Backgrounder on Enhancing Rural Resilience: Examples from the Northeastern U.S.

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What is resilience? According to the National Academies of Science: "Resilience is the ability to prepare and plan for, absorb, respond, recover from, and more successfully adapt to adverse events."[1]

I. The Problem

In 2018, it is estimated that natural disasters cost the nation almost $100 billion and took nearly 250 lives. And that came on the heels of the record set in 2017, when the United States experienced more than $312 billion in disaster-related damages, with more than two-thirds of the total from Hurricanes Harvey, Irma, and Maria alone. Extreme hazards have been on the rise: From 2012-17, there were at least 10 major disasters per year in the U.S. that each generated more than $1 billion in damages, which is double the average number of such events from 1980-2016.

Flooding is by far the most common, costliest and deadliest natural hazard nationwide. Extreme rains and flooding events are expected to be more common in many parts of the U.S. in the coming years, including in America's heartland, according to the *Fourth National Climate Assessment*.[2]

Key Points of this Presentation:

- In response to the increase in natural hazards in recent years, there has been a tremendous amount of state and local level resilience planning, especially in parts of the Northeast, where I live, which experienced massive flooding and power outages during Tropical Storm Irene in 2011 and Superstorm Sandy in 2012.
- Nevertheless, experts say these efforts are not comprehensive enough. There is still a "resilience gap" – a gap between the size of the challenge and the efforts to address it.
- Some of the areas that are seeing the least level of planning but exhibiting the greatest need are rural areas.
- The good news: There is a growing awareness of the need to enhance resilience, particularly in rural areas increasingly prone to flooding and power outages. A number of innovative policies and technologies are being incorporated into pilots, with the goal of reducing the risks of future flood damages, promoting energy resilience, and providing minimum disruption to local economies from natural hazards.

[1] See http://www.nationalacademies.org/topics/resilience/.

[2] USGCRP (2018). *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*[Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018. Available at https://nca2018.globalchange.gov/.

II. Rural Challenges: Barriers to Resilience Planning, and Opportunities

Some 20 percent of the nation's population lives in rural areas, and manages 95 percent of our land. Rural areas are considered to be ill-equipped to address the threats they face from the impacts of extreme weather, fires, droughts, and invasive species on farms, forests, fisheries and wildlife. A report from the Institute for Agriculture and Trade Policy[3] notes that rural communities tend to be under-resourced, with limited funding and capacity to engage in planning related to changes in climate. The reasons are varied. The poverty rate is frequently higher than in urban areas, and rural residents tend to spend a higher percentage of their income on energy costs. Typically, they have less efficient homes that require more energy to heat and cool, so more extreme temperatures will place a greater burden on them. In addition, rural communities that have resource-based economies are more vulnerable to impacts to the natural environment; and emergency preparedness is more difficult because of large distances separating homes and businesses, and a lack of public transportation. State government programs can help close this gap, but they are often underutilized, the report says.

In communities across the U.S. that are experimenting with adaptation, cities are emerging as leaders. There is a general understanding that the emphasis on urban adaptation is leaving small towns and rural areas behind.[4]

A 2016 report prepared for the Kresge Foundation interviewed 50 "thought leaders" from communities around the country to analyze what motivated them to develop resilience plans, and barriers standing in the way.[5] The report encompassed two years of research and was the first in-depth study of climate adaptation efforts in communities across the United States. Here are some of their responses:

- Recent extreme events were the most motivating factor for communities to begin the process of adapting to changing weather patterns.
- Strong leadership from an elected official or community leader could be critical to moving an effort forward.
- Government mandates can help raise awareness to motivate communities to act.
- The availability of funding from the local, state or federal government, or from foundations or nonprofits, can be the key lever that prompts a community to engage in resilience planning.
- Communities can integrate adaptation/resilience plans into existing processes. For example, the federal Disaster Mitigation Act of 2000 (DMA) requires all cities, counties, and special districts to adopt a Local Hazard Mitigation Plan (LHMP) to be eligible to receive disaster mitigation funding from the Federal Emergency Management Agency (FEMA). Communities can ensure that their hazard plans prepare for future extreme weather events by including in them aspects of climate adaptation.
- Focusing on actions that have multiple benefits over the long-term are more appealing to communities, like local efforts to procure more affordable renewable energy, weatherize homes

[3] Ritter, Tara and Aguiar, Phoebe (February 2019). "Building Rural Climate Resilience: The Role for Minnesota State Agencies," p.3. Institute for Agriculture and Trade Policy. Available at https://www.iatp.org/sites/default/files/2019-05/2019_02_BuildingRuralClimateResilience_report_appendix.pdf.
[4] Ibid, pp. 251-3.
[5] Abt Associates (November 2016). Climate Adaptation: The State of Practice in U.S. Communities, pp. 251-3. The Kresge Foundation. Available online at https://kresge.org/sites/default/files/library/climate-adaptation-the-state-of-practice-in-us-communities-full-report.pdf.

to make them more resilient during storms and reduce energy costs, and enhance emergency response.
- Policy tools can be very helpful to enable communities to move beyond the planning stage.
- Having dedicated technical staff can be key to implementing plans.

Other research talks about the need for communities to work proactively to "enhance adaptive capacity" – to help residents forge strong social ties, good health, economic well-being, and a strong sense of empowerment and engagement.[6]

III. State Efforts to Promote Resilience

State-level resilience or adaptation planning is important, because it can focus state agencies on climate risks and preparedness, promote collaboration across regions and between the public and private sectors, and pool the resources and expertise of different state agencies to support local risk-reduction efforts. State and regional efforts are seen as offering the most realistic hope for enabling and scaling up local adaptation efforts.

Approximately 16 states have enacted some form of proactive legislation to safeguard infrastructure and communities against the threat of extreme weather, storm surge, inland flooding and sea-level rise, according to the Georgetown Climate Center.[7] Several states are in the process of developing plans. But they vary in terms of their requirements, specificity and rate of implementation. For example: Florida's plan has 28 goals, while California's has 345.

Increasingly, resilience plans are being "mainstreamed" – added to existing plans and procedures, including general/comprehensive plans, hazard mitigation plans, capital improvement plans, and sector-specific planning documents -- i.e., including them into broader goals that communities want to achieve, with the intent of creating more comprehensive and systematic efforts to build resilience to extreme weather events and climate variability.

Examples of Forward-Looking State Policies:

A recent study from Rutgers[8] examined six states that have been working proactively to promote or require local resilience planning:

California: The state's 2009 Climate Adaptation Strategy[9] was one of the first multi-sectoral plans for preparing for the impacts of climate change. The plan was updated in 2014 to provide the most recent

[6] Island Press (2018). Cultivating Resilience: Opportunities for Action. A companion resource to the *Community Resilience Reader*, p. 12-13. Available at https://islandpress.org/sites/default/files/resilience-compilation_urp2018.pdf.

[7] You can access the plans on the Georgetown Climate Center's website at https://www.georgetownclimate.org/adaptation/plans.html.

[8] Alexander, Zoe (November 2018). "Integration of Climate Change Provisions in State Authority Governing Municipal Planning: Experiences outside New Jersey," Rutgers Climate Institute and Bloustein School of Planning and Public Policy. Available at https://njadapt.rutgers.edu/docman-lister/njcaa-meetings/205-mlul-final-report/file.

[9] Available at https://www.climatechange.ca.gov/adaptation/strategy/.

information on climate vulnerabilities and management approaches,[10] and will be updated every five years thereafter.

Legislation[11] adopted in October 2015 requires the state Natural Resources Agency to update its climate adaptation strategy every three years. It also mandates that the safety element of a local hazard mitigation plan "address climate adaptation and resiliency strategies" applicable to that local jurisdiction.[12]

Note: One key aspect of California's approach is that it gives priority to strategies that also achieve benefits beyond climate risk reduction, like health benefits, economic, environmental justice and conservation benefits.

Connecticut: Connecticut Public Act 18-82,[13] enacted in 2018, requires that certain updates to sea-level rise occur at least every ten years in the following plans: municipal evacuation or hazard mitigation plans; the state's civil preparedness plan and program; municipal plans of conservation and development; and revisions to the state's plan of conservation and development.

Florida: 2015 legislation (Florida Statute section 163.3178, 2015) requires that the coastal management element required for a local government comprehensive plan take into account consideration of future flood risk from storm surge and sea-level rise.

Massachusetts: In 2018, the state enacted "An Act Promoting Climate Change Adaptation, Environmental and Natural Resource Protection and Investment in Recreational Assets and Opportunity" which requires the Secretary of Energy and Environmental Affairs and the Secretary of Public Safety to develop a framework to provide guidance for towns and cities to incorporate certain climate resilience actions into their plans (as opposed to placing a requirement on the local government directly). The secretaries are also required to provide technical assistance to cities and towns, so the towns can complete vulnerability assessments, identify strategies and begin implementation of those strategies.

Rhode Island: Amendments to the Rhode Island General Laws Title 45, referred to as the "Rhode Island Comprehensive Planning and Land Use Act" in 2011 revised the requirements of comprehensive planning by municipal governments. The law requires an identification of areas that would be vulnerable to the effects of sea-level rise, flooding, storm damage, drought, or other natural hazards in plans. The amendment placed a new requirement on municipal comprehensive plans to incorporate goals, policies, and specific techniques for implementing actions that would help or minimize the effects of natural hazards.

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[10] See Natural Resources Agency (July 31, 2014). "Safeguarding California: Reducing Climate Risk: An Update to the 2009 California Climate Adaptation Strategy." Available at http://resources.ca.gov/docs/climate/Final_Safeguarding_CA_Plan_July_31_2014.pdf.

[11] See AB 1482 (2015-16). Available at https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB1482.

[12] See California Governor's Office of Emergency Services (September 2018). "2018 State of California Hazard Mitigation Plan," p. 138. Available at https://drought.unl.edu/archive/plans/GeneralHazard/state/CA_2018.pdf.

[13] Available at https://www.cga.ct.gov/2018/ACT/pa/pdf/2018PA-00082-R00SB-00007-PA.pdf.

Flooding and Sea-Level Rise Training: In addition, legislation[14] enacted in 2017 requires all members of local planning boards and commissions to participate, every two years, in a training program on the potential future impacts to the state from development in a flood plain and from the effects of sea-level rise.

Virginia: Legislation enacted in 2015 requires all localities in the Hampton Roads Planning District Commission – which includes 17 local governments in southeastern Virginia -- to incorporate into either their comprehensive plans or local hazard mitigation plans strategies to address sea-level rise and recurrent flooding.

Other State Legislation that Addresses Adaptation/Resilience Planning:

Maryland: Legislation enacted in 2018 requires that state capital and local projects for which at least 50 percent of the project costs are funded with state funds must incorporate siting and design criteria that take into account sea-level rise and coastal flooding.[15] The legislation also requires state agencies to establish a plan to adapt to saltwater intrusion; and local jurisdictions to devise plans to adapt to nuisance flooding, which must be updated every five years.

New York: The Community Risk and Resilience Act (2014)[16] designates specific state permitting, facility siting and funding programs that must take into account the intensified impacts of storm surges and floods as sea levels rise. The law directs the state Department of Environmental Conservation to adopt science-based sea-level rise projections and to provide guidance to help state agencies apply these projections, and to consider them in state public-funded infrastructure projects. It also requires state agencies to develop guidance on the use of natural resources and natural processes to enhance community resiliency, and to devise model local laws that include consideration of future risk due to sea-level rise, storm surge and/or flooding.

The Act incorporates a number of important recommendations of the NYS 2100 Commission,[17] which Governor Cuomo convened after Superstorm Sandy to develop more resilient infrastructure systems across the state. In addition, the Act is reportedly the only legislation in the nation to require that climate impacts be a part of the planning, permitting and funding process in all counties in the state.

IV. Case Studies: Flood Prevention

Here are examples of some case studies in which rural communities are taking proactive steps to address flooding.

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[14] See S1005 (2017). Available at http://webserver.rilin.state.ri.us/BillText/BillText17/SenateText17/S1005.pdf.

[15] SB1006 (2018). Available at http://mgaleg.maryland.gov/2018RS/bills/sb/sb1006E.pdf.
A summary of the legislation and related links are available on the website of the Adaptation Clearinghouse at the Georgetown Climate Center at https://www.adaptationclearinghouse.org/resources/maryland-hb-1350-sb-1006-sea-level-rise-inundation-and-coastal-flooding-construction-adaptation-and-mitigation.html.

[16] Source: New York state Department of Environmental Conservation. Available at https://www.dec.ny.gov/energy/102559.html.

[17] See NYS 2100 Commission (2013). "Recommendations to Improve the Strength and Resilience of the Empire State's Infrastructure. Available at https://www.governor.ny.gov/sites/governor.ny.gov/files/archive/assets/documents/NYS2100.pdf.

a. Riverine Flooding: Vermont

On August 27 and 28, 2011, Tropical Storm Irene pummeled Vermont with heavy wind and rainfall that totaled as much as 11 inches in many parts of the state. Irene followed three major rainstorms that had produced localized flooding since the spring of that year, and its concentrated precipitation caused rivers and streams already operating at full capacity to overflow. The flooding was the worst experienced by Vermont since a historic 1927 flood.

Hundreds of buildings, more than 2,400 roads, and 300 bridges were destroyed, cutting off 13 communities from vehicle access. In addition, 90 percent of residents and businesses in the most affected areas lost power.

One of the big realizations after Irene was that development had changed the landscape around rivers. It had made them straighter and easier to build around, but this also turned them into sources of destruction when they overflowed their banks. Efforts to contain dynamic rivers from encroaching property and infrastructure had led to greater erosion, which concentrated the power of high water flows, which destroyed roads, culverts, and bridges. The evidence showed that 75 percent of streams and river channels in the state had been pushed out of their geomorphic equilibrium and were either "incised" and straightened, or widened.[18] The straightened channels had lost their access to floodplains, and during the storm, they delivered more water faster. Eventually the banks of the deepened channels collapsed, causing damage to adjacent roads and properties, and sending large quantities of sediment downstream. After Irene, there was a renewed awareness that rivers need room, and the state began to focus its efforts on the protection of river corridors and floodplain services, and to emphasize the importance of creating no adverse impacts to a river system. This could be achieved through establishment of a river corridor, which enables a river's natural meandering to take root.

Lessons Learned:

1. Irene broke down the traditional silos separating different state agencies.

Interagency collaboration was critical to the recovery effort. While rebuilding roads and bridges, the Vermont Agency of Transportation began working in a close partnership with the Agency of Natural Resources. That partnership continues, and is seen as key to the state's longer-term recovery efforts and improved resilience to weather extremes.

Part of the new perspective includes joint trainings to ensure that road engineers and road crews have a shared understanding of fluvial geomorphology, so that they can recognize issues critical to the future health of both rivers and roads. The agency is also incorporating these principles into its best practices.

2. Conservation investments prior to Irene prevented major damages to some towns.

The town of Middlebury, in north-central Vermont, would have sustained heavy flooding during Irene, save for the fact that there had been serious investments in wetlands and bogs upstream of the town that protected its infrastructure and buildings.

[18] Kline, Mike and Swanberg, Ned (November 8, 2018). "Vermont – Avoiding the Vicious Cycle." Available at http://resilientneighbors.com/article-vermont-avoiding-the-vicious-cycle/.

Since Irene, there has been a statewide initiative to prioritize policies for flood resilience. A key strategy of Vermont State Hazard Mitigation plans, regional and municipal plans has been to avoid losses to river corridor and floodplain functions.

Vermont provides incentives for municipalities to manage development near rivers. It provides funding through the Vermont Emergency Relief and Assistance Fund that matches federal assistance after a disaster is declared. The federal government covers 75 percent of eligible public costs, and the state contributes an additional 7.5 percent. But communities that have taken steps to reduce flood damage get 12.5 percent. The majority of municipalities now reportedly qualify for the supplement. In addition, 91 percent of roads and bridges meet current standards, and 80 percent of communities have an updated local emergency operations plan.[19]

3. Legislation

- Act 138,[20] the "Rivers and Lakes Bill," (2012). The bill was a collaborative effort among several agencies, including the Agency of Transportation, Agency of Natural Resources, Department of Agriculture and disaster-management officials. The act includes provisions aimed at mitigating future flood hazards or fluvial erosion, and provides a framework along with state assistance to help individuals and towns meet eligibility criteria for FEMA's National Flood Insurance Program. Among other measures, the bill requires river corridor mapping with the goal of protecting highly sensitive areas that promote natural stream and river stability. It establishes guidelines that identify which lands are under the jurisdiction of municipalities for zoning, and gives municipalities the authority to regulate development within river corridor protection areas. The bill also emphasizes the importance of education for officials at the local level, and identifies funding resources that incentivize and help municipalities learn about best management practices for river corridors and floodplains.
- Act 16 (2013). The legislation requires that state and municipal plans address flood resilience and river corridor protection. The act states that "new development in identified flood hazard, fluvial erosion, and river corridor areas should be avoided." The legislation also encourages the protection of floodplains and upland forested areas that moderate flooding and fluvial erosion.

4. Vermont Economic Resiliency Initiative (VERI)

The Vermont Economic Resilience Initiative (VERI) was developed by the Vermont Agency of Commerce and Economic Development in partnership with several state agencies, including the Agencies of Natural Resources and Transportation. The goal of the project is to help communities recover quickly from disasters, minimize interruptions to businesses and the local economy, and reduce flood recovery costs. The initiative helps communities devise tailored action plans to reduce the risks of future flood damages that could harm their economic health.

One of the challenges after Irene was that the FEMA flood maps only covered 20 percent of the state's rivers and streams, and since map updates are infrequent, they were of limited use in helping to assess future flood risks from both inundation and fluvial erosion. As part of VERI, the Agency of Natural

[19] Inside Climate News (September 1, 2016). "Five Years after Hurricane Irene, Vermont Still Striving for Resilience." Available at https://insideclimatenews.org/news/31082016/five-years-after-hurricane-irene-2011-effects-flooding-vermont-damage-resilience-climate-change.

[20] This information is based on a personal interview with Vermont State Senator Ginny Lyons, Chair of the Natural Resources and Energy Committee, in Williston, Vermont on October 10, 2012. The statute is available at http://www.leg.state.vt.us/DOCS/2012/ACTS/ACT138.PDF.

Resources developed river corridor maps for all streams in Vermont, to identify areas at greatest risk of fluvial erosion and future inundation.[21] The study also identified Vermont's top 32 communities where infrastructure and economic activity are at a high risk of being impacted by flooding, and chose five communities to receive technical assistance to help them identify projects that reduce, avoid, or minimize these risks and ensure that local businesses quickly bounce back from floods. The five pilot communities were studied and were given recommendations and assistance for policy changes, transportation infrastructure, property buy-outs and other strategies to reduce the impact of flooding to protect downtowns, villages centers, and agricultural assets.

The initiative's methodology could be useful to any region or community working to reduce its flood risks and protect its businesses and economy from future floods.

Tools: The VERI Project Report[22] describes the data gathering process, the community ranking process, efforts to promote community engagement, policy review, and steps to identify project recommendations.

The state offers a number of available tools for municipalities to enhance their resilience to flooding, including: Vermont's FloodReady[23] website, which provides access to flood hazard maps, guidance and information about the incentives available to help towns plan for flood resilience; model flood hazard area and river corridor bylaws for municipalities to comply with "no adverse impact" standards for proposals in flood hazard areas and river corridors; and information on state grants that provide incentives for community development, hazard mitigation, and the use of natural systems to reduce flood and fluvial erosion hazards, among other tools.

b. Coastal Flooding: Avalon, New Jersey

The report from Abt Associates identified successful resilience projects nationwide, including one that has been implemented over the course of several decades in the small coastal community of Avalon, New Jersey, population 1,300. In response to severe storms, starting in the late 1960s, Avalon decided to limit shoreline development by creating a "no-build" zone along the beach front, setting properties back from the ocean, and buying up hundreds of acres of beachfront to create a 500-foot buffer between the dunes and the first row of homes. This effort included three key elements:

1) **Protective infrastructure:** These projects included a seawall, a 4,500-foot bulkhead, and a jetty. They also protected hard infrastructure through building codes that increased the lowest elevation at which structures can be built. They also tested storm mitigation projects: in 1993, they created an artificial reef to see if it would reduce wave energy and beach erosion.

2) **Development Codes:** The borough changed development codes to reduce the impact of future storms. This included restricting the number of hotels and motels; limiting the size of private homes; and starting a buy-out program to acquire land from owners whose properties were destroyed.

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[21] Vermont Department of Housing and Community Development (September 30, 2015). "Vermont Economic Resiliency Initiative," p. 2.12. Available at https://outside.vermont.gov/agency/ACCD/bylaws/NDRC/VERI_Report_Final_150930_web.pdf.

[22] Ibid.

[23] Available at https://floodready.vermont.gov/.

3) **Developing a Sand Dune System:** They built an expansive dune system (some are 20-25 feet tall) on vacated lots, which provides a protective barrier from storm surge, wind, and flooding associated with coastal storms. This was in response to a devasting 1962 nor'easter that destroyed buildings and parts of the shoreline. The borough has worked with county officials and federal agricultural officials to select appropriate plants to fortify the dune's root structure, which even led to the development of a specialized "Cape Dune Grass" that's also suitable for different parts of the country with similar climate and soil conditions. The dunes must be maintained after storm events. The borough also replenishes beaches to combat erosion, using sand that's dredged from a nearby inlet or the south end of the borough, and in 2003 entered into a 50-year agreement with the Army Corps of Engineers to replenish the beaches every 3-5 years.

People who were interviewed for the case study said the dune system has been very successful at minimizing damage. For example, after Sandy, not one property was lost, though several experienced flooding.

One of the key factors attributed to the success of the effort has been strong, stable leadership, plus ongoing public education and outreach, which has led to significant community buy-in, including getting shoreline protection into the local school curriculum. For example, students grow Avalon's specialized dune grass in greenhouses and later help to plant it in the dunes with the Department of Public Works. The town maintains a diverse pool of funding, including substantial funding from local taxes and bonds. They also have hired a lobbyist to help them secure federal, state and local funding.

In addition, the town created a communication plan that includes an online social media presence to share up-to-date information with the public when storms occur; a reverse 911 system to contact residents with emergency information; and a dedicated AM radio station. There are tide markers on telephone poles throughout the borough, so residents can know when the tide is high and prepare.

For Further Reference: Here are links to resilience projects outside of the Northeastern United States that are devising innovative programs to safeguard rural (and urban) communities and infrastructure from flooding during future disasters:

--Iowa Watershed Approach: https://iowawatershedapproach.org/

--The Water Institute of the Gulf: https://thewaterinstitute.org/

--Southeast Florida Regional Climate Change Compact: http://southeastfloridaclimatecompact.org/

V. Energy Resilience: Northeastern State Efforts to Promote Microgrids

In the wake of Superstorm Sandy, a number of states in the Northeast began looking at microgrids as a way to provide resilient energy to critical infrastructure, such as hospitals, police and fire stations, and wastewater treatment facilities, as well as "tier 2" sites: grocery stores, gas stations, and schools and libraries, which can be used as warming centers.

Microgrids are small-scale, integrated electricity generation and distribution systems that can be managed locally and independently from the broader power grid and importantly, can separate, or "island" from the macrogrid when it goes down. The system is powered by onsite, distributed generation that can include a combination of power sources, depending on the system's design. They include natural-gas-fueled combined heat and power (CHP), diesel generators, fuel cells, anaerobic

digesters powered by methane from sewage-treatment plants, solar arrays, wind turbines, and battery storage.

States that are promoting microgrids see them as an opportunity to help green the grid and meet renewable-energy and greenhouse-gas-reduction goals, because of their ability to incorporate a suite of clean-energy technologies. Microgrids can also enhance system efficiency, by avoiding the 7-10 percent in energy losses that are typical in a conventional transmission and distribution system.

The projects being spearheaded by state and local governments in the Northeast contrast with efforts in the Southeast, where military installations reportedly account for the majority of microgrids, and in the Southwest and West – namely, in California -- where universities have historically been the main drivers of microgrid development.

A recent report[24] from the National Renewable Energy Laboratory identified 28 policies, initiatives, or programs that have been developed to support microgrid deployment in 13 states. Of the total, seven states (California, Maryland, Massachusetts, Minnesota, New Jersey, New York, and Rhode Island) have commissioned "microgrid roadmaps," which evaluate how microgrids operate within a state's legal, regulatory, and financial frameworks and provide recommendations for future microgrid deployment. Some of these roadmaps are focused specifically on resilient microgrids. Four states have adopted policies relating to energy market reforms that could enable microgrid deployment, including Hawaii, Illinois, New York, and Rhode Island.

Here is an overview of some recent state programs in the Northeast:

Connecticut

Public Act 12-148,[25] signed by Governor Dannel Malloy in 2012, established the first-in-the nation statewide microgrid pilot program, following prolonged, widespread storm-related outages in 2011. The program tested a range of engineering, technological, and policy approaches to keeping critical facilities operating when the main grid loses power.

As part of the first phase of Connecticut's pilot program, in 2013 the General Assembly allocated an initial $18 million to fund nine small-scale projects across the state. These microgrids are intended to provide electricity around the clock to a range of facilities in the case of a power outage. Recipients of the first round of funding include universities, hospitals, local emergency-response facilities and commercial centers.

Since then, the program has awarded three additional rounds of funding for new projects.

You can read more about the program on the website of the Connecticut Department of Energy and Environmental Protection.[26]

Maryland

In February 2014, Governor Martin O'Malley established the Resiliency through Microgrids Task Force,

[24] National Renewable Energy Laboratory (November 2018). "Check the Stack: An Enabling Framework for Resilient Microgrids." Available at https://www.nrel.gov/docs/fy19osti/71594.pdf.
[25] "An Act Enhancing Emergency Preparedness and Response." Available at https://www.cga.ct.gov/2012/ACT/Pa/pdf/2012PA-00148-R00SB-00023-PA.pdf.
[26] Visit https://www.ct.gov/deep/cwp/view.asp?a=4405&Q=508780.

which organized a series of stakeholder meetings that included representatives of other states, project developers, utilities, nonprofit think tanks, ratepayer advocates, legal thought leaders, and others.

The task force released a report[27] four months later that included the following recommendations:

- Maryland should pursue "public-purpose" microgrids in the short term, for uninterrupted electric service to critical community assets such as community centers, commercial hubs, and emergency service complexes;
- Utility-owned and operated microgrids are in the state's public interest and practical under current law, which supports development and further regulatory approval;
- The Task Force should provide sample policy outlines to potentially authorize third-party public-purpose microgrids, operated by local governments and private developers, with an eye toward spurring innovation and ensuring consumer protection; and
- The state should create a new Grid Transformation Program to help facilitate these recommendations and run three new grant programs for public-purpose microgrid projects, advanced controls, and energy storage.

This piece from Utility Dive[28] (note: the piece is sponsored by the International District Energy Association) discusses two microgrid projects in Montgomery County, Maryland commissioned in the summer of 2018 that incorporate CHP systems and solar energy.

Massachusetts

In January 2014, Governor Deval Patrick announced a $40 million municipal resilience grant program to develop microgrids. The program was part of the Governor's Climate Preparedness Initiative, and prioritized investments in clean energy technology. Money for the program comes from renewable energy Alternative Compliance Payments.

This article from Utility Dive[29] offers an overview of the three rounds of funding that have been awarded from the program, and provides information on a recent MIT analysis on the cost-saving potential of microgrids for the city of Boston. It also mentions an industry overview from Navigant research, among other related materials.

Other policies promoting microgrids:

Under the Solar Massachusetts Renewable Target (SMART), projects under 5 MW receive an incentive from the utility company. SMART replaces the existing solar renewable energy credit program. The SMART program is reportedly the first in the nation to offer incentives to solar projects that are paired with storage to capture the benefits of solar regardless of time of day or weather conditions.

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[27] State of Maryland (2014). "Resiliency Through Microgrids Task Force Report." Available at https://energy.maryland.gov/Documents/MarylandResiliencyThroughMicrogridsTaskForceReport_000.pdf.

[28] Utility Dive (September 20, 2018). Note: Content sponsored by the International District Energy Association. "Microgrids in Maryland: Supporting public safety, community resiliency." Available at https://www.utilitydive.com/news/microgrids-in-maryland-supporting-public-safety-community-resiliency/532313/.

[29] Utility Dive (October 4, 2016). "Massachusetts medical facilities net $14M in microgrid resiliency grants." Available at https://www.utilitydive.com/news/massachusetts-medical-facilities-net-14m-in-microgrid-resiliency-grants/427490/.

The Act to Advance Clean Energy (H.4857),[30] signed by Gov. Charlie Baker in August 2018, sets an energy storage target, creates utility resiliency heat maps, and paves the way for non-wires alternatives (NWAs) solicitations. Specifically, the legislation creates a new requirement for electric utilities to file annual resiliency reports for their local distribution systems with the DPU, including maps that show (i) electric load, particularly during peak time periods, (ii) the most congested and constrained areas of the distribution grid, and (iii) areas vulnerable to outages.

Separately, the Massachusetts Clean Energy Center (MassCEC) has been undertaking various actions to boost microgrid development in the state. The economic development agency named 14 microgrid projects as recipients of grants for feasibility studies in February. The goal is to be able to attract private investment to the projects.

Other Initiatives: In June 2014, the Department of Public Utilities (DPU) issued an order requiring each Massachusetts utility to develop and implement a 10-year grid modernization plan. The DPU's order cites microgrids as one strategy among several to meet multiple, broadly shared objectives. Since then, the MassCEC has been exploring business and financial models for microgrids and addressing concerns about regulatory barriers.

Last February, the MassCEC Community Microgrid Program awarded $1.05 million to provide feasibility studies for 14 projects across the state.

More information is available on the MassCEC website.[31]

New Jersey

New Jersey Transit is moving forward with a plan to build the nation's first microgrid tailored specifically to support public rail-infrastructure operations in case of a commercial power-grid disruption. The effort was begun following Superstorm Sandy in 2012, which flooded the New Jersey Transit train station in Hoboken and an adjacent rail yard. The project is one of five New Jersey Transit projects that received $1.276 billion[32] in federal funds in 2014 designed to harden rail infrastructure.

In 2015, under Governor Chris Christie, the state updated the New Jersey Energy Master Plan,[33] which included the goal of improving energy infrastructure resiliency and emergency response following several extreme weather events that left many people and businesses without power for extended periods of time. These policy recommendations included: 1) increasing the use of microgrid technologies and applications for distributed energy resources to improve the grid's resiliency and reliability in the event of a major storm; and 2) directed the state to work with the U.S. Department of Energy, utilities, local and state governments and other strategic partners to identify, design, and implement "Town Center" microgrids to power critical facilities and services across the state.

[30] Available at https://malegislature.gov/Bills/190/H4857.
[31] Visit https://www.masscec.com/community-microgrids-program.
[32] NJ Transit (September 17, 2014). Governor Christie Announces NJ Transit to Receive $1.276 Billion in Resiliency Funding." Available at https://www.njtransit.com/tm/tm_servlet.srv?hdnPageAction=PressReleaseTo&PRESS_RELEASE_ID=2939.
[33] New Jersey is statutorily required to create an Energy Master Plan every 10 years and to provide updates every three years.

In 2017, the Board of Public Utilities approved $2 million in funding for 13 Town Center microgrid proposals[34], which are in the final stages of producing feasibility studies.

Last year, Governor Phil Murphy issued an executive order[35] that sets a goal for the state to get 100 percent of its power from "clean energy" by 2050. In its recently released 2019 Draft Energy Master Plan[36], the Murphy administration promoted decentralized and locally produced carbon-neutral generation as a means to reduce the risk of a widespread blackout; and also as a way to avoid price shocks if the cost of natural gas, the dominant fuel used for electricity, should rise in the future.

New York

In January 2014, New York Governor Andrew Cuomo announced the $40 million "NY Prize" competition to build 10 microgrids serving communities of approximately 40,000 residents each. The program is being administered by the New York State Energy Research and Development Authority (NYSERDA).

The first stage of the program kicked off in 2015, and offered more than $8 million in grants to selected communities to fund 83 engineering feasibility studies across the state, to evaluate the potential for installing and operating a community microgrid. Those studies assessed site constraints, commercial and financial feasibility, legal issues, environmental suitability, and net project benefits, among other considerations.

In 2017, New York awarded $11 million in grants in Stage 2 of the competition. Eleven teams received $1 million each to develop detailed engineering designs and business plans for microgrid projects in their area.

Going forward, NYSERDA anticipates issuing a Stage 3 "Project Build-Out" competitive RFP this year, with winners announced in late 2019.

For more information, please visit the NY Prize website.[37]

VI. Case Studies: Microgrids in Rural Areas

There are numerous examples of microgrids operating or being developed in rural areas to provide resilience and increasingly, to incorporate innovative technologies to lower costs. Here are three:

Alaska: Cordova Cooperative: In the remote town of Cordova, Alaska, located on the coast between Anchorage and Juneau, a local cooperative runs an isolated microgrid that provides electricity for the town. It's powered by 7.25 megawatts of run-of-river hydropower supplemented by diesel generation. The diesel can cost up to 10 times as much as the local hydropower, but it's often needed to manage peak demand when the seasonal salmon catch comes in and needs to be processed. In June, the cooperative incorporated a 1 megawatt, utility-scale lithium-ion battery system to enable it to use less diesel, save money and reduce energy waste by ramping up quickly to meet demand. It will also

[34] New Jersey Board of Public Utilities News Release (June 30, 2017). "Christie Administration Moves Forward with the Development of Town Center Microgrids to Improve Storm Resiliency of Critical Facilities." Available at https://www.state.nj.us/bpu/newsroom/announcements/pdf/20170630_MicrogridFeasibilityStudies.pdf.
[35] Available at https://nj.gov/infobank/eo/056murphy/pdf/EO-28.pdf.
[36] New Jersey Board of Public Utilities (June 10, 2019). "Draft 2019 New Jersey Energy Master Plan: Policy Vision to 2050," p. 45. Available at https://nj.gov/emp/pdf/Draft%202019%20EMP%20Final.pdf.
[37] Visit https://www.nyserda.ny.gov/All-Programs/Programs/NY-Prize.

enhance resilience, given that the town is only accessible by ship or plane, and does not have a broader grid to rely on if the power goes down.[38]

California: Blue Lake Rancheria Microgrid: A rural tribal reserve that hosts a 55,000 square-foot casino in Northern California has developed a solar-powered microgrid that can disconnect from the main grid and run off Tesla battery power. The tribe is under constant threat from wildfires. The tribe contributed funding for the microgrid, and received a $5 million R&D grant from the California Energy Commission. The microgrid could theoretically power the casino indefinitely by recharging the batteries daily with solar power. The project is considered a model for other communities.[39]

New Hampshire: Eversource Battery Backup Plan for Westmoreland: The utility wants to deploy an innovative "non wires" pilot: providing energy storage to back up the outage-prone, rural New Hampshire town of Westmoreland, population 1,700, while reducing bills at other times by lowering the town's peak consumption. The town relies on a single radial power line that runs through a forest to connect it to the grid, but it often goes down during storms. Installing the battery in the long run will be cheaper than constructing a second transmission line.[40]

[38] Greentech Media (June 12, 2019). "Remote Alaskan Microgrid Will Use Battery Storage for Seasonal Salmon Surges." Available at https://www.greentechmedia.com/articles/read/remote-alaskan-microgrid-will-use-storage-for-seasonal-salmon-surges?utm_medium=email&utm_source=Daily&utm_campaign=GTMDaily#gs.iqzzsd.
[39] Scientific American (May 16, 2019). "This Casino's Microgrid Might Be the Future of Energy." Available at https://www.wired.com/story/casino-microgrid-future-of-energy/.
[40] Greentech Media (June 7, 2019). "Eversource Wants to Back Up an Entire Rural Town With Batteries Large and Small." Available at https://www.greentechmedia.com/articles/read/eversource-wants-to-back-up-an-entire-rural-town-with-batteries-large-and-s?utm_medium=email&utm_source=Storage&utm_campaign=GTMStorage#gs.im014n.