructure sector highlighting the need to adopt climate-resilient standards by incorporating energy efficiency and clean energy in retrofits as well as developing resiliency hubs to support community's key facilities during power outages.<sup>11</sup>



Evolving physical and cybersecurity threats will warrant regular updates to state resilience plans. These updates can include a discussion of progress to date and ongoing challenges that the state needs to address. For example, **Oregon's** five-year update to its initial resilience plans details accomplishments by indicating whether prior recommendations have been completed or are still in progress and builds the next series of strategies accordingly.<sup>12</sup>

### **Convene new or leverage existing working groups**

Resilience investments – particularly those supporting the energy sector – can be complex to plan and often involve coordination across state government, with local governments, and with the private sector. Energy resilience is implemented to support critical assets often regulated by other agencies, such as health care facilities. Local governments and communities often have the best understanding of who is in the greatest need of these investments and the private sector generally owns and operates the grid and will be the implementer of many resilience measures.

To proceed with the best information and undertake investments that maximize resilience investments, states frequently organize their planning processes through inter-agency working groups and task forces. These working groups can include representatives from multiple state agencies, local governments, community organizations, utilities, and other private sector providers. Often, a broad approach is effective to identify local or sector-specific resilience needs and maximize the impact of any investments and energy is generally a core component. To address the energy resilience needs of local communities, direct engagement and involvement of those communities – or trusted community advocates – is important.

These can be charged with resilience as a core charge or may be focused on a broader threat such as climate change, with resilience as a focused track. **New Mexico**, for example, conducted a *Climate Resilience Gap Assessment*, using an adapted version of NGA's *State Resilience Assessment and Planning Tool*, through its *Climate Change Task Force*. This effort compiled input from all major state agencies and offices using the National Governors Association's State Resilience Assessment and Planning Tool. Much of this assessment focused on energy resilience, assessing the state's current coordination with local and tribal governments, understanding of the vulnerabilities facing energy systems and solutions that could address them, identifying opportunities for improved local and community engagement, and addressing the energy resilience needs of multiple critical sectors. To complete the tool, input was sought from all *New Mexico Climate Change Task Force* members.

Former **Rhode Island** Governor Gina Raimondo signed an Executive Order in 2017 to create a chief resilience officer position housed in the Rhode Island Infrastructure Bank and to develop an action plan for climate resilience efforts, now known as "Resilient Rhody." The plan was created with guidance from the state's Executive Climate Change Coordinating Council (EC4), which had been created in 2014 through legislative action. After the Resilient Rhody plan was developed, EC4 was tasked with leading implementation of the Resilient Rhody plan strategy and continues to provide regular updates to the Governor and public on progress.<sup>13</sup> To date \$20 million in funding has been provided by the state for resilience projects, establishing a state microgrid grant program and a zero-emissions vehicle program for purchasing new electric buses.<sup>14</sup>

### Design and implement energy resilience programs through state agencies

State Energy Offices play a leading role in in-depth resilience program design and deployment. The **Connecticut** Department of Energy and Environmental Protection led an interagency working group and report to identify how the state is responding to climate change and increasing resilience for all. This is part of a process to develop a statewide resilience plan and identify vulnerable assets for all state agencies.<sup>15</sup> It builds on the state's long-running and legislatively-established Microgrid Grant and Loan Program, which provided funding to local communities, universities, and other grantees for microgrid design and installation.<sup>16</sup>

The **Indiana** Office of Energy Development energy office operates several grant programs to achieve varying energy policy goals by leveraging U.S. Department of Energy State Energy Program funds. Organizations can apply for funding for projects that bolster energy resilience. Applicants must detail how projects improve resilience, how energy disruptions impact communities, and how the project incorporates new technologies or innovations.<sup>17</sup> The **Washington** State Department of Commerce's *Clean Energy Fund* has provided funding for microgrid projects across the state. Projects were funded through the state's capital budget and supported 18 grid modernization projects worth nearly \$4 million total in 2021.<sup>18</sup>

States can also consider programs to improve the resilience of state facilities. Many Governors order state "lead by example" initiatives – often administered through a state general services agency or State Energy Office – that address the energy efficiency, energy expenditures, and overall environmental impacts of state-owned and leased facilities. Resilience can be a core component to these initiatives and multiple funding mechanisms exist that can offset the upfront costs of these investments, limiting reliance on capital budgets and shifting some risk and responsibility to private sector partners. For example, energy savings performance contracts and energy-as-a-service models can be used to improve the efficiency of facilities and deploy on-site generation and storage, improving the ability for state facilities to remain online during a grid outage. **Kansas** offers a Facility Conservation Improvement Program, which allows local governments, universities, or other entities to retrofit their energy systems. Projects are budget-neutral, with the cost of conservation measures paid for by energy savings.<sup>19</sup>

### Engage stakeholders through meaningful forums

When designing energy resilience programs, it is important to consider how resilience investments can impact or benefit communities, industries, and other important stakeholders. To achieve this, establishing meaningful stakeholder engagement processes allows communities and other stakeholders to voice their concerns, highlight priorities, and provide input to help the state maximize any resilience investments.

Many states are incorporating equity-focused engagement by proactively seeking input from underserved and disadvantaged communities. NASEO recently identified equity-focused stakeholder engagement strategies that include:<sup>20</sup>

- Transparently explaining how state programs are structured
- Coalition building by identifying areas of mutual interest
- Empowering communities to take ownership over projects



- Engaging trusted community organizations to understand their needs and how energy transitions or investments will impact citizens

State energy resilience plans and activities are typically developed through an active stakeholder process, incorporating many of the previously mentioned principles. One example of robust stakeholder engagement lies with the **New Jersey** Interagency Council. The Council, led by the Governor's energy and climate policy advisor, involved hundreds of key participants, including the New Jersey Board of Public Utilities, in their planning processes through workshops, webinars, and other engagements. The state conducted a survey to identify concerns and highlight preferred strategies. The Council worked extensively with environmental justice and low-income communities to understand and meet community needs, approach planning responsively and transparently, and build capacity in priority areas.<sup>21</sup>

### Important Actions for State Energy Resilience Planning

As Governors, State Energy Offices, and other states leaders pursue energy resilience, it is important that careful planning is in place at the outset to maximize the impact of investments, ensure the success of projects, and to meet the needs of communities across their states. Drawing on experience from recent state resilience planning and governance efforts, this section describes some factors and actions that state leaders will need to consider.

These include the need to:

- Establish state-level energy resilience governance
- Assess threats to energy security in the state
- Catalog technologies that can address identified threats
- Identifying viable sources of funding and financing
- Ensure investments in resilience are equitable
- Prioritize investments across communities, industries, and facilities
- Engage with private sector partners, local communities, and the public

States may implement these actions individually, implement a subset of these actions, or opt for a more comprehensive approach that involves all six. *Appendix 1: State Resilience Plans* describes many of the recent state resilience plans. Some of the actions recommended in the plans are described below.

#### Establish state-level energy resilience governance

Recognizing the complex and multi-sector nature of energy resilience planning, it can be valuable for Governors to establish and formalize resilience governance structures or mechanisms with an energy sector focus, adapting a broader multi-agency and multi-sector approach. Such mechanisms may include resilience leaders, dedicated resilience offices, crossagency and intergovernmental task forces, and/or the designation of leadership responsibility to a sector-specific agency such as the State Energy Office.

### **Identify energy security threats**

A key first step in energy resilience is assessing the state-specific physical and cybersecurity threats and vulnerabilities that may lead to energy supply disruptions or leveraging assessments already undertaken through other processes, such as the development of state energy security plans. These not only vary by state but can vary by region or locality within a state, given varied topography, climate, and infrastructure types. The solutions that will need to be deployed are dependent on the nature of the energy and interdependent infrastructure systems and the threats they face.

Further complicating this analysis is the evolving nature of natural hazards resulting from a changing climate. Data indicates that storms, droughts, and extreme temperatures are becoming more frequent and severe in many parts of the country, underscoring the need for proactive investments. A comprehensive assessment of these threats will serve as a backbone to state energy resilience planning as it allows state leaders to understand where the need for investment is highest and what those investments will need to protect against. As these threats inflict a disproportionately high impact on disadvantaged communities, it is critical for state decision makers to understand how these communities are impacted during disasters and what mitigation tools are available.

### **Catalog technologies and actions to avoid or mitigate identified threats**

With threats and energy infrastructure vulnerabilities identified, states can then catalog the technologies and policies that can be adopted and implemented to address those vulnerabilities and prioritize their deployment accordingly. These may include distributed resources such as on-site solar generation, energy storage, microgrids, building or grid automation and control technologies, and grid hardening.

States are implementing policies with inherent energy resilience benefits, such as energy efficiency measures, transportation fleet fuel diversification, and clean energy technologies with energy storage. Energy efficiency, for example, can contribute to energy resilience by reducing demand and thus enabling facilities to right-size back-up power sources; by allowing customers to stay in buildings longer and more comfortably during a power outage; and by enabling buildings to operate in energy-saving mode and thus shorten recovery time to restart the electricity system after a power outage.<sup>22</sup> Resilience value can be found across a variety of existing and new state energy programs, and states should be cognizant of resilience benefits and implications across all their program areas.

Governors can also coordinate with local, academic, utility, and private sector partners to identify the optimal solutions for each use case. This becomes particularly important where the state does not own or operate the assets in question. In those instances, the state can partner with infrastructure and facility owners to offer technical assistance, make grant funding available, or address any legal or regulatory barriers preventing resilience investments. Additionally, partnering with community-based organizations can help state leaders identify high-impact actions to serve underserved areas.

### **Identifying viable sources of funding and financing**

A perennial need and ongoing constraint to robust energy resilience planning and investment is limited funding. State governments can encourage the private and utility sectors to make resilience investments

where there is a viable business case or where they can recover costs through rates. Federal funding through programs like the Federal Emergency Management Administration’s Building Resilient Infrastructure and Communities grant program and the U.S. Department of Energy’s State Energy Program offer direct funding to states that can be used to support resilience. The state can expend these dollars directly or grant/lend them to the private sector, homeowners, or local governments to facilitate those investments. Additionally, for some larger resiliency projects the customer may require multiple streams of funding and/or financing to cover the costs of the upgrades. Helping customers identify potential institutions or capital providers to partner with to share costs (where needed) early in the funding/financing process is therefore critical to the success of these projects.

### **Ensure investments in resilience are equitable**

Not all communities or demographics face the same threats, and some are more vulnerable to energy disruptions than others. Low-income communities, communities of color, disabled individuals, and elderly populations can be disproportionately impacted by an energy outage. They are also less likely to have the means to purchase resilient technologies or invest in the housing upgrades that could help them weather an outage. When crafting outreach strategies, it is important to work closely with communities to understand their needs and desired outcomes so effective and appropriate solutions can be deployed. State officials should also consider the need for a multi-modal and multi-lingual communications as not all individuals have access to affordable or reliable internet service and may not have full mastery of the English language.

By working with vulnerable and underserved populations directly and including them in state planning processes, Governors and State Energy Officials can effectively prioritize and address their needs, ensuring that energy can be more resilient for all. For example, **Maryland’s** Resiliency Hub Grant Program provides “grant funding for the development and construction of solar plus energy storage systems to serve as ‘Resiliency Hubs.’” These resiliency hubs are intended to provide low- and moderate-income neighborhoods capital for installations that generate no-cost resilience to the communities they serve. Applications are submitted by those communities, businesses, and non-profits, providing ground-up input on where investment will be impactful.<sup>23</sup>

### **Prioritize investments across communities, industries, and facilities**

With threats assessed, projects identified, and funding secured, it is unlikely that a state will have the full funding needed to address all of their identified energy resilience needs. A prioritization exercise can help state officials to identify critical assets and underserved communities, pursue partnerships with key stakeholders and funders, and ultimately deploy resilience funds where they will be most impactful. For example, in 2021, **Kentucky** released the *Commonwealth of Kentucky Regional Microgrids for Resilience Study*, examining the potential resilience benefits of site-specific and community microgrids from more than 6,000 potential sites. A core component of the study is an assessment of Kentucky mapped natural hazards overlaid with data on population, demographics, critical infrastructure facility locations, energy burden and, if citizens are underserved, prioritize sites by potential benefit.<sup>24</sup> Resilience prioritization can be a challenge since the potential impacts and cost of an avoided energy disruption – in particular one that is longer term – are difficult to estimate.<sup>25</sup> As a result, there is no commonly agreed-upon method to quantify

resilience benefits in project cost effectiveness screens. (However, there are several efforts underway to do so, as documented in a [recent report](#) by the National Association of Regulatory Utility Commissioners).

Given the challenges of estimating the value of resilience, states can work with experts from DOE's national laboratory system or their in-state academic institutions, including minority-serving institutions, to perform more targeted analyses, estimate resilience values, and use qualitative data points to identify impactful investments. For example, Sandia National Laboratory and Los Alamos National Laboratory worked with the city of New Orleans, Louisiana, to conduct a city-wide assessment of the electric grid. The labs modeled the impacts to the city of a hurricane of various strengths, assessed potential damage to grid infrastructure, and mapped those impacts with critical infrastructure assets to calculate the resilience benefits of system modernization investments.<sup>26</sup> Other national labs developing methods to value and prioritize resilience investments include Lawrence Berkely National Laboratory,<sup>27</sup> the National Renewable Energy Laboratory<sup>28</sup> and the Pacific Northwest National Laboratory.<sup>29</sup>

### **Engage with State Agencies, Local Communities, Private Sector Partners, and the Public to Identify, Prioritize, and Coordinate investments**

Economy-wide resilience requires a whole-of-government approach with involvement from local communities and the private sector. Resilience plans should have clearly stated objectives and, to the extent possible, take local and private sector needs and constraints into account. This involves proactive outreach from the state to include those entities early and frequently in the process.

For public engagement, states may want to consider using a range of communications methods, including digital and social media, along with traditional media and partnerships with trusted community organizations. Recognizing that connectivity is variable and not everyone has access to affordable broadband, a multi-modal approach to public messaging will help the state reach the broadest audience in a more equitable fashion. For effective outreach into multi-lingual communities, communications may need to be adapted into languages other than English.

Governors and State Energy Officials can partner with a wide array of government agencies, companies, and non-governmental organizations to study, prioritize, and deploy energy resilience technologies and practices. The section on *Governance Approaches to Enhancing State Resilience* describes some of the formal mechanisms, such as resilience task forces, that Governors have initiated, but this intergovernmental and cross-sector coordination can also happen through less formal means such as informal relationship-building.

Energy systems are interconnected across state borders and natural disasters are often not confined to a single state. Collaborations through regional, multistate, and national organizations can provide meaningful opportunities to identify interstate infrastructure dependencies (such as a state relying on liquid fuels refined in and pumped from another). FEMA's 2016 Cascadia Rising event, for example, was a multi-state exercise through which states in the Pacific Northwest, along with federal, local, and tribal partners, examined the impacts and response to a Cascadia Subduction Zone earthquake and tsunami. Planning is

underway for Cascadia Rising 2022, which is anticipated to involve participation from **Washington, Oregon, and Idaho**.<sup>30</sup> State officials can also learn from one another through direct coordination and through technical assistance offered by organizations like NGA and NASEO.

As discussed in this section, there are multiple actions states can undertake for a robust and deliberate approach to energy resilience. These actions can be implemented as stand-alone efforts or together as part of a robust strategy. However state officials opt to proceed, it is important to seek input from entities and experts across the state given the complexity of comprehensive energy resilience planning.

### **Funding and Financing Mechanisms for Energy Resilience**

To enhance the resilience of the energy sector, states, the federal government, and the private sector are taking advantage of innovative finance and funding approaches. Funding a project entails using public funds (for example tax revenues) to provide grants or other financial support to the project. Financing mechanisms use capital funds through bank financing or private capital investments to furnish the needed capital for a project.

This section provides an overview of how states have utilized various funding sources and financing mechanisms to finance resiliency improvements, which can enable State Energy Office and Governor's office staff to assess different funding mechanisms and evaluate the best opportunities. Additional information about each funding opportunity and additional considerations and limitations are in the body of the report

**Summary Table of Resiliency Financing Options**

The table below provides a summary of the various financing mechanisms covered in the case studies in this section. It highlights the potential technology categories that each mechanism can fund/finance, the unique mechanisms by which each program operates, and the roles that Governors’ Offices and State Energy Offices can play to determine which financing mechanism is optimal.

<b>Funding/Financing Program</b>	<b>Program Mechanisms</b>	<b>Potential Roles for Governors / State Energy Offices*</b>	<b>Associated Case Study</b>
<b>Ratepayer Funds</b>	Utility borrows funds to finance projects;  Capital repaid through customers’ utility bills;  Utility earns a specified rate-of-return on investments (subject to regulator approval and can be ratebased or added via surcharge)	<b>Governors’ Offices:</b>  - Can pass/sign legislation directing Public Utility Commissions to explore grid resiliency improvements  <b>State Energy Offices:</b>  - Can intervene in rate cases (where they have the authority to do so) to influence direction of utility investments	PSE&G Energy Strong Programs
<b>On-bill Financing/On-bill Repayment</b>	Utilities fund or borrow capital from a third-party lender to complete projects which the customer, will repay over time through a surcharge on their utility bills	<b>Governors’ Offices:</b>  - Can develop policy encouraging the development of on-bill programs for resiliency	Holy Cross Energy’s Battery Energy Storage System Program



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<b>Funding/Financing Program</b>	<b>Program Mechanisms</b>	<b>Potential Roles for Governors / State Energy Offices*</b>	<b>Associated Case Study</b>
<i>On-bill Financing/On-bill Repayment Continued</i>		<p><b>State Energy Offices:</b></p> <ul style="list-style-type: none"> <li>- Can convene stakeholders to discuss the outlines of potential on-bill programs for utilities</li> <li>-Can design and offer on-bill financing programs to various customer classes</li> </ul>	
<b>Public-private Partnerships (P3s)</b>	<p>State and local governments partner with private sector firms to design/develop/operate resiliency projects.</p> <p>P3s shift some of the project risk and revenue/ownership from governments to the private sector.</p>	<p><b>Governors’ Offices:</b></p> <ul style="list-style-type: none"> <li>- Can set state energy goals and develop policies that encourage public sector (including state) use of P3s</li> </ul> <p><b>State Energy Offices:</b></p> <ul style="list-style-type: none"> <li>-Can provide education and technical assistance on P3s to state/local governments</li> </ul>	Pittsburgh Airport Microgrid

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Funding/Financing Program	Program Mechanisms	Potential Roles for Governors / State Energy Offices*	Associated Case Study
<p><b>Energy Savings Performance Contracts (ESPCs)</b></p>	<p>A P3 model in which a state or local government contracts with an energy service company (ESCO) to perform efficiency/resilience retrofits to a guaranteed level of energy savings, and then repays the ESCO using those savings over time.</p>	<p><b>Governors’ Offices:</b></p> <ul style="list-style-type: none"> <li>- Can enable ESPC or amend existing ESPC legislation to spur program development; can direct state agencies to explore or undertake ESPCs.</li> </ul> <p><b>State Energy Offices:</b></p> <ul style="list-style-type: none"> <li>- Can operate ESPC programs: assist with audits, prequalify ESCOs, review M&amp;V, and provide other assistance as needed.</li> </ul>	<p>Cannon Air Force Base ESPC-Funded Base Upgrades</p>
<p><b>Energy-as-a-Service (EaaS)</b></p>	<p>A state or local government contracts with an EaaS provider, which designs, finances, constructs, owns, and operates a resilience project. The customer pays for the technology and manage over a set timeframe</p>	<p><b>Governors’ Offices:</b></p> <ul style="list-style-type: none"> <li>- Can clarify policy and uses for EaaS in a state</li> </ul> <p><b>State Energy Offices:</b></p> <ul style="list-style-type: none"> <li>- Can educate customers on the differences between ESPCs and EaaS and P3s</li> </ul>	<p>U.S. Marine Corps Recruit Depot</p>

Funding/Financing Program	Program Mechanisms	Potential Roles for Governors / State Energy Offices*	Associated Case Study
<p><b>Commercial Property Assessed Clean Energy (C-PACE)</b></p>	<p>A customer repays loans for efficiency and resilience projects through an assessment on their property taxes.</p>	<p><b>Governors' Offices:</b></p> <ul style="list-style-type: none"> <li>- Can pass C-PACE-enabling legislation or push to amend existing legislation to allow CPACE to finance resiliency improvements.</li> </ul> <p><b>State Energy Offices:</b></p> <ul style="list-style-type: none"> <li>- Can oversee third-party or green bank C-PACE administrators</li> <li>- Can provide education and convene stakeholders on CPACE program development</li> </ul>	<p>Single-Building microgrid in Hanover, Maryland</p>

**State Governance, Planning, and Financing to Enhance Energy Resilience**

Funding/Financing Program	Program Mechanisms	Potential Roles for Governors / State Energy Offices*	Associated Case Study
<b>Green/Resilience Banks</b>	Lend capital to provide financing that fills “gaps” in the clean energy marketplace, and/or develop products that incent the private sector to invest in target areas.	<p><b>Governors’ Offices:</b></p> <ul style="list-style-type: none"> <li>- Can introduce/sign legislation to establish a Green/Resilience Bank and provide initial seed capital through state budget appropriations</li> </ul> <p><b>State Energy Offices:</b></p> <ul style="list-style-type: none"> <li>- Can help develop guidelines for green/resilience banks, can convene key stakeholders to discuss potential bank organization / products / priorities, can house green banks</li> </ul>	Florida Solar Energy Loan Fund Resilience Loans
<b>Bonds</b>	Issued by state and local governments to finance infrastructure and other projects, including resilience upgrades	<p><b>Governors’ Offices:</b></p> <ul style="list-style-type: none"> <li>- Can preside over bond sales to finance infrastructure/resilience projects</li> </ul> <p><b>State Energy Offices:</b></p> <ul style="list-style-type: none"> <li>- Can provide education and support on bonds/resilience bonds for potential users</li> </ul>	Louisiana Public Service Commission Bond Issuances for Grid Repairs

The case studies below represent examples of states using each funding/financing mechanism in action to help support state resilience goals. Each case study describes the use of the financing mechanism in each scenario, what measures the mechanism financed, and how the customer will repay the financing mechanism. The second part of each case study describes each mechanism more generally and how it works to provide financing for resiliency improvement

### **Utility and Ratepayer Funds**

#### **Case Study: PSE&G Energy Strong Programs (Ratepayer funds)**

In the aftermath of Superstorm Sandy's landfall in 2012, the New Jersey Board of Public Utilities (NJ BPU), the state's Public Utility Commission (PUC), issued an order requiring the state's electric utilities to increase their resiliency and preparedness for future severe weather events and provide NJ BPU with a cost-benefit analysis of potential resiliency upgrades to the grid.<sup>31</sup> Public Service Electric & Gas Company (PSE&G), one of the investor-owned utilities (IOUs) in New Jersey, created a plan to invest approximately \$1.7 billion into grid hardening improvements over its service territory. NJ BPU approved a version of the program consisting of \$620 million in improvements in May 2014.<sup>32</sup> NJ BPU then approved a second version of the program (Energy Strong II) in 2019.

The Energy Strong programs aimed to improve the resiliency of PSE&G's electric grid through three pathways: hardening substations, installing advanced technologies, and improving contingency reconfiguration. To ensure that the utility was able to fund these investments and recover its capital, NJ BPU approved an accelerated rate recovery mechanism for Energy Strong II, which allowed PSE&G to apply for up to six rate adjustments as long as it provided specific information to NJ BPU, including performance reports using reliability metrics (CAIDI, SAIFI, SAIDI, and MAIFI).<sup>33,34</sup> While the program is ongoing, several resilience investments have already paid off: substations that flooded during Hurricanes Sandy and Irene were not affected by Hurricane Ida in 2021.<sup>35</sup> and PSE&G will continue to use rate recovery to further its grid resiliency upgrades.

Utility ratepayer funds (rate based), like those used by PSE&G, are a potential source of capital for resiliency investments.

Subject to PUC approval, utilities have the ability to raise capital and use it for grid improvements, and then recoup costs from their ratepayers. Utility owned-and-operated resiliency improvements can be advantageous because utilities can streamline the processes for connection of these improvements to the larger grid, and possible third-party ownership issues, such as right-of-way concerns, can be mitigated. However, including resiliency projects into the rate base allocates costs across a utility's entire population of customers, even those that might not directly benefit from the investments. PUCs may need to carefully weigh the pros and cons of allowing utilities to develop resiliency improvements in their jurisdictions before determining whether they can recover funds from ratepayers for these projects. Governors can sponsor legislation and work with the state legislature to direct their state's PUC to consider allowing utilities to recover certain costs related to clean energy investments, and State Energy Offices, where they have the authority, can intervene in rate cases where the utility is considering rate-basing resiliency investments.

### **Case Study: Holy Cross Energy's Power + Program (On-bill Financing)**

Holy Cross Energy, a rural electric cooperative located in Colorado, launched an on-bill financing program in September 2020 to help its residential customers deploy battery storage systems on their properties.<sup>36</sup> The pilot program, known as the Power + program, initially involved six customers in the utility's service territory who received Tesla Powerwall battery packs. The customers will repay the utility for the cost of the battery and the installation costs over a period of ten years through a surcharge on their utility bills and allow the utility to control the batteries to manage power on the grid. In exchange for the periodic control of the battery, the utility will provide each customer with a distribution flexibility credit of \$10.30 per kW per month (\$51.50 per Powerwall 2 each month), which offsets some of the upfront costs.<sup>37</sup> The utility is using Power + to test access to the batteries and how best to utilize them to ensure grid reliability. The customers gain additional resilience from having on-site backup battery power for their buildings. Holy Cross fully launched the program in mid-2021.

**On-bill financing (OBF) programs** provide ways for residential and commercial customers to finance resiliency, energy efficiency, and renewable energy property improvements through a surcharge on their utility bills. Customers in a utility service territory with an active OBF program receive improvements to their properties which they repay overtime on utility bills. Funding for the capital improvements can come from either a third-party lender, federal programs like U.S. Department of Agriculture's Rural Energy for America Program or the utility itself. OBF programs can also potentially fund investments in resiliency, including on-site battery storage or generators, to ensure building owners can keep the lights on in case of a grid disruption. While statutory approval is not usually needed for rural utilities to move forward with on-bill programs, Governors and State Energy Offices can both develop working groups to review research and get feedback on the feasibility of on-bill programs for their states, encourage utility adoption, help train the needed workforce to perform projects, provide additional funding if needed, and provide support with outreach and education. A variant of OBF programs are Pay-As-You-Save programs or PAYS. The PAYS loan is paid on the utility bill, but the loan is attached to the meter, making this an attractive option for renters. PAYS also has some additional consumer safeguards if the savings are not achieved by the energy efficiency measures installed.<sup>38</sup>

## **Private Funding**

### **Case Study: Pittsburgh Airport Microgrid (Public-Private Partnerships)**

In 2019, the Allegheny County Airport Authority (ACAA), which owns the Pittsburgh International Airport, announced an agreement with a private company to design, develop, and operate a natural gas and solar-powered microgrid that will generate power for the entire airport and adjacent facilities.<sup>39</sup> The microgrid will take over as the primary source of power for the airport, and the airport would only rely on the main electric grid for emergency or backup power. The airport expects the microgrid to help avoid outages that could result in flight delays or cancellations.

To develop the microgrid, ACAA issued a Request for Proposals (RFP), which received 64 responses.<sup>40</sup> ACAA contracted with Peoples Natural Gas, an energy company based in Pittsburgh, to build, operate, and maintain the system for 20 years at no cost to the airport. The airport also agreed to purchase power from Peoples for the next 20 years. The resulting microgrid will leverage five natural gas generators and over 7,800



solar panels and produce approximately 20 MW of electricity, which is more than sufficient to cover the airport's peak demand of 14 MW. The natural gas generators will be supplied from gas wells located on the airport's land. The Airport Authority's microgrid came online in mid-2021.

**Public-private partnerships (P3s)** are agreements between a public entity (typically a state or local government) and a private company where the private company provides services that the state or local government has historically provided.<sup>41</sup> P3s have flexible structures and roles for both the government and the private partner,<sup>42</sup> and can be advantageous to both parties by shifting the risks associated with a project to the entity that is best able to manage those risks. P3s also allow for cost savings through private sector procurement practices and can utilize private financial resources and capital to fund the project(s). However, P3s can also have substantial transaction costs, including legal and consulting fees, and higher interest rates charged by private capital providers. Additionally, the complexity of these arrangements makes projects more prone to risk overall. Nevertheless, P3s can offer the flexibility states need when considering investments in resiliency upgrades. While not a financing or funding mechanism per se, State Energy Offices have traditionally played an important role in encouraging P3s, especially Energy Savings Performance Contracts (ESPC).<sup>43</sup> As P3s are considered for resilience investments, State Energy Offices and other state agencies can encourage their success by provide state guidance, model programs and contracts, and education on success stories.

### **Case Study: Cannon Air Force Base Upgrades (Energy Savings Performance Contracts)**

Cannon Air Force Base in New Mexico recently finalized an Energy Savings Performance Contract (ESPC) to install energy efficiency and resiliency improvements throughout the base.<sup>44</sup> The \$19.2 million contract with Ameresco will upgrade 119 buildings throughout the base, generate energy savings of 77,883 million BTUs, achieve financial savings of approximately \$1.1 million in the first year and \$33 million over the course of the project, and reduce annual carbon emissions by 10,700 tons.<sup>45</sup> The upgrades will include a lighting controls system, LED lighting upgrades, transformers, and HVAC duct sealing. Ameresco will also install an on-site solar array of 1.9 MW to provide power to the base and reduce its reliance on the larger electric grid. The base anticipates all upgrades will be installed by June 2022.

**Energy Savings Performance Contracts (ESPCs)**, are well-established mechanisms that have driven the implementation of over \$50 billion in cost-effective energy-related building infrastructure improvements since the 1980s.<sup>46</sup> An ESPC consists of an agreement between a customer and an Energy Service Company (ESCO). As part of the agreement, the ESCO performs an Investment Grade Audit (IGA) to determine the savings opportunities available within the building(s) in its current condition.

The ESCO and the customer agree to a specific, guaranteed level of energy savings, then the ESCO replaces and upgrades the building infrastructure based on the agreed-upon level of savings. The customer repays the ESCO for its work through the energy bill savings it receives from the improvements. The energy savings should pay for the cost of the upgrades. However, if the savings do not match the level of savings agreed to in the contract, the ESCO either installs additional energy conservation measures or financially compensates the customer to make up the difference. State Energy Offices play significant roles in the development and execution of successful ESPC programs. They can develop rules and regulations for the program, prequalify ESCOs for use by other state agencies, review IGA and measurement and verification (M&V) reports, market ESPC to potential customers, and walk customers through the entire ESPC process.

### **Case Study: U.S. Marine Corps Recruit Depot (Energy-as-a-Service)**

The U.S. Marine Corps Recruit Depot trains more than 20,000 Marine Corps recruits on the remote Parris Island. To enhance the site's resilience, the U.S. Marine Corps contracted with Ameresco to deploy energy efficiency measures and build a 10-MW microgrid powered by combined heat and power, solar installations, a battery system, and diesel back-up generators. The microgrid, which started operating in 2019, can withstand earthquakes and storms. The project is projected to save \$6.9 million in annual utility and operational costs and reducing energy demand by 75 percent.<sup>47</sup> The project was financed without any upfront costs by the U.S. Marine Corps and the energy savings during the 22-year period of performance will repay the project.<sup>48</sup>

Energy-as-a-service (EaaS) (or in the case of Parris Island, microgrid-as-a-service) is a pay-for-performance model that can be used to finance resiliency improvements. The EaaS provider designs, finances, constructs, owns, and operates the project, and receives the revenues it generates as compensation as well as a fee from the user of the project. EaaS financing can be a useful way for customers to increase building resiliency without upfront costs. EaaS is currently considered to be an offbalance sheet transaction, which means that it does not appear on an agency's balance sheet as a liability, so it does not count as debt.<sup>49</sup> This may make EaaS appealing to localities that have budgetary restrictions or are limited in the amount of debt they can issue. However, compared to other financing models, EaaS agreements are complex arrangements involving multiple players: the state or local government, the EaaS provider, and the contractor(s). State Energy Offices and PUCs may wish to consider implementing policies and regulations to appropriately value resiliency to encourage the use of these contracts for resiliency improvements. While state and local governments have leveraged EaaS to construct microgrid projects, its versatility allows it to finance a wide range of building or campus resiliency improvements.

### **Case Study: Single-Building Microgrid in Hanover, Maryland (C-PACE)**

As the COVID-19 pandemic caused a dramatic increase in telework, office buildings are looking for additional benefits to provide their tenants. A commercial office building in Hanover, Maryland, partnered with Ozop Energy Solutions to deploy a near zero microgrid to reduced energy costs and increase resilience. The near zero microgrid will include a battery, a natural gas generator, a PV system, two EV charging stations and a several energy efficiency measures.<sup>50</sup> The anticipated savings include costs savings of \$4 million over the life of the 20-year project and energy savings of 1,279,290 kWh per year.<sup>51</sup> The project is financed by a C-PACE loan for twenty years and is also benefiting from a grant from the Maryland Energy Administration and federal investment tax credits. The unique project knits together several funding streams and is the first time this first-of-a-kind near zero microgrid is being deployed in the U.S. The building will remain fully operational in the event of a power outage and will also be able to participate in demand response programs.<sup>52</sup>

C-PACE, which is financing the microgrid in Hanover, is a financing tool that allows commercial building owners to borrow and repay funds to install energy and water efficiency, renewable energy, and resiliency upgrades through a voluntary special assessment on the building's property taxes.<sup>53</sup> Depending on the project, the reduction in the building's energy bills partially or fully offsets the corresponding increase in the property tax bill via the assessment. The use of C-PACE is expanding across the country: as of June 2020, 37 states have passed legislation enabling C-PACE, and 22 states and the District of Columbia have active C-PACE programs in place.<sup>54</sup> Customers usually use C-PACE to

completely finance a project, to increase the scope of the project, or to replace more expensive debt or equity for the project.<sup>55</sup> The longer-term repayment period allows for the annual costs to be lower than the costs of mezzanine debt or equity.<sup>56</sup> Otherwise energy efficiency, renewable energy, and equipment replacement measures that reduce a building's energy footprint and enhance its resilience might be left out of a property's construction or renovations.<sup>57</sup> Thus, C-PACE is a flexible source of capital that can be used to help finance singlebuilding resiliency improvements, including on-site battery storage and generators. However, states need to specifically allow C-PACE to finance resiliency measures in statute. **Alabama's** statute specifically enabled C-PACE for resiliency improvements in 2015, including flood mitigation, wind resistance, and stormwater management.<sup>58</sup> Governors play a valuable role in championing legislation to enable C-PACE in their states and ensuring that resiliency improvements are financeable; in **New Jersey**, Governor Phil Murphy was able to secure passage of C-PACE legislation in 2021.<sup>59</sup>

### **State and Local Funding Mechanisms**

#### **Case Study: Florida Solar Energy Loan Fund Resilience Loans (Green Banks)**

The **Florida** Solar & Energy Loan Fund (SELF) is a non-profit green bank operating within the state of Florida. Founded in 2010 through a U.S. DOE Energy Efficiency Community Block Grant (EECBG) award, SELF leverages a loan portfolio of over \$7 million to provide loans to residential and commercial customers to invest in energy efficiency, solar, and resiliency upgrades to their properties. SELF's storm resilience loans can be used to finance window and door repairs and replacements, shutters, weatherization and insulation of homes, and other storm-hardening options. Resilience loans currently represent 22% of SELF's loan portfolio, which is equivalent to retrofitting approximately 250 homes.<sup>60</sup>

Green banks typically use innovative financing mechanisms to attract private capital with the goal of deploying energy efficiency, renewable energy, and resilience projects, including microgrids, at scales that public funds alone would be unable to achieve. A green bank is a focused entity tasked with delivering innovative financing solutions to help states transition to clean energy and reduce climate impacts.<sup>61</sup> To meet their goals, green banks offer a variety of products aimed at reducing the cost of capital for resilience and clean energy projects. These can include credit enhancement mechanisms, aggregation and warehousing of projects, co-investment, on-bill financing, technical assistance, and education and technical assistance on these products for prospective customers.<sup>62</sup> Green banks typically focus on commercially available clean energy technologies and solutions due to the greater potential for payback from those types of projects.<sup>63</sup>

#### **Case Study: Louisiana Public Service Commission Bond Issuances for Grid Repairs (Bonds)**

Recognizing the importance of maintaining a reliable and resilient grid, in 2007 the Louisiana legislature passed a bill that enabled the **Louisiana** Public Service Commission (LPSC) to sell "system restoration bonds" to provide utilities with low-cost financing to make needed grid repairs.<sup>64</sup> The LPSC has since leveraged this mechanism to provide a lower-cost way to pay for the costs of rebuilding the electric grid after hurricanes. For example, in 2014, the LPSC issued an order to sell \$315 million of bonds to repay Entergy Corp. for rebuilding the electric grid after Hurricane Isaac.<sup>65</sup> The LPSC repaid the bonds by including a surcharge on Entergy's customers' energy bills. Commissioners on the LPSC noted that the decision to sell the bonds would save customers approximately \$150 million compared to the utility directly recovering those costs as

the utility rebuilt the grid following the hurricane.<sup>66</sup> The bond issue was based on the recoverable costs for the utility as well as some storm reserve funding.

Louisiana demonstrates how state and local governments can issue bonds to directly finance resiliency projects. Bonds represent loans made from a capital provider to a borrower and consist of the amount being loaned as well as a repayment schedule with a specific level of interest. There are two main types of bonds: “general obligation” or GO bonds, where the bond is backed by “the full faith and credit” of the issuer, and revenue bonds, where the bond is repaid through the revenue generated from the investment (such as a toll road, stadium, or parking garage). State and local governments, as well as private organizations, are exploring new types of bonds to help finance resilience projects. These bonds, known as resilience bonds, are a segment of the growing green bond market and are designed to specifically finance climate resiliency projects, although most financed projects to date have focused on mitigation projects instead of climate adaptation efforts.<sup>67</sup>

### **Other Funding/Financing Sources**

#### **State Energy Revolving Loan Funds**

Many State Energy Offices operate one or more State Energy Revolving Loan Funds (RLFs). These programs enable state energy officials or similar entities to use an initial capital allocation to offer long-term, low-interest financing for various uses, from commercial and public building retrofits to industrial efficiency and renewable energy adoption.<sup>68</sup> The loan repayments are then used to re-seed the fund, enabling RLFs to continue to catalyze energy efficiency and renewable energy investments for years. The ability of these programs to finance various energy projects with long-term, below-market interest rate loans can make them very attractive to resilience projects looking for capital. They are also relatively flexible in what they can finance, which can provide opportunities for resilience projects to use the capital for part or all of their components. Many RLFs are capitalized with U.S. State Energy Program (SEP) funds, which support the deployment of energy efficiency and renewable energy technologies throughout the country. However, RLFs may be limited by the technologies they are allowed to fund under state rules governing their funds. Additionally, many RLFs were capitalized with funding from the American Recovery and Reinvestment Act (ARRA), so Davis-Bacon, Buy American, and ARRA reporting provisions apply to those funds.<sup>69</sup> This may make them more cumbersome and expensive to use than private capital.

#### **Regional Greenhouse Gas Initiative (RGGI) Auction Revenues**

Most states in the Northeast and Mid-Atlantic<sup>70</sup> have access to Regional Greenhouse Gas Initiative (RGGI) auction proceeds. RGGI is a cap-and-trade system where states auction a specific number of allowances to various carbon emitters. The states then use the revenues from those allowances to invest in energy efficiency, renewable energy, and GHG abatement programs. Several states, including **Delaware** and **Maryland**, allow RGGI funds to be used for climate resiliency projects in addition to energy efficiency and renewable energy.<sup>71</sup> This provides a potentially large source of funding to support resiliency improvements to the electric grid and critical infrastructure in those states, and can enable them to set up the other programs discussed in this section to efficiently deliver capital to vulnerable communities in need of resiliency upgrades.

### **Federal Funding Opportunities**

**Case Study: Electrical System Ice and Wind Storm Mitigation Projects in Kansas and Nebraska (FEMA HMGP and BRIC)** In 2007, the Federal Emergency Management Agency (FEMA) funded two projects in Kansas and Nebraska that aimed to increase the resiliency of the local electric grid to ice and wind storms.<sup>72</sup> FEMA partnered with the City of Kiowa, Kansas, and the Southwest Public Power District (SWPPD) to fund three projects: the replacement of electric poles and installation of stronger conductors on two different sets of transmission lines in Nebraska; and the replacement of distribution conductors, poles, and transformers in Kiowa itself. FEMA's Hazard Mitigation Grant Program (HMGP) provided \$1.15 million for the two projects. In the winter of 2006-2007, Kansas and Nebraska experienced a severe ice storm that damaged many parts of the state. A FEMA study examining how the resilience improvements fared found that total losses avoided amounted to \$1.33 million, providing a return of investment of 115 percent for the projects.<sup>73</sup>

FEMA's Hazard Mitigation Grant Program (HMGP) funds projects in areas under a Presidential Major Disaster Declaration that is determined by the state's Governor.<sup>74</sup> The formula for HMGP provides funding for disaster areas depending on the amount of disaster assistance required for the designated area.<sup>75</sup> State governments apply for the funding and then award funding to subapplicants, who administer the grants and comply with program requirements. Qualifying uses of this funding include infrastructure retrofits that mitigate risk to existing utility systems.<sup>76</sup> Resilience projects that prove they fit this category may be awarded funding for development.<sup>77</sup> In 2021, for example, FEMA awarded the Utility Board of the City of Key West over \$5.5 million for the protection of utility poles from future storms. The HMGP funding will "help pay for protection from corrosion due to water and salt air for 119 water crossing transmission poles near the north end of the Seven Mile Bridge in Marathon Key, resulting in a more resilient electrical grid for southern Monroe County."<sup>78</sup>

FEMA also provides assistance through the Building Resilient Infrastructure and Communities (BRIC) Program (formerly the Pre-Disaster Mitigation Grant program), which is designed to assist state and local governments with mitigation planning and projects while reducing reliance on federal money in a future disaster.<sup>79</sup> These grants are awarded, based on an annual state and territory allocation, a tribal set-aside, and a national competitive selection process, with the latter making up the bulk of BRIC funding. State, territorial, tribal, and local governments need to adopt hazard mitigation plans before applying for funds for Pre-Disaster Mitigation projects.<sup>80</sup> Once the governing body has developed and adopted a hazard mitigation plan that is approved by FEMA, it can apply for project funding consistent with the plans. Localities may be eligible for funding for microgrid projects if those projects meet the mitigation goals. FEMA announced the availability of \$1 billion in funding under the program for FY 2020.<sup>81</sup> Governors can play an important role here in prioritizing energy investments across state agencies (including the State Energy Office and Office of Emergency Management, which is typically the lead on these applications), bring project partners to the table, and facilitate effective applications.

### **Case Study: New Jersey Energy Resilience Bank (HUD CDBG)**

In 2014, **New Jersey** used \$200 million in U.S. Department of Housing and Urban Development's Community Development Block Grant – Disaster Recovery program (HUD CDBG) funds to capitalize an Energy Resilience Bank. The Resilience Bank's mission is to finance the installation of distributed energy resources to improve the resiliency of critical facilities throughout the state.<sup>82</sup> Technologies eligible for the Resilience Bank to finance include (but are not limited to) combined heat and power systems, fuel cells, and solar panels.<sup>83</sup> Eligible facilities

include water/wastewater treatment plants, hospitals, transportation networks, emergency response facilities, and schools that function as shelters.<sup>84</sup> Since its establishment, the Resilience Bank has made several low-interest grants and loans to increase critical facility resiliency. For example, in 2017 the Resilience Bank financed the installation of CHP systems at three New Jersey hospitals to ensure their operation during future black sky conditions.<sup>85</sup> The bank also provided funding to improve the resiliency of a wastewater treatment plant's existing CHP system, to raise the substations serving the plant to above flood levels, and to install a biogas storage tank to ensure availability of gas for the plant's CHP systems in the event of a disruption.<sup>86</sup> The Resilience Bank is no longer accepting new applications for funding at this time as it has no further funding to distribute.

HUD CDBG offers funding for resilience projects in areas affected by recent natural disasters.<sup>87</sup> The program aims to assist communities in developing projects to mitigate the risk from future disasters. Potential grantees must develop action plans that include Mitigation Needs Assessments, which analyze current and potential disaster risks to develop a baseline for potential resilience improvements.<sup>88</sup> As of 2018, HUD had nearly \$16 billion available to award for resiliency mitigation projects.

### **Case Study: Transmission and Smart Grid Upgrades in Minnesota (USDA Electric Loan Program)**

In 2021, the U.S. Department of Agriculture's Electric Loan Program provided \$22.8 million in low-interest loans to Minnesota Valley Cooperative Light & Power to build transmission and smart grid improvements in its service territory.<sup>89</sup> The improvements will connect 132 customers to the utility grid and improve over 137 miles of electric lines. The utility plans to install over \$1.3 million in smart grid technologies to improve grid operations and resilience.

The U.S. Department of Agriculture's Rural Utilities Service (RUS) operates an Electric Infrastructure Loan & Loan Guarantee Program which loans capital at low interest and long repayment terms to rural utilities in order to assist those utilities with upgrading their infrastructure. Eligible improvements covered by this program include maintenance, upgrades, and replacement of transmission and distribution facilities; energy efficiency; and renewable energy upgrades.<sup>90</sup> The program recently invested \$598 million in eleven states to improve rural electric infrastructure and install smart grid technologies in rural communities and Tribal lands.<sup>91</sup>

## **Other Federal Resilience Funding/Financing Options**

### **HUD Section 108 Loan Guarantee Program**

HUD's Community Redevelopment Block Grant program also offers low-cost, long-term financing for economic and community development, including to improve the resilience of infrastructure damaged by natural disasters, under its Section 108 Loan Guarantee Program.<sup>92</sup> State and urban local governments are eligible to borrow funds, and states can borrow funds on behalf of local governments that would otherwise be ineligible for funding. Eligible projects for these funds include green infrastructure projects or activities, or reconstruction of public facilities.<sup>93</sup> Section 108 financing is usually used to fill gaps in the financing for larger projects, or to provide security that private investors may need to invest in a project.<sup>94</sup> HUD currently has \$83.9 billion allocated for this program, of which \$55.1 billion is in active grants.<sup>95</sup> HUD also provides [several tools and resources](#) for states and other stakeholders to learn more about how to use CDBG Programs and grant for a number of resilience-related investments.



### Opportunity Zones

The passage of the Tax Cuts and Jobs Act of 2017 created Governor-designated Qualified Opportunity Zones (QOZs) that provide tax incentives for businesses to invest in underserved communities in specific census tracts. 8,763 census tracts in all 50 states, the District of Columbia and the 5 territories were designated as QOZs.<sup>96</sup> The Act allows investors to develop Qualified Opportunity Funds, (QOFs) which are investment vehicles designed to invest into QOZs. Investors are allowed to defer taxes for capital gains reinvested into QOFs until December 31, 2026, or when the investment is sold. If the investor holds the investment in the Opportunity Fund for over ten years, the investor may also permanently avoid capital gains taxes altogether.<sup>97</sup>

### Key Questions and Considerations for Financing a Resilience Project

To help state and local governments understand their options when considering financing for resilience projects, NASEO and NGA have developed a list of key questions and considerations that underlie a customer's decision to invest in a resilience project. Please note that many projects can use several of these financing options in concert with one another and that this is not an exhaustive list of the decisions a state or local government may need to make as part of the financing process. Please consult with state or local tax or financial experts before making any final decisions on the financing projects highlighted in this report. DOE has several tools that provide additional information on these questions (for example [the better building financing navigator, a flowchart](#) of traditional and specialized financing options for renewable energy and energy efficiency, and a [resilience roadmap](#) for commercial buildings).

1. Who owns/will own the project?
2. What type of project is the decision-maker considering?
  - a. Energy infrastructure?
  - b. Public sector/MUSH market, or private sector?
  - c. Single-building?
  - d. Multiple-building?
  - e. Campus/base?
3. What is the capacity of the decision-maker to take on the funding or the financing of the project?
  - a. Are there grant funds available (via state or federal or other sources)?
  - b. Does the decision-maker have its own budget for the project?
  - c. Does the decision-maker have the ability to issue a bond?
4. Are there willing or interested partners to share costs?
  - a. Other state agencies?
  - b. Local agencies?

- c. Owners of the property or infrastructure in question?
  - d. Can federal funding be leveraged?
- 5. Is financing an option and if so what financing preferences do you have (shorter vs. longer, complexity, timeline of project, etc.)?
- 6. What potential revenue streams are accessible through the project?
  - a. What policies are in place from the state that the decision-maker can leverage?
  - b. What technologies can produce monetizable outputs?
  - c. Are there interested parties available to finance the project in part or whole with the monetizable outputs identified?

## Appendix 1: State Resilience Plans

State governments prepare for natural disasters and other threats to energy and infrastructure security through multiple formalized planning mechanisms. These are well-established and are important foundations upon which state emergency preparedness is built. These include:

- **Emergency operations plans** can take different forms in each state, but all document the procedures, roles, and guidelines a state will employ to guide its response to and recovery from an emergency. These generally include annexes for the Federal Emergency Management Administration's (FEMA) Emergency Support Functions, one of which is energy. These annexes provide a sectoral structure to the state's emergency response and foster improved planning and coordination between the state and federal governments.
- **Energy security plans** (also known as energy assurance plans) are preparedness, response, and recovery plans specific to energy emergencies. NASEO maintains robust energy assurance planning resources for state energy and emergency response leaders, available here: <https://www.naseo.org/energyassurance>
- At times similar in nature to the state-wide resilience plans discussed in this document, **hazard mitigation plans** help state and communities identify the risks from potential natural and human-caused hazards, assess response and mitigation capabilities, and identify actions to mitigate potential impacts from these hazards. FEMA requires state, local, and tribal governments to develop and maintain these plans as a condition for receiving some non-emergency assistance through its Hazard Mitigation Assistance Grant Program. FEMA maintains a maps with the latest state hazard mitigation plans here: [FEMA Map of State Hazard Mitigation Plans](#)

The energy resilience plans discussed in this resource guide and listed in this appendix differ from these three formal planning types in that they provide state leaders more flexibility in how they develop and target pre-disaster mitigation plans. Where developed, state-wide resilience plans generally complement these other formal emergency plans.

<u>Plan</u>	<u>Authorization (EO or legislation)</u>	<u>Release Date</u>	<u>Lead Entity and Energy Stakeholder Involvement</u>	<u>Energy Technologies or Measures Discussed</u>	<u>Funding Mechanisms Identified</u>	<u>Stakeholders Involved</u>
<a href="#"><u>Colorado Resiliency Framework</u></a>	<a href="#"><u>Colorado Revised Statute 24-32-122</u></a>	Originally released in 2015, updated in 2020.	Colorado Resiliency Office	<ul style="list-style-type: none"> <li>Integrate resilience into infrastructure funding</li> <li>Build network of resiliency hubs</li> </ul>	Resilience framework spent considerable effort to quantify future impacts to detail why investments are necessary.	State agencies, local communities.
<a href="#"><u>Florida Sea-Level Rise Vulnerability Assessment Tools and Resources</u></a>	NA	June 2015. Updated Resilience Plan scheduled for 2023.	Department of Economic Opportunity and Environmental Protection	Document modeled how sea level rise would impact Florida, using modeling and geographic visualization tools to identify impacted jurisdictions.	While not a funding mechanism, the plan identifies which tools can achieve certain adaptation and mitigation goals.	State agencies, NOAA

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<u>Plan</u>	<u>Authorization (EO or legislation)</u>	<u>Release Date</u>	<u>Lead Entity and Energy Stakeholder Involvement</u>	<u>Energy Technologies or Measures Discussed</u>	<u>Funding Mechanisms Identified</u>	<u>Stakeholders Involved</u>
<a href="#">New Jersey Climate Change Resilience Strategy</a>	<a href="#">Executive Order 89</a>	April 2021	New Jersey Department of Environmental Protection	<ul style="list-style-type: none"> <li>• Clean energy investments</li> <li>• Building retrofits to include energy efficiency investments</li> </ul>	Prioritizing publicprivate partnerships, utilize state infrastructure bank, create pilot projects with pay for success models.	State agencies, federal agencies, non-profits, local governments, business, academia.
<a href="#">North Carolina Climate Risk Assessment and Resilience Plan</a>	<a href="#">Executive Order 80</a>	June 2020	North Carolina Department of Environmental Quality	<ul style="list-style-type: none"> <li>• Diversifying utility scale and distributed generation with microgrids</li> <li>• Grid hardening and modernizing grid assets with smart meters</li> <li>• Explore alternative fuel strategies to secure fuel supply</li> <li>• Disaster recovery framework is expanding to include both storm-related outages and cyberattacks.</li> </ul>	Partnered with federally funded agencies, rely on research from universities and continues to allocate state budgetary funds to various programs.	State agencies, federal agencies, academia, non-profits, local communities

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<u>Plan</u>	<u>Authorization (EO or legislation)</u>	<u>Release Date</u>	<u>Lead Entity and Energy Stakeholder Involvement</u>	<u>Energy Technologies or Measures Discussed</u>	<u>Funding Mechanisms Identified</u>	<u>Stakeholders Involved</u>
<a href="#">Oregon Resilience Plan</a>	<a href="#">House Resolution 3</a>	Originally released in 2013, updated in 2018	State Resilience Office	<ul style="list-style-type: none"> <li>• Hire a Resilience Officer</li> <li>• Receive annual updates on energy provider preparedness</li> <li>• Assess seismic vulnerabilities</li> <li>• Prepare a fuel action plan</li> </ul>	State budget is providing grants, resilience office also tasked with resource distribution.	State agencies, business leaders, local communities.
<a href="#">Oregon Guidebook for Local Energy Resilience</a>	NA	June 2019	Oregon Department of Energy	<ul style="list-style-type: none"> <li>• Assess local utility vulnerabilities and develop a plan to address risks</li> <li>• Utilities to coordinate with local governments and protect critical interdependencies.</li> <li>• Retrofit or rebuild transmission or distribution stations to protect infrastructure</li> <li>• Utilize distributed energy resources to improve local energy resilience</li> </ul>	Monetization of utility or grid benefits, tax incentives, public private partnerships, ratepayer investments, or other state or federal grants.	State agencies, federal agencies, utilities, nonprofits, academia.



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<a href="#">Rhode Island – Resilient Rhody</a>	<a href="#">Executive Order 17-10</a>	September 2017	Executive Climate Change Coordinating Council and Resilient Rhody Leadership Team.	<ul style="list-style-type: none"> <li>State agencies oversee fuel supply monitoring, promotes microgrids and incorporate resilience into cost-benefit analyses.</li> <li>Utility submits reliability plans to boost resilience investments like grid hardening or nonwires alternatives PUC requires utilities to manage a “Storm Fund” to recover storm expenses and spread recovery over many years.</li> </ul>	Using funds from Hurricane Sandy Community Development Block Grants. Page 71 of plan references all available financing tools. Included are federal funds, state bonds, ratepayer funds, investment bank funds, and tax financing.	State agencies, local communities, non-profits, business leaders.
<a href="#">Virginia Coastal Resilience</a>	<a href="#">Executive Order 24</a>	October 2020	Department of Natural Resources	<ul style="list-style-type: none"> <li>Using RGGI funds to improve energy efficiency and resiliency in buildings</li> </ul>	Exploring environmental impact bonds, resilience bonds,	State agencies, federal agencies, local
<a href="#">Master Planning Framework</a>				Prioritizing CPACE at the local level	catastrophe bonds, green banks, tax increment financing, and philanthropic support. Already utilizing state and federal emergency mitigation programs.	communities, non-profits, and academia.

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<a href="#">Resilient Washington State</a>	Launched by the Washington State Seismic Safety Committee	November 2012	Washington Emergency Management Council	Targeted recovery times for transmission and distribution systems for 1 week to 1 month following a significant earthquake. Estimates as of 2012, suggested transmission recovery times would last 1-3 years, indicating much work was required to improve timeframes.	Not identified, report focused on system vulnerabilities.	State agencies, federal agencies, academia, private sector.
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## Appendix 2: Resilience Officers

The following appendix details which states have resilience officers as well as task forces or working groups leading resilience activities.

These formalized governance structures are often established through legislation or executive action. Roles vary, objectives, and participating agencies vary from state to state, however most address energy resilience in some capacity, recognizing the how critical energy supply is to other sectors and infrastructure systems.

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State	State Resilience Lead Title	Task Force	Home/Lead Agency	Authority (legislation or EO)	Functions (per legislation or Executive Order)
Colorado	Chief Resilience Officer	NA	Colorado Resilience Office – within Colorado Department of Local Affairs	<a href="#">Statute 24-32-122</a>	Improve state agency coordination, provide technical assistance to local governments, and integrate resilience metrics into grant programs.
Florida	Chief Resilience Officer	NA	Department of Environmental Protection	Governor appointment	Coordinate with state agencies to prepare for the environmental, physical, and economic impacts of sea level rise.
Louisiana	Chief Resilience Officer	NA	Governor’s Office of Coastal Activities	<a href="#">Executive Order 2020-19</a>	Assessing asset vulnerabilities posed by coastal change, support agencies incorporating the Coastal Master Plan, and propose adaptation actions.

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<p><b>New Jersey</b></p>	<p>Chief Resilience Officer</p>	<p>Interagency Council on Climate Resilience</p>	<p>Department of Environmental Protection</p>	<p><a href="#">Executive Order 89</a></p>	<p>Develop a scientific report on climate change, develop a statewide climate change resilience strategy, and provide direction to the Interagency Council on Climate Resilience.</p>
<p><b>New Mexico</b></p>	<p>Sustainability and Resilience Officer</p>	<p>Climate Change Task Force</p>	<p>Energy, Minerals and Natural Resources Department</p>	<p><a href="#">Executive Order 2019-003</a></p>	<p>Coordinates state agencies to develop and implement a climate resilience and sustainability plan and assess how state infrastructure will be impacted by climate change.</p>
<p><b>North Carolina</b></p>	<p>Chief Resilience Officer</p>	<p>North Carolina Climate Change Interagency Council</p>	<p>North Carolina Office of Recovery and Resiliency</p>	<p>NC Gen Stat § 143B-1040 (2020)  <a href="#">Executive Order 80</a></p>	
<p><b>Oregon</b></p>	<p>State Resilience Officer</p>	<p>Oregon Seismic Safety Policy Advisory Commission</p>	<p>Office of Governor Kate Brown</p>	<p><a href="#">Statute 401.913</a></p>	<p>Directing, implementing and coordinating seismic safety, setting resilience goals, and coordinating state agency planning.</p>

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<b>Rhode Island</b>	Chief Resiliency Officer	Executive Climate Change Coordinating Council	Rhode Island Infrastructure Bank	<a href="#">Executive Order 17-10</a>	Develop a statewide action plan, identify and prioritize actions to respond to climate change.
<b>South Carolina</b>	Chief Resilience Officer	NA	Office of Resilience, formerly the Disaster Recovery Office	<a href="#">Act No. 163</a>	Preparing for and reducing the impacts of flood disasters.
<b>Virginia</b>	Chief Resilience Officer	NA	Department of Natural Resources	<a href="#">Executive Order 24</a>	Primary coordinator of resilience and adaptation initiatives, as well as primary point of contact for resilience and recurrent flooding.
<b>Washington</b>	Chief Resilience Officer	NA	Department of Natural Resources	<a href="#">Agency-appointed position</a>	Advancing Plan for Climate Resilience, protect natural ecosystems from climate change, and promote environmental justice.
<b>West Virginia</b>	State Resiliency Officer	State Resiliency Office Board	Office of Governor Jim Justice	<a href="#">Senate Bill 586</a>	Office works with state agencies to ensure they are more resilient and manages non-federal disaster and hazard mitigation grant funding.

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<b>Wyoming</b>	Chief Resiliency Officer	NA	Office of Homeland Security	Administrative	Coordinate resilience projects across state, develop a resilience strategy, drive adoption of mitigation and resilience programs.
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<sup>1</sup> National Oceanic and Atmospheric Administration. (2021). *Billion-Dollar Weather and Climate Disasters: Time Series*. <https://www.ncdc.noaa.gov/billions/time-series>

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- <sup>2</sup> Cobalt. (2021). Business Cost of Cybercrime. <https://cobalt.io/blog/business-cost-of-cybercrime>
- <sup>3</sup> IBM Security. (2021). *X-Force Threat Intelligence Index 2021*. <https://www.ibm.com/downloads/cas/M1X3B7QG>
- <sup>4</sup> Multi-Hazard Mitigation Council (2019.). *Natural Hazard Mitigation Saves: 2019 Report*. Principal Investigator Porter, K.; Co-Principal Investigators Dash, N., Huyck, C., Santos, J., Scawthorn, C.; Investigators: Eguchi, M., Eguchi, R., Ghosh., S., Isteita, M., Mickey, K., Rashed, T., Reeder, A.; Schneider, P.; and Yuan, J., Directors, MMC. Investigator Intern: Cohen-Porter, A. National Institute of Building Sciences. Washington, DC. [www.nibs.org](http://www.nibs.org)
- <sup>5</sup> Colorado Resiliency Office. (2021). *The CRO*. State of Colorado. <https://www.coresiliency.com/the-cro>
- <sup>6</sup> Office of South Carolina Governor Henry McMaster. (2021 March). *Gov. Henry McMaster Names South Carolina's First Chief Resilience Officer*. <https://governor.sc.gov/news/2021-03/gov-henry-mcmaster-names-south-carolinas-first-chief-resilience-officer>.
- <sup>7</sup> Oregon Department of Energy. (2019). *Oregon Guidebook for Local Energy Resilience: For Small and Medium Electric Utilities*. State of Oregon. <https://www.oregon.gov/energy/safety-resiliency/Documents/Oregon-Resilience-Guidebook-COUs.pdf>
- <sup>8</sup> North Carolina Department of Environmental Quality. (2020 June). *North Carolina Climate Risk Assessment and Resilience Plan*. State of North Carolina. <https://files.nc.gov/ncdeq/climate-change/resilience-plan/2020-Climate-Risk-Assessment-and-Resilience-Plan.pdf>
- <sup>9</sup> New Jersey Department of Environmental Protection. (2021, October 21). *Climate Change Resilience Strategy*. State of New Jersey. <https://www.nj.gov/dep/climatechange/resilience-strategy.html>
- <sup>10</sup> Office of Governor Ralph Northam. (2020 October). *Virginia Coastal Resilience Master Planning Framework*. Commonwealth of Virginia. <https://www.governor.virginia.gov/media/governorvirginiagov/governor-of-virginia/pdf/Virginia-Coastal-Resilience-Master-Planning-Framework-October-2020.pdf>
- <sup>11</sup> Colorado Resilience Office. (2020). *Colorado Resiliency Framework*. State of Colorado. <https://www.coresiliency.com/colorado-resiliency-framework>
- <sup>12</sup> Office of Governor Kate Brown. (2018). *Oregon Resiliency Report - Index*. State of Oregon. <https://www.oregon.gov/gov/policy/orr/Pages/index.aspx>
- <sup>13</sup> Rhode Island Infrastructure Bank. (2018 July). *Resilient Rhody. An Actionable Vision for Addressing the Impacts of Climate Change in Rhode Island*. State of Rhode Island. <http://climatechange.ri.gov/documents/resilientrhody18.pdf>
- <sup>14</sup> State of Rhode Island Climate Change. (2021, September 30). *EC4 Progress Update*. State of Rhode Island. <http://climatechange.ri.gov/documents/ec4-210930-resilience.pdf>
- <sup>15</sup> Connecticut Department of Energy and Environmental Protection. (2021, January). *Climate Change GC3 Phase 1 Report*. State of Connecticut. [https://portal.ct.gov/-/media/DEEP/climatechange/GC3/GC3\\_Phase1\\_Report\\_Jan2021.pdf](https://portal.ct.gov/-/media/DEEP/climatechange/GC3/GC3_Phase1_Report_Jan2021.pdf)
- <sup>16</sup> Connecticut Department of Energy and Environmental Protection. (2021). *Microgrid Grant and Loan Program*. State of Connecticut. <https://portal.ct.gov/DEEP/Energy/Microgrid-Grant-and-Loan/Microgrid-Grant-and-Loan-Program>
- <sup>17</sup> Indiana Office of Energy Development. (2021). *ETI Grant Funding Information Document*. State of Indiana. [https://www.in.gov/oed/files/2021\\_ETIGrant\\_FundingInformationDocument.pdf](https://www.in.gov/oed/files/2021_ETIGrant_FundingInformationDocument.pdf)
- <sup>18</sup> Washington State Department of Commerce. *Grid Modernization Program*. <https://www.commerce.wa.gov/growing-the-economy/energy/clean-energyfund/energy-grid-modernization/>



- 
- <sup>19</sup> Kansas Corporation Commission. (2020). Facility Conservation Improvement Program. State of Kansas. [https://kcc.ks.gov/images/PDFs/kansas-energyoffice/fcip/fcip\\_brochure.pdf](https://kcc.ks.gov/images/PDFs/kansas-energyoffice/fcip/fcip_brochure.pdf)
- <sup>20</sup> Koewler, M., Fazeli, S. & Powers, C. (2020 July). *Designing Equity-Focused Stakeholder Engagement to Inform State Energy Office Programs and Policies*. National Association of State Energy Officials. [https://www.naseo.org/data/sites/1/documents/publications/13-0376\\_0549\\_000208-KOEWLER%20FINAL%20cover.pdf](https://www.naseo.org/data/sites/1/documents/publications/13-0376_0549_000208-KOEWLER%20FINAL%20cover.pdf)
- <sup>21</sup> New Jersey Department of Environmental Protection. (2021, October 21). *Climate Change Resilience Strategy*. State of New Jersey. <https://www.nj.gov/dep/climatechange/resilience-strategy.html>
- <sup>22</sup> Relf, G. & Jarrah, A. (2020 February). Measuring Three Rs of Electric Energy Efficiency: Risk, Reliability, and Resilience. ACEEE. [https://www.aceee.org/sites/default/files/pdfs/3rs\\_topic\\_brief\\_final\\_2-6-20.pdf](https://www.aceee.org/sites/default/files/pdfs/3rs_topic_brief_final_2-6-20.pdf)
- <sup>23</sup> Maryland Energy Administration. *FY22 Resiliency Hub Grant Program*. <https://energy.maryland.gov/Pages/Resiliency-Hub.aspx>
- <sup>24</sup> Kentucky Energy and Environmental Cabinet. (2021 April). *Commonwealth of Kentucky Regional Microgrids for Resilience Study*. Smart Electric Power Alliance. [https://eec.ky.gov/Energy/Documents/SEPA%20Kentucky%20Regional%20MG%20Study\\_April%202021.pdf](https://eec.ky.gov/Energy/Documents/SEPA%20Kentucky%20Regional%20MG%20Study_April%202021.pdf)
- <sup>25</sup> National Association of Regulatory Utility Commissioners. (April 2019). *The Value of Resilience for Distributed Energy Resources: An Overview of Current Analytical Practices*. Prepared by Converge Strategies, LLC.
- <sup>26</sup> Jeffers, Robert, et al. (October 2017) *A Grid Modernization Approach for Community Resilience: Application to New Orleans, LA*. Sandia National Laboratory. <https://www.osti.gov/servlets/purl/1510648>
- <sup>27</sup> Lawrence Berkeley National Laboratory. (2021). *Resilient Communities and Infrastructure*. <https://buildings.lbl.gov/metrics-measurement-and-evaluation>
- <sup>28</sup> National Renewable Energy Laboratory. *Resilient Energy Systems*. <https://www.nrel.gov/energy-solutions/resilient-systems.html>
- <sup>29</sup> Pacific Northwest National Laboratory. *Resilience and Security*. <https://www.pnnl.gov/resilience-and-security>
- <sup>30</sup> Washington Military Department. (December 2019). *Cascadia Rising 2022 Planning Underway*. <https://mil.wa.gov/news/cascadia-rising-2022-planningunderway>
- <sup>31</sup> Sandia National Laboratories (2021 June). *Regulatory Mechanisms to Enable Investments in Electric Utility Resilience*. [https://www.synapse-energy.com/sites/default/files/Regulatory\\_Mechanisms\\_to\\_Enable%20Investments\\_in\\_Electric\\_UTILITY\\_Resilience\\_SAND20216781\\_19-007.pdf](https://www.synapse-energy.com/sites/default/files/Regulatory_Mechanisms_to_Enable%20Investments_in_Electric_UTILITY_Resilience_SAND20216781_19-007.pdf), p. 33.
- <sup>32</sup> *Ibid.* at 34.
- <sup>33</sup> System Average Interruption Frequency Index (SAIFI) is the average number of sustained interruptions per customer per year; System Average Interruption Duration Index (SAIDI) represents the *duration* of interruptions per customer per year; Consumer Average Interruption Duration Index (CAIDI) is the average duration of an interruption; and Momentary Average Interruption Frequency Index (MAIFI) is the average number of short (under 5 minute) duration interruptions a customer experiences per year. For more information, see [http://www.egr.unlv.edu/~eebag/Reliability\\_Indices\\_for\\_Utilities.pdf](http://www.egr.unlv.edu/~eebag/Reliability_Indices_for_Utilities.pdf).
- <sup>34</sup> *Ibid.*

- <sup>35</sup> Walton, Robert (2021). *Northeast Utilities are spending billions on resilience, and the investments are paying off*. Utility Dive. <https://www.utilitydive.com/news/northeast-utilities-are-spending-billions-on-resilience-and-the-investment/608378/>
- <sup>36</sup> Yanez-Barnuevo, Miguel (2020 December). *Colorado Utility Launches Innovative Financing Tool for Battery Storage*. Environmental and Energy Study Institute. <https://www.eesi.org/articles/view/colorado-utility-launches-innovative-financing-tool-for-battery-storage>
- <sup>37</sup> Holy Cross Energy. *Power+*. <https://www.holycross.com/programs-overview/>
- <sup>38</sup> Wazowicz, Maddie. *On-Bill Financing 101*. Midwest Energy Efficiency Alliance. <https://www.mwalliance.org/sites/default/files/meea-research/on-bill-fact-sheet-11.5.18.pdf>
- <sup>39</sup> Waltz, Amanda (2019). *PIT airport plans to become completely powered by solar and natural gas microgrid*. Pittsburgh City Paper. <https://www.pghcitypaper.com/pittsburgh/pit-airport-plans-to-become-completely-powered-by-solar-and-natural-gas-microgrid/Content?oid=16049514>
- <sup>40</sup> Burger, Andrew (2018 March). *Avoiding the Fate of Atlanta, Pittsburgh Looks to Build an Airport Microgrid*. <https://microgridknowledge.com/airportmicrogrid-pittsburgh/>
- <sup>41</sup> Gifford, Jonathan Dr. (2014). *Understanding Public-Private Partnerships*. National Governors Association. <https://www.nga.org/wp-content/uploads/2021/05/ILChicagoGifford.pdf>
- <sup>42</sup> Types of P3 contracts can include Design-Build; Design-Build-Finance; Design-Build-Operate-Maintain; Design-Build-Finance-Operate-Maintain; Build-Operate-Transfer; Lease; and other potential iterations.
- <sup>43</sup> National Association of State Energy Officials. National Association of Energy Services Companies (2019). *NASEO-EC-NAESCO State ESPC Program and Project Principles*. <https://www.naesco.org/data/industryreports/espc-naseo-esc-naesco-principles-february-2019.pdf>
- <sup>44</sup> Strzelczyk, Courtney (2021 June). *ESPC Awarded for Cannon AFB*. Air Force. <https://www.af.mil/News/Article-Display/Article/2648248/espc-awarded-for-cannon-afb/>
- <sup>45</sup> *Ibid.*
- <sup>46</sup> Stuart, Elizabeth. Rep (2016 October). *U.S. Energy Service Company (ESCO) Industry: Recent Market Trends*. Lawrence Berkeley National Laboratory. [https://emp.lbl.gov/sites/default/files/esco\\_recent\\_market\\_trends\\_30sep2016\\_1.pdf](https://emp.lbl.gov/sites/default/files/esco_recent_market_trends_30sep2016_1.pdf)
- <sup>47</sup> Wood, Elisa (2019 June). *Ameresco's Parris Island Military Microgrid Goes Live*. Microgrid Knowledge. <https://microgridknowledge.com/military-microgrid-ameresco-parris/>
- <sup>48</sup> Ameresco. *Comprehensive Resiliency Project Assures Continuity of Mission-Critical Operations at MCRD Parris Island*. <https://www.ameresco.com/portfolio-item/parris-island/>
- <sup>49</sup> NASEO and NARUC encourage state energy officials and public utility commissioners exploring EaaS solutions to confer with their state Treasurer's Office to confirm the treatment of EaaS as debt/not-debt.
- <sup>50</sup> Gorman, Mark (2021 April). *Ozop Energy Systems Supplying a 'net zero microgrid' building solution in Hanover, Maryland*. Solar Builder. <https://solarbuildermag.com/news/ozop-energy-systems-supplying-a-net-zero-microgrid-building-solution-in-hanover-maryland/>
- <sup>51</sup> *Ibid.*

- 
- <sup>52</sup> Ozop Energy Solutions (2021 April). *Ozop Energy to Supply \$600,000 of Energy Generation, Storage and Switchgear Equipment for Groundbreaking Near Net Zero Microgrid Commercial Real Estate Project*. Cision PR Newswire. <https://www.prnewswire.com/news-releases/ozop-energy-to-supply-600-000-of-energy-generation-storage-and-switchgear-equipment-for-groundbreaking-near-net-zero-microgrid-commercial-real-estate-project-301276149.html>
- <sup>53</sup> Leventis, Greg, Lisa Schwartz, Chris Kramer, and Jeff Deason. Rep (2018 February). *Lessons in Commercial PACE Leadership: The Path from Legislation to Launch*. Lawrence Berkeley National Laboratory. [https://www.energy.gov/sites/prod/files/2018/05/f51/Lessons\\_in\\_Commercial\\_PACE\\_Leadership\\_Finalv2.pdf](https://www.energy.gov/sites/prod/files/2018/05/f51/Lessons_in_Commercial_PACE_Leadership_Finalv2.pdf).
- <sup>54</sup> PaceNation (2020 November). *PACE Programs*. <https://pacenation.org/pace-programs/>.
- <sup>55</sup> Better Buildings Solutions Center (2017). *Greenworks Lending Funds Efficiency, Renewable and Microgrid Improvements Using Commercial PACE*. U.S. Department of Energy. <https://betterbuildingssolutioncenter.energy.gov/implementation-models/greenworks-lending-funds-efficiency-renewable-andmicrogrid-improvements-using>.
- <sup>56</sup> Mezzanine debt is debt that is subordinate to other forms of debt, but still senior to equity. As a consequence, it possesses higher interest rates due to being less secure in the capital stack than other forms of debt.
- <sup>57</sup> Better Buildings Solutions Center (2017). *Greenworks Lending Funds Efficiency, Renewable and Microgrid Improvements Using Commercial PACE*. U.S. Department of Energy. <https://betterbuildingssolutioncenter.energy.gov/implementation-models/greenworks-lending-funds-efficiency-renewable-andmicrogrid-improvements-using>.
- <sup>58</sup> Hightower, Glover, and Albritton (2015 March). Act No. 2015-494. Alabama. <https://adeca.alabama.gov/wp-content/uploads/Act-2015-494-PACE-PIERA.pdf>
- <sup>59</sup> State of New Jersey, Governor Phil Murphy (2021 August). *Governor Murphy Signs Legislation Establishing the Garden State C-PACE Program* [www.nj.gov/governor/news/news/562021/20210824c.shtml](http://www.nj.gov/governor/news/news/562021/20210824c.shtml)
- <sup>60</sup> Solar Energy Loan Fund. *Results*. <https://solarenergyloanfund.org/results/>
- <sup>61</sup> Coalition for Green Capital. *What Is a Green Bank*. Coalition for Green Capital. <https://coalitionforgreencapital.com/what-is-a-green-bank/>.
- <sup>62</sup> Coalition for Green Capital. *Green Bank Techniques*. <https://coalitionforgreencapital.com/what-is-a-green-bank/green-banktechniques/>.
- <sup>63</sup> *Ibid.*
- <sup>64</sup> Louisiana Public Service Commission (2014 July). *PSC Approved Bonds Totaling \$315 Million Sold*. [https://lpsc.louisiana.gov/\\_docs/\\_press/PSC%20Approved%20Bonds%20Sold.pdf](https://lpsc.louisiana.gov/_docs/_press/PSC%20Approved%20Bonds%20Sold.pdf)
- <sup>65</sup> *Ibid.*
- <sup>66</sup> *Ibid.*
- <sup>67</sup> Vajjhala, Shalini (2015 December). *Financing infrastructure through resilience bonds*. Brookings. <https://www.brookings.edu/blog/the-avenue/2015/12/16/financing-infrastructure-through-resilience-bonds/>
- <sup>68</sup> NASEO. *State Revolving Loan Funds and Credit Enhancement Mechanisms*. <https://www.naseo.org/issues/energyfinancing/revolving-loan-funds>.

- <sup>69</sup> The Davis-Bacon Act requires that contractors and sub-contractors must pay their laborers the prevailing wage (as determined by the Department of Labor) in the area where they are executing a contract. Buy American provisions stipulate that for any ARRA-funded project, the manufactured items used for that product are produced in the United States. These two requirements together can potentially increase the costs of a project.
- <sup>70</sup> RGGI participants include the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Virginia.
- <sup>71</sup> The Regional Greenhouse Gas Initiative (2018 July). *The Investment of RGGI Proceeds in 2018*. [https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI\\_Proceeds\\_Report\\_2018.pdf](https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2018.pdf)
- <sup>72</sup> Federal Emergency Management Agency. Hazard Mitigation Assistance, Mitigation Action Portfolio. [https://www.fema.gov/sites/default/files/documents/feam\\_fy21-bric-mitigation-action-portfolio.pdf](https://www.fema.gov/sites/default/files/documents/feam_fy21-bric-mitigation-action-portfolio.pdf)
- <sup>73</sup> Federal Emergency Management Agency (2008 April). *Electrical Transmission and Distribution Mitigation: Loss Avoidance Study*. [https://www.fema.gov/sites/default/files/documents/fema\\_electrical-transmission-loss-avoidance-study.pdf](https://www.fema.gov/sites/default/files/documents/fema_electrical-transmission-loss-avoidance-study.pdf).
- <sup>74</sup> Federal Emergency Management Agency (2015). Hazard Mitigation Assistance Guidance §. [https://www.fema.gov/media-library-data/142498316544938f5dfc69c0bd4ea8a161e8bb7b79553/HMA\\_Guidance\\_022715\\_508.pdf](https://www.fema.gov/media-library-data/142498316544938f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf).
- <sup>75</sup> *Ibid.*
- <sup>76</sup> *Ibid.* at 37.
- <sup>77</sup> Consult with FEMA to assess the viability of resilience projects under this or any other potential source of funding.
- <sup>78</sup> Federal Emergency Management Agency (2021 July). *FEMA Awards Utility Board of City of Key West \$5.59 Million to Protect Water Crossing Transmission Poles*. <https://www.fema.gov/press-release/20210722/fema-awards-utility-board-city-key-west-559-million-protect-water-crossing>
- <sup>79</sup> Federal Emergency Management Agency. *Pre-Disaster Mitigation (PDM) Grant*. <https://www.fema.gov/pre-disastermitigation-grant-program>.
- <sup>80</sup> FEMA's website lists requirements for qualifying Hazard Mitigation Plans. See <https://www.fema.gov/hazard-mitigation-plan-requirement>.
- <sup>81</sup> Federal Emergency Management Agency (2021). *BRIC Notice of Funding Opportunity*. <https://www.fema.gov/node/bric-notice-funding-opportunity>
- <sup>82</sup> New Jersey Energy Resilience Bank (2014 October). *Grant and Loan Financing Guide*. <https://www.state.nj.us/bpu/pdf/erb/Final%20ERB%20Program%20Guide.pdf>.
- <sup>83</sup> *Ibid.*
- <sup>84</sup> New Jersey Economic Development Authority (2014 July). *Christie Administration Takes Steps to Establish Energy Resilience Bank*. <https://www.njeda.com/christie-administration-takes-steps-to-establish-energy-resilience-bank/>
- <sup>85</sup> New Jersey Economic Development Authority (2017 March). *Energy Resilience Bank Helps Four Hospitals Advance Vital Infrastructure Projects*. <https://www.njeda.com/%e2%80%8benergy-resilience-bank-helps-four-hospitals-advance-vital-infrastructure-projects/>
- <sup>86</sup> New Jersey Economic Development Authority (2016 July). *EDA Advances Two Projects for Energy Resilience Bank Funding*. <https://www.njeda.com/eda-advances-two-projects-for-energy-resilience-bank-funding/>
- <sup>87</sup> HUD Exchange. CDBG Mitigation Funds. <https://www.hudexchange.info/programs/cdbg-mit/>

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- <sup>88</sup> A checklist for Action Plans can be found at <https://www.hudexchange.info/resource/5901/cdbg-mit-action-plan-checklist/>
- <sup>89</sup> United States Department of Agriculture (2021 March). *Electric Loan Program*. [https://www.rd.usda.gov/sites/default/files/electricloan\\_nr\\_chart\\_march162021.pdf](https://www.rd.usda.gov/sites/default/files/electricloan_nr_chart_march162021.pdf)
- <sup>90</sup> Rural Development. Electric Infrastructure Loan and Loan Guarantee Program. United States Department of Agriculture [https://www.rd.usda.gov/sites/default/files/fact-sheet/508\\_RD\\_FS\\_RUS\\_ElectricInfrastructure.pdf](https://www.rd.usda.gov/sites/default/files/fact-sheet/508_RD_FS_RUS_ElectricInfrastructure.pdf)
- <sup>91</sup> United States Department of Agriculture (2021 March). *USDA Invests \$598 Million to Improve and Modernize Rural Electric Infrastructure After Severe Weather and Age Test the Grid*. <https://www.usda.gov/media/press-releases/2021/03/16/usda-invests-598-million-improve-and-modernize-rural-electric>
- <sup>92</sup> HUD Exchange. About the Section 108 Loan Guarantee Program: Section 108 Loan Guarantee Program Overview. <https://www.hudexchange.info/programs/section-108/section-108-program-eligibility-requirements/#overview>.
- <sup>93</sup> Current HUD guidance references 78 FR 69104, which allows HUD funding to be used for “microgrids or energy banks that may provide funds to entities consistent with all applicable requirements.” For further information, see <https://www.govinfo.gov/content/pkg/FR-2013-11-18/pdf/2013-27506.pdf>.
- <sup>94</sup> HUD Exchange. About the Section 108 Loan Guarantee Program: How the Section 108 Program Works.://www.hudexchange.info/programs/section-108/section-108-program-eligibility-requirements/#how-the-section-108-program-works
- <sup>95</sup> U.S. Department of Housing and Urban Development (2020 March). *Community Development Block Grant Disaster Recovery: CDBG-DR Overview*. <https://files.hudexchange.info/resources/documents/CDBG-Disaster-Recovery-Overview.pdf>.
- <sup>96</sup> U.S. Department of the Treasury. Community Development Financial Institutions Fund, Opportunity Zones Resources. <https://www.cdfifund.gov/opportunity-zones>,
- <sup>97</sup> Carol, Dan. *From Recovery to Resilience: How Opportunity Zones Can Help Accelerate Post-COVID Economic Resurgence: A Milken Institute Working Paper*. The Milken Institute. [https://milkeninstitute.org/sites/default/files/reports-pdf/FromRecoverytoResilience-FINAL\\_0.pdf](https://milkeninstitute.org/sites/default/files/reports-pdf/FromRecoverytoResilience-FINAL_0.pdf)