

Biennial Report to Congress: Preventing Outages and Enhancing the Resilience of the Electric Grid

Report to Congress July 2024

> United States Department of Energy Washington, DC 20585

# **Message from the Secretary**

Pursuant to statutory requirements, this report is being provided to the following Members of Congress:

- The Honorable Cathy McMorris Rodgers Chair, House Committee on Energy and Commerce
- The Honorable Frank Pallone, Jr. Ranking Member, House Committee on Energy and Commerce
- The Honorable Tom Cole Chairman, House Committee on Appropriations
- The Honorable Rosa DeLauro Ranking Member, House Committee on Appropriations
- The Honorable Chuck Fleischmann Chairman, Subcommittee on Energy and Water Development, and Related Agencies House Committee on Appropriations
- The Honorable Marcy Kaptur Ranking Member, Subcommittee on Energy and Water Development, and Related Agencies House Committee on Appropriations
- The Honorable Joe Manchin Chairman, Senate Committee on Energy and Natural Resources
- The Honorable John Barrasso Ranking Member, Senate Committee on Energy and Natural Resources
- The Honorable Patty Murray Chair, Senate Committee on Appropriations;
- The Honorable Susan Collins Vice Chair, Senate Committee on Appropriations
- The Honorable Patty Murray Chair, Subcommittee on Energy and Water Development Senate Committee on Appropriations

#### • The Honorable John Kennedy

Ranking Member, Subcommittee on Energy and Water Development Senate Committee on Appropriations

If you have any questions or need additional information, please contact me or Ms. Meg Roessing, Deputy Director for External Coordination, Office of Budget, Office of the Chief Financial Officer, at (202) 586-3128, or Mr. Brian Eiler, Deputy Assistant Secretary for Senate Affairs or Mr. Eric Delaney, Deputy Assistant Secretary for House Affairs, Office of Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Hu

Jennifer Granholm

# **Executive Summary**

Communities across the United States are increasingly dependent on electricity for most daily activities and vital services such as transportation, commerce, communications, health care, water, and emergency response. It is more important than ever to enhance the resilience of our Nation's electricity delivery infrastructure to reduce the impact from extreme weather, wildfire, and other natural disasters on our quality of life, economic activity, and national security. As our Nation's aging electric infrastructure faces more challenges and threats — from an increasing frequency of extreme events, including wildfires, to transformational changes in electrification of our country, it is imperative that action is taken to prepare for these challenges.

The Bipartisan Infrastructure Law (BIL) provides approximately \$1.2 trillion to improve and rebuild our Nation's infrastructure. The Department of Energy (DOE) is responsible for more than \$62 billion for investments in energy infrastructure that can support a pathway to a clean, resilient, and equitable energy future. The funding includes approximately \$12.8 billion in financial assistance<sup>1</sup> for improving the Nation's electric grid resilience, which is administered by DOE's Grid Deployment Office (GDO).

BIL Section 40101, *Preventing Outages and Enhancing the Resilience of the Electric Grid*, authorizes \$5 billion for 1) formula grants to states, Tribes, and territories; and 2) competitive grants to utilities and industry. These grants are intended to support investments to reduce the impact of disruptive events on the electric grid due to extreme weather, wildfire, and natural disasters. DOE is encouraging innovative approaches to address these challenges and spark private sector investments to accelerate the adoption of novel concepts.

Pursuant to BIL Section 40101(i), this Biennial Report provides an update on the status of these programs, and includes information on the following activities:

- the costs of the projects for which grants are awarded to eligible entities;
- the types of activities, technologies, equipment, and hardening measures funded by those grants; and
- the extent to which the ability of the power grid to withstand disruptive events has increased.

<sup>&</sup>lt;sup>1</sup> U.S. Department of Energy - Grid Deployment Office, 2023. <u>Federal Financing Tools.</u>

### **Program Implementation**

The Grid Resilience grants administered by GDO include competitive utility and industry grants (authorized by BIL Section 40101(c)), and formula grants for states, territories, and Tribes (authorized by BIL Section 40101(d)). The first round of the competitive Grid Resilience Utility and Industry Grants Program<sup>2</sup> received 289 concept paper submissions, and ultimately received 122 full applications. Following a merit review process, DOE selected 16 applications for award negotiations, with an approximate total of \$919 million in conditional Federal funding<sup>3</sup> for the first round (fiscal year (FY) 2022 and FY 2023). The corresponding private investment for these awards totals approximately \$837 million. The geographical distribution of selected projects is shown in Figure ES.1.



\*Includes multi-state applications

**Figure ES.1** Geographical representation of first round of competitive grid resilience grant awards and their dollar amount. SU=small utility; LU = large utility or other eligible entity.

Of the 16 total awards from the grid resilience competitive solicitation, nine of the awards totaling approximately \$340 million in conditional Federal funding are for small utilities (utilities selling less than 4 million megawatt-hours of electricity per year),<sup>4</sup> while seven awards totaling approximately \$580 million in conditional Federal funding are for other entities, including

<sup>&</sup>lt;sup>2</sup> U.S. Department of Energy - Grid Deployment Office, 2023 <u>Grid Resilience and Innovation Partnerships (GRIP)</u> <u>Program</u> | Department of Energy.

<sup>&</sup>lt;sup>3</sup> The competitive grid resilience awards are conditional pending negotiation of award terms and conditions.

<sup>&</sup>lt;sup>4</sup> The Bipartisan Infrastructure Law Sections 40101(c) and 40101(d) (42 U.S.C. § 18711(c) and (d)) describe a "small utilities set aside" in which funds are "made available to eligible entities that sell not more than 4,000,000 megawatt hours of electricity per year."

utilities selling more than 4 million megawatt-hours of electricity per year. Similar resilience project types were proposed in both small utility and other entity awards.

The Grid Resilience State and Tribal Formula Grant Program<sup>5</sup> received applications from nearly all states, the District of Columbia, five U.S. territories, and 231 Tribal applications (including Tribal consortium applications), covering FY 2022 and FY 2023 grant allocations. Over \$750 million has been awarded to states, Tribes, and territories as of October 2023. Figure ES.2, below highlights the formula grant funding available to each of the U.S. states for FYs 2022–2023.



Figure ES.2. BIL 40101(d) FY 2022 and 2023 Total Available Funding: U.S states.

DOE has established partnerships with National Laboratories, national associations, and other Federal agencies to develop technical assistance and other resources that are informed by and useful to grid resilience grant recipients. Beginning in FY 2024, DOE intends to form additional partnerships with universities and private sector experts to help support grid resilience planning and project implementation.

### **Resilience Impact**

Historically, data collection on resilience performance improvement for specific resilience investments has been challenging due to inconsistency in outage reporting and limitations in tracking specific outage causes. To mitigate these challenges and ensure transparent reports on

<sup>&</sup>lt;sup>5</sup> U.S. Department of Energy - Grid Deployment Office, 2023. <u>Grid Resilience State and Tribal Formula Grant</u> <u>Program</u>.

grid resilience impact will be available, DOE is implementing a robust baselining and data tracking process for projects funded by these programs.

DOE began awarding funds under the Grid Resilience State and Tribal Formula Grants Program in May 2023, and DOE announced the full cohort of competitive Grid Resilience Utility and Industry Grant awards in October 2023. Given the early stage of program implementation, no specific resilience projects have been completed.

However, as noted above, DOE awarded 16 competitive grant awards. If these projects meet their goals, over 17,000 distribution poles will be hardened, almost 800 miles of power lines (including advanced or covered conductors) will be installed, over 100 miles of power lines will be undergrounded, multiple battery systems will be installed, eight or more microgrids will be constructed to enhance community resilience, and over 4,000 fuses and switches will be installed to minimize outages from extreme events.

With respect to the Grid Resilience State and Tribal Formula Grants Program, recipients are in the beginning stages of project identification, with a total of 15 projects approved by DOE from six grant recipients, as of March 2024. DOE expects that many grant recipients will continue identifying and selecting grid resilience investment opportunities through the remainder of FY 2024, with project implementation continuing into FY 2025. States and Tribes are engaging communities and stakeholders at multiple stages of implementation. In developing their applications, applicants are required to hold a public hearing to describe their program goals and narrative. In their program narratives, applicants must describe how they will address equity in implementing their grid resilience program. Some applicants have gone above these minimum requirements and conducted more extensive stakeholder engagement (e.g., via workshops or formal requests for input). Some recipients are also incorporating stakeholder engagement as a factor in project selection (e.g., prioritizing projects that have letters of support from the community or can demonstrate that community input was considered). As resilience projects funded by these programs are implemented, DOE will provide detailed performance data on the cost and types of projects invested in and on the impact these investments have had on mitigating disruptive events.

Overall, the portfolio of resilience investments will benefit hundreds of communities across the country and help address risks that are unique to their service territories. The high level of interest for grid resilience funding from both public and private sector grant recipients demonstrates the urgency and value of Federal funding to modernize and improve the existing electric grid infrastructure. Grants awarded by these programs will support a diverse set of technologies that when combined, are expected to provide improved power restoration services, reduced ignition risks for wildfire mitigation, increased outage monitoring capability, and increased energy storage capacity, among other benefits.

### Next Steps

DOE's GDO will continue execution of the grid resilience program activities discussed in this Report. Year 3 (FY 2024) application cycles are ongoing with anticipated selection of additional awardees of funding in late summer 2024.

Pursuant to BIL Section 40101(g), DOE will continue to provide technical and other assistance to awardees and eligible entities to support and monitor the impact of the grid resilience projects. Technical and other assistance includes supporting grant recipients across all stages of resilience planning, including:

- 1. Risk assessment
- 2. State of the grid assessment
- 3. Resilience strategy tradeoffs
- 4. Acquiring resources (funding, material, and a capable workforce)
- 5. Prioritization and valuation of projects
- 6. Data collection and performance tracking

This assistance is informed by and responsive to grant recipient needs; all grant recipients have the opportunity to submit assistance requests directly to DOE<sup>6</sup>. Planned technical assistance activities for stakeholders in FY 2024 include training workshops, vulnerability analysis, advanced power system modeling, and cohort opportunities for peer sharing on best practices in grid resilience investments. These efforts will improve knowledge and practice around grid resilience planning and help grant recipients successfully implement resilience projects.

States, Tribes, territories, utilities, and other grant recipients are beginning to plan and invest in grid resilience projects. Pursuant to BIL Section 40101(i), DOE will update this Report to Congress every two years and will provide detailed information demonstrating the resilience benefits of specific investments, including data and analysis on the extent to which the ability of the power grid to withstand disruptive events has increased.

<sup>&</sup>lt;sup>6</sup> U.S. Department of Energy - Grid Deployment Office, 2023. <u>Request Grid Resilience Assistance | Department of Energy.</u>



# PREVENTING OUTAGES AND ENHANCING THE RESILIENCE OF THE ELECTRIC GRID

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# I. Introduction

The Bipartisan Infrastructure Law (BIL) was enacted by the 117th U.S. Congress and signed into law by President Joseph R. Biden on November 15, 2021. The BIL provides approximately \$1.2 trillion of funding for investments needed to strengthen our Nation's infrastructure.

Pursuant to the BIL, the Department of Energy (DOE) is responsible for administering more than \$62 billion for investments in energy infrastructure that supports the transition to a clean, resilient, and equitable energy future. DOE's Grid Deployment Office (GDO) is tasked with distributing approximately \$12.8 billion of this total funding to states, Indian Tribes, territories, utilities, and other entities for infrastructure projects that modernize the electric grid and improve the Nation's electric grid resilience.

In particular, BIL Section 40101, *Preventing Outages and Enhancing the Resilience of the Electric Grid*, authorizes \$5 billion for (1) formula grants to states, Tribes, and territories; and (2) competitive grants to utilities and industry. These grants are intended to support investments to reduce the impact of disruptive events on the electric grid due to extreme weather, wildfire, and natural disasters.

### 1.1 Biennial Report to Congress

This Report is submitted pursuant to BIL Section 40101(i),<sup>7</sup> wherein it is stated:

"(i) BIENNIAL REPORT TO CONGRESS.—

(1) IN GENERAL.—Not later than 2 years after [November 15, 2021], and every 2 years thereafter through 2026, the Secretary shall submit to the Committee on Energy and Natural Resources of the Senate and the Committee on Energy and Commerce of the House of Representatives a report describing the program.

(2) REQUIREMENTS.—The report under paragraph (1) shall include information and data on—

(A) the costs of the projects for which grants are awarded to eligible entities;

(B) the types of activities, technologies, equipment, and hardening measures funded by those grants; and

(C) the extent to which the ability of the power grid to withstand disruptive events has increased."

As such, this Report provides the first biennial review of the BIL Section 40101 programs to the Senate and House Energy Committees.

<sup>&</sup>lt;sup>7</sup> 42 U.S.C. § 18711(i).

### 1.2 Frequency of Extreme Events is Increasing

The country continues to face an increasing number of extreme events. As of October 2023, the National Oceanic and Atmospheric Administration (NOAA) reports that there have been 23 weather and climate disasters with losses exceeding \$1 billion as shown in Figure 1.1. These events, which included "2 flooding events, 18 severe storm events, 1 tropical cyclone event, 1 wildfire event, and 1 winter storm event," resulted in over 250 direct and indirect fatalities and cost more than \$57.6 billion (Consumer Price Index-adjusted). These figures are part of a larger trend: 24 percent of the total inflation-adjusted cost of all major<sup>8</sup> weather and climate disaster events since 1980 was incurred in the last five years.<sup>9</sup>



#### U.S. 2023 Billion-Dollar Weather and Climate Disasters

**Figure 1.1**. National Oceanic and Atmospheric Administration - National Centers for Environmental Information, 2023.<u>U.S. Billion-Dollar Weather and Climate Disasters</u>. Notably, 2020, 2021, and 2022 each had total event costs well over \$100 billion.<sup>10</sup>

<sup>&</sup>lt;sup>8</sup> "Major" defined as an event with damages costing over \$1 billion. National Oceanic and Atmospheric Administration (NOAA) - National Centers for Environmental Information (NCEI), 2023. <u>U.S. Billion-Dollar Weather</u> and Climate Disasters..3.

 <sup>&</sup>lt;sup>9</sup> Comparisons of CPI-adjusted costs by select time periods. NOAA - NCEI, 2023. <u>U.S. Billion-Dollar Weather and Climate Disasters</u>, <u>United States Summary</u> (last accessed September 21, 2023).
 <sup>10</sup> NOAA - NCEI, 2023. U.S. Billion-Dollar Weather and Climate Disasters.

In addition to severe weather, the Nation continues to see an increase in wildfire impacts. In the last five years there have been five major wildfire events that each cost over \$1 billion in damages with 180 fatalities.<sup>11</sup> Additionally, the largest total acreage burned in wildfires during the last 70 years have all occurred in the last decade as shown in Figure 1.2 below.





The electric power sector can be both the cause of wildfires and be susceptible to them. Although a wide variety of factors contribute to wildfire initiation, electrical equipment has been a cause for six out of the 20 most destructive wildfire events in California from 2015– 2022.<sup>12</sup> This can occur when distribution or transmission lines fail in high wind or other harsh weather conditions, igniting nearby vegetation and sparking rapidly spreading wildfires. However, wildfires can also be damaging to the power system by causing physical damage to energy infrastructure and disrupting power service, with resulting financial and societal consequences.

### 1.3 Aging Infrastructure and the Need for Investment

America's economy, national security, and the health and safety of our citizens depend on the reliable delivery of electricity. The U.S. electric grid is comprised of more than 9,200 electric generating units having more than 1 million megawatts of generating capacity connected to over 600,000 miles of transmission lines.<sup>13</sup>

Much of the U.S. electric grid was built in the 1960s and 1970s. Although in recent years the grid has been augmented with automation and some emerging technologies, it is still mostly

<sup>&</sup>lt;sup>11</sup> NOAA - NCEI, 2023. U.S. Billion-Dollar Weather and Climate Disasters.

<sup>&</sup>lt;sup>12</sup> Auditor for the State of California, March 24, 2022. <u>Electric System Safety: California's Oversight of the Efforts by</u> Investor-Owned Utilities to Mitigate the Risk of Wildfires Needs Improvement.

<sup>&</sup>lt;sup>13</sup> U.S. Department of Energy – Office of Electricity, 2023. <u>Grid Modernization and the Smart Grid</u>.

dependent on legacy systems. Indeed, 70 percent of transmission lines are over 25 years old and approaching the end of their typical 50–80-year lifecycle.<sup>14</sup>

Aging infrastructure together with increasing demand for power have made the grid susceptible to cascading failures, where the failure of one component leads to a series of subsequent failures.<sup>15</sup> This has been observed during periods of extreme weather<sup>16</sup>. Additionally, aging electric infrastructure is being pushed to do more than it was originally designed to do. Modernizing the grid to make it "smarter" and more resilient through the use of cutting-edge technologies, equipment, and controls that communicate and work together to deliver electricity more reliably and efficiently can greatly reduce the frequency and duration of power outages, reduce storm impacts, and restore service faster when outages occur.

The increased frequency of extreme events, advanced age of U.S. grid infrastructure, heightened risk of physical and cyber-attacks, and expanding dependence on electricity for vital services such as transportation, among other challenges, signal an urgent need for modernizing the U.S. electric grid. This funding provided by BIL Section 40101 offers a unique opportunity to respond to these risks and improve grid resilience against extreme weather, wildfire, and natural disasters.

### 1.4 Challenges to Improving Grid Resilience

Congress has allocated significant funding to increase the resilience of the electric grid. However, increasing resilience to these disruptive events can be challenging.

First, the timing, intensity, and location of future risks to the grid from extreme weather and natural disasters are uncertain and are changing over time, making it difficult to predict the impact and plan for outage events. Second, there is a wide range of activities that improve grid resilience, including those which seek to prevent outages in the first place and those which seek to minimize or mitigate the impacts of outages when they do occur. The process of assessing all options and prioritizing which resilience investments to pursue can often be challenging for utilities, public sector agencies, and other stakeholders. Third, evaluating the costs and benefits of investments is extremely difficult, not only because the data needed to do so has not been historically collected, but because the efficacy of similar investment types can vary dramatically due to climate, policy, and grid topology factors specific to a certain location, and because of the inherent difficulty of evaluating the benefit of guarding against uncertain risks. Finally, while

<sup>&</sup>lt;sup>14</sup> The White House – Briefing Room, November 18, 2022. <u>FACT SHEET: The Biden-Harris Administration Advances</u> <u>Transmission Buildout to Deliver Affordable, Clean Electricity</u>.

<sup>&</sup>lt;sup>15</sup> U.S. Department of Energy, 2015. <u>Quadrennial Technology Review 2015</u>.

<sup>&</sup>lt;sup>16</sup> Hellmuth, M., Bruzgul, J., Schultz, P., Spindler, D., & Pacini, H. (ICF International for the Western Electricity Coordinating Council), December 26, 2014. <u>Assessment of Climate Change Risks to Energy Reliability in the WECC</u> <u>Region</u>.

there is significant unrealized ability to harden the electric grid against threats, there is limited appetite for investments that must be funded in whole or in part by electric ratepayers, and resilience improvements are only one of many investment demands on the electric grid. All these upgrades present competing priorities for decision-makers who must weigh the benefits of these grid investments.

DOE has considered these difficulties and has accounted for them in the program design and implementation of the Grid Resilience programs authorized by BIL Section 40101. The design of these programs and status to date of these programs and the projects that have been funded are outlined in Section 2 of this report. Section 3 of the report describes how DOE plans to determine the impact of the investments funded through BIL Section 40101.

## **II.** Program Design and Implementation

### 2.1 Grid Deployment Office

The GDO was established within DOE in August 2022 to catalyze the development of new and upgraded electric infrastructure across the country by maintaining and investing in critical generation facilities; developing and upgrading high-capacity electric transmission lines nationwide; and deploying transmission and distribution technologies to provide reliable, affordable electricity to everyone, everywhere.

Working in partnership with energy sector stakeholders on a variety of grid initiatives, GDO has organized its efforts into three divisions: Resource Adequacy; Transmission; and Grid Modernization. These divisions leverage unique authorities to drive investment, improve resource adequacy, boost transmission and distribution system resilience and flexibility, and provide access to expertise, capabilities, and technical assistance on a variety of transformational grid modernization and market strategies.

GDO's activities support the Building a Better Grid Initiative, which seeks to catalyze nationwide development of new and upgraded high-capacity electric transmission lines and support investments to modernize the flexibility and resilience of the distribution system. The initiative, enabled by the BIL and the Inflation Reduction Act of 2022 (IRA), is identifying national transmission and distribution needs and supporting the buildout of long-distance, high-voltage transmission facilities and distribution systems that are critical to reaching 100 percent clean electricity by 2035 and a zero-emissions economy by 2050.

The Grid Resilience funding authorized by Section 40101(c) and 40101(d) of the BIL are administered by the Grid Modernization Division and are run under two separate programs: Section 40101(c) funding is included as one topic area within the Grid Resilience and Innovation Partnerships (GRIP) Program, and Section 40101(d) funding is operated as the State and Tribal Assistance Program, which are each described below.

In addition, the National Energy Technology Laboratory (NETL)<sup>17</sup> provides contractual support for grant administration for both the competitive and the formula grant programs and issues the Funding Opportunity Announcement (FOA) for GRIP and the Administrative and Legal Requirements Document (ALRD) for the formula funding program, as well as subsequent FOA and ALRD amendments on behalf of GDO. Additional contractual support is provided by ICF Consulting to support GDO in the development of the formula grant allocations using the most recent and best available underlying data in updating the annual formula grant allocations.

<sup>&</sup>lt;sup>17</sup> NETL is a DOE government-owned and government-operated laboratory. See <u>NETL website</u>.

### 2.2 Grid Resilience and Innovation Partnerships (GRIP) Program

The competitive grid resilience grants for utilities and industry are administered through the GRIP Program. The Program includes three funding mechanisms: (1) Grid Resilience Utility and Industry Grants (under Section 40101(c) of BIL, \$2.5 billion in total funding); (2) Smart Grid Grants (under Section 40107 of BIL, \$3 billion in total funding); and (3) Grid Innovation Program (under Section 40103(b) of BIL, \$5 billion in total funding). This Report focuses on the Grid Resilience Utility and Industry Grants.

The Grid Resilience Utility and Industry Grants support activities that will reduce the likelihood and consequences of impacts to the electric grid due to extreme weather and natural disasters. This program funds comprehensive transformational transmission and distribution technology solutions that will mitigate multiple hazards across a region or within a community, including wildfires, floods, hurricanes, extreme heat, extreme cold, storms, and other events that can cause a disruption to the power system. Grants are provided to electric grid operators, electricity storage operators, electricity generators, transmission owners or operators, distribution providers, and fuel suppliers.

# 2.2.1 Grid Resilience Utility and Industry Grant Application and Award Status

Concept papers for the first GRIP funding opportunity were due on December 16, 2022. The first round (FY 2022 and FY 2023) of the competitive utility and industry grants program received 289 concept paper submissions, and ultimately received 122 full applications. In October 2023, following a merit review process, DOE announced 16 applications had been selected for award negotiations, with an approximate total of \$919 million in conditional Federal funding. The corresponding private investment for these awards totals approximately \$837 million.

Of the 16 total awards from the grid resilience competitive solicitation, nine of the awards totaling approximately \$337 million in conditional Federal funding are for small utilities (utilities selling less than 4 million megawatt-hours of electricity per year),<sup>18</sup> while seven awards totaling approximately \$582 million are for other eligible entities, including utilities selling more than 4 million megawatt-hours of electricity per year. The geographical distribution of proposed projects selections is shown in Figure 2.1.

<sup>&</sup>lt;sup>18</sup> 42 U.S.C. § 18711(c)(5).



### 40101c Utility/Industry Resilience Proposed Selection

\*Includes multi-state applications

*Figure 2.1* 40101(c) Utility/Industry Resilience Proposed selections by state. SU = small utility, LU = large utility.



Similar resilience project types were included in both large and small entity awards, as shown in Figure 2.2.

**Figure 2.2** Summary of project types funded in first cycle of 40101(c) grant awards. Many projects selected<sup>19</sup> for awards include multiple project types, thus the total percentage of project types by award recipients adds up to greater than 100 percent.

<sup>&</sup>lt;sup>19</sup> For full list of selected projects, visit this website: U.S. Department of Energy - Grid Deployment Office, 2023. Grid Resilience and Innovation Partnerships (GRIP) Program Projects.

Federal Dollars	Total Project	Prime Recipient	Project Description
Awarded	Budget		
\$99.633.723	\$205.739.242	PacifiCorp	<ul> <li>Installing covered conductors on the distribution system.</li> <li>Installing fire-resistant steel or composite distribution poles.</li> <li>Installing non-expulsion fuses.</li> <li>Upgrading a Tribal distribution substation with new transformers and circuit breakers, as well as raising the ground level by 10-15 feet to help cease flood-related outages.</li> </ul>
¢100.000.000	¢256 761 176	DECO Enormy Compony	<ul> <li>Rebuilding multiple aging transmission circuits with new tubular monopoles and High Temperature Low Sag (HTLS) conductor.</li> <li>Installing a microgrid with a backup battery storage to support resilient storm response activities during a distribution system</li> </ul>
\$100,000,000	\$250,701,170	PECO Energy Company	outage.
			<ul> <li>Hardening transmission and distribution line structures by upgrading towers and poles to a wind design rating of &lt;140 mph for transmission structures and to 140 mph for distribution poles.</li> <li>Installing of a battery near a Solar</li> </ul>
¢E1 000 170	\$100 656 256	Entergy New Orleans,	Photovoltaic generation interconnection
\$32,375,691	\$64,751,382	Electric Power Board of Chattanooga	<ul> <li>Installing 6 microgrids with batteries.</li> <li>Converting fused lateral circuits from overhead to underground.</li> <li>Replacing distribution poles.</li> </ul>
		Hawaiian Electric	<ul> <li>Hardening structures on transmission system.</li> <li>Targeted pole hardening of critical poles on the distribution system.</li> <li>Deploying intelligent switches to minimize sparks caused by line contact.</li> <li>Undergrounding of lateral lines on the distribution.</li> </ul>
\$95,313,716	\$190,627,434	Company, Inc.	• Developing a backup control center.
\$100,000,000	\$200,310,996	Consumers Energy	<ul> <li>Installing lateral fuses.</li> <li>Reconductoring lines to create new ties between adjacent circuits.</li> <li>Hardening distribution poles.</li> <li>Replacing all fuses in wildfire risk areas with non-expulsion fuses.</li> </ul>
		Xcel Energy Services,	<ul> <li>Covering wood poles with a fire-resistant coating.</li> </ul>
\$100,000,000	\$242,020,463	Inc. (Xcel Energy)	Undergrounding high-risk distribution lines.

Table 2.1. Competitive Grid Resilience Utility and Industry Grant Awards

Federal Dollars Awarded	Total Project Budget	Prime Recipient	Project Description
			<ul> <li>Installing microgrids supporting community resilience in emergencies.</li> <li>Developing tools to ensure that electric vehicle (EV) drivers are alerted, and the company is aware of their charging needs as Public Safety Power Shutoff is deployed.</li> </ul>
Small Utility Set	Aside		
\$99,328,430	\$145,091,246	Holy Cross Electric Association, Inc.	<ul> <li>Working with consortium of National Rural Electric Cooperative Association (NRECA) and 39 rural electric cooperatives to deploy advanced technologies to eliminate utility- ignited wildfires.</li> </ul>
\$15,430,118	\$23,145,698	Kit Carson Electric Cooperative	<ul> <li>Installing a battery energy storage system connected to three different facilities to provide power during public safety power shutoffs.</li> </ul>
\$17,377,945	\$23,170,593	Jamestown Board of Public Utilities	<ul> <li>Installing a microgrid with a battery storage system to support town radial fed by transmission line.</li> </ul>
\$52,857,560	\$70 476 750	Sumter Electric	<ul> <li>Converting distribution overhead to underground lines.</li> <li>Overhead hardening of wires and poles.</li> <li>Building a new substation to increase capacity.</li> </ul>
	¢, 0, 1, 0, 1, 0	Southern Maryland	<ul> <li>Replacing and hardening of transmission lines.</li> <li>Retrofitting and hardening the distribution system with strategic undergrounding and replacing aging conductors.</li> <li>Installing high-capacity optical ground wire (OPGW) along transmission lines and create a fiber loop that encompasses five distinct</li> </ul>
\$33,567,016	\$49,209,016	Fort Pierce Utilities	<ul> <li>Upgrading two bulk transformers.</li> <li>Converting one substation to a ring bus.</li> <li>Installing Trip Savers, a type of fuse protoctor.</li> </ul>
\$4,665,803	\$6,998,706	Tri-County Electric Cooperative, Inc. (TCE)	<ul> <li>Installing Al-Dash software system, which utilizes satellite imagery to assess vegetation growth.</li> <li>Upgrading meters to advance radio frequency smart meters.</li> </ul>
\$96,942,707	\$144,660,119	Midwest Energy, Inc.	<ul> <li>Substation and transmission line upgrading, including rebuilding and/or replacing transmission lines, updating lines with optical ground wire, installing gas-insulated breakers capable of faster clearing times, installing digital relays at four substations.</li> </ul>

Federal Dollars Awarded	Total Project Budget	Prime Recipient	Project Description
			and building one new substation to serve a growing urban load.
			<ul> <li>Improving vegetation management practices.</li> </ul>
			<ul> <li>Replacing existing conductor with covered wire.</li> </ul>
			Implementing a distribution automation
		Mora-San Miguel	system.
		Electric Cooperative,	<ul> <li>Installing an outage management system for</li> </ul>
\$11,270,193	\$15,026,924	Inc.	the first time.

### 2.3 Grid Resilience State and Tribal Formula Grant Program

The Grid Resilience State and Tribal Formula Grant Program distributes up to \$2.5 billion in provision funding over a period of five years to states, territories, and Federally recognized Indian Tribes, including Alaska Native Regional Corporations and Alaska Native Village Corporations. Funding allocation is based on a formula that includes five factors: population size; land area; probability of disruptive events in the state; territory or land of the Indian Tribe during the previous 10 years; the number and severity of disruptive events experienced by the state, territory, or Indian Tribe since January 1, 2011; and a locality's historical expenditures on mitigation efforts.<sup>20</sup> The states, territories, and Indian Tribes will then subaward these funds to a diverse set of eligible entities, with priority given to efforts that generate the greatest community benefit providing clean, affordable, and reliable energy.

# 2.3.1 Grid Resilience State and Tribal Formula Grant Application and Award Status

The Grid Resilience State and Tribal Formula Grant Program received applications from nearly all states, Washington DC, five U.S. territories, and 231 Tribal entities (some of which were consortium applications) for FY 2022 and FY 2023 grid resilience funding.<sup>21</sup>

As of October 2023, DOE had awarded over \$750 million in formula grants to eligible applicants. Awards were made to all state applicants, the District of Columbia, 3 territories, and 52 Indian Tribes, including one Tribal consortium. Once the remaining applications are awarded, DOE expects to have provided over \$814.5 million in grid resilience formula grants for FYs 2022 and 2023. States, Indian Tribes, and territories that receive awards will develop an approach to subgrant awards to eligible entities for resilience projects. Frequently, this involves a competitive solicitation process. Each resilience project must be approved by DOE prior to

<sup>&</sup>lt;sup>20</sup> 42 U.S.C. § 18711(d)(3)(B).

<sup>&</sup>lt;sup>21</sup> South Dakota and Alabama chose not to apply for the first two years of their funding allocations.

beginning any work. Recipients are in the beginning stages of project identification, with a total of 15 projects approved by DOE from six grant recipients as of March 2024. DOE expects that many grant recipients will continue identifying and selecting grid resilience investment opportunities through the remainder of FY 2024, with project implementation continuing into FY 2025.

Funding allocations for all eligible recipients are shown in Figures 2.3 and 2.4.





American Samoa

Puerto Rico

BIL 40101(d) Fiscal Years 2022 and 2023 Total Funding: U.S. Federally Recognized Tribes

#### **Total Funding**

- o \$0 \$250,000
- O > \$250,000 \$500,000
- O > \$500,000 \$1,000,000
- O > \$1,000,000 \$1,500,000
- > \$1,500,000 \$5,000,000
- Indian Tribe Type
- U.S. Federally Recognized Tribes



BIL 40101(d) Fiscal Years 2022 and 2023 Total Funding: Alaskan Federally Recognized Tribes and Alaska Native Corporations





### 2.4 Implementation Challenges

Several important challenges arose in developing and implementing the grid resilience grant programs. Feedback from potential grant recipients and other stakeholders was pivotal in informing programmatic flexibilities that DOE was able to implement, such as application deadline extensions, acceptance of Tribal consortium applications, and approval of a cost share waiver for insular areas. A summary of key implementation challenges is described below.

### 2.4.1 Grid Resilience Utility and Industry Grants

The Grid Resilience Utility and Industry Grants program faced several implementation challenges within the constraints described in the BIL 40101(c) statute. Each of these issues are briefly described in Table 2.2 along with the mitigation measures that the program developed in response.

Challenge	DOE mitigation measure and response			
Limitations due to statutory requirements:				
Restriction allowing any new generation facilities as an allowable project	BIL Section 40101(e)(2)(A)(i) prohibits the use of grant funds for construction of a "new electric generating facility."			
	DOE has clarified that modification of an existing generation facility may be an eligible use of funds, but the scope of the project would need to reduce the likelihood and consequences of disruptive events and meet one of the eligible uses of grant funds listed in BIL Section 40101(e). DOE has also clarified that microgrids that are paired with new generation funded from non-40101 programs would be eligible to participate as well.			
Statutory timeline for project deployment dissuaded applicants applying	DOE conducted a series of webinars with extensive question and answer sections, responses to public inquiry, meetings with trade groups and technology vendors, and explicit discussion of future funding cycles to help streamline applications and prepare applicants for the rigorous timeline. The program ultimately received 122 applications requesting \$7.5 billion in Federal funding indicating strong industry need despite the timeline challenge.			
Challenges faced by most applicants:				
Applicants concentrating on day-to-day reliability versus resilience to disruptive events and natural disasters	The GRIP Program is revising subsequent FOA drafts to reflect the latest DOE guidance for clarity regarding the need for applicants to emphasize resilience in particular.			
Incorporating meaningful community engagement, feedback and benefits into their overall project planning and execution process	The GRIP Program is revising subsequent FOA drafts to reflect the latest DOE guidance for clarity regarding Community Benefits Plans design and requirements.			
Small utility specific issues:				
Calculating required cost match (versus cost share requirement for other GRIP provisions)	The GRIP Program is revising subsequent FOA drafts to reflect the latest DOE guidance for clarity regarding the cost match and the cost share required for small utilities.			
Under-resourced utilities challenged by the detailed requirements of the application process	The team held several direct conversations with the National Rural Electric Cooperative Association (NRECA) and the American Public Power Association (APPA) to better understand under-resourced utility			

**Table 2.2.** Summary of challenges and mitigation measures in Grid Resilience Utility and

 Industry Grants Program

Challenge	DOE mitigation measure and response
	needs. In the next cycle of funding, DOE is encouraging
	a consortium approach from applications, and will also
	implement a separate review cohort for small utilities
	vs. large utilities to better consider their unique
	characteristics and ensure funding to the statutory
	level.

### 2.4.2 Grid Resilience State and Tribal Formula Grant Program

The Grid Resilience State and Tribal Formula Grant Program conducted extensive outreach to states, Tribes, and territories through in-person and virtual conferences, program webinars, and through direct engagement by phone and one-on-one meetings. These outreach efforts informed the identification of several implementation challenges within the constraints described in the BIL 40101(d) statute. Each of these issues are briefly described in Table 2.3 along with the mitigation measures that the program developed in response.

Challenge	DOE mitigation measure and response		
Limitations due to statutory requirements			
Lack of comprehensive, public data for factors needed in the formula grant calculation	There is an absence of data needed to support certain factors in the formula calculations. DOE has focused on using the most recent, comprehensive, and best available data sets for FY 2022-FY 2023 allocations, and is exploring how technical assistance resources may be used to improve data available for future funding allocations.		
Cost match requirements for Tribes and territories	The cost match requirements explicitly described in the statute include a 15 percent cost match for formula grant applicants. An eligible entity that is sub-granted an award is required to provide a cost match of 100 percent, or 1/3 of the amount of the grant if the eligible entity meets the definition of a small utility. <sup>4</sup>		
	DOE was able to waive the cost match requirement for Insular Areas, based on the Office of Management and Budget (OMB) Controller Alert CA-23-04, Waiving Matching Fund Requirements for Insular Areas. As a result, U.S. Insular Areas (U.S. Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands) are not required to provide the 15 percent cost match. Sub-awardees in insular areas are still responsible for providing the required cost-match for resilience projects.		
	Although Tribes have continued to request cost-match waivers, there is no similar applicable cost match waiver for Tribes.		
Funding restrictions affect the ability to develop a comprehensive approach – for	DOE received many inquiries around the potential for the program to fund distributed generation resources, which is not an eligible use of funding under the statute. BIL Section 40101(e)(2)(A)(i) also prohibits the use of grant funds for construction of a "new electric generating facility."		
instance, restrictions prevent any new electric generation	DOE has clarified that modification of an existing generation facility may be an eligible use of funds, but the scope of the project would need to reduce the likelihood and consequences of disruptive events and meet one of the eligible uses of grant funds listed in BIL Section 40101(e), such as weatherization or hardening of facilities.		

Table 2.3. Summary of challenges and mitigation measures in Formula Grant Program

facilities as an allowable project	Additionally, any work performed on an existing generating system cannot increase the maximum rated output of the original nameplate capacity.
Implementation issues in	DOE has also provided potential applicants with lists of alternative Federal funding opportunities that could support new electric generation projects that cannot be funded with the BIL Section 40101 Grid Resilience Grants.
implementation issues it	antifica from states, moes, and territories
Timely communication and outreach to Tribes with limited internet	The program leveraged all available resources to coordinate outreach to Tribes within the DOE and in collaboration with other Federal agencies, regional Tribal organizations, and other partners.
access, and the lack of a comprehensive updated Tribal contact list	Through extensive outreach and engagement efforts, the program was ultimately able to provide application information to all 775 eligible Tribal entities via mail, email, phone, or fax in advance of the Tribal application deadline. The program also provided significant direct application support and assistance to Tribes through webinars, attendance at Tribal events, and one-on-one meetings with Tribal representatives. DOE also provided multiple deadline extensions to Tribal applicants to ensure as many Tribes as possible could apply for the funding.
	Thes as possible could apply for the funding.
Feedback from Tribes about the need for Tribal consortia applications	Under Section 40101(d) of the BIL, grant funds are required to be provided directly to states and Indian Tribes. However, DOE received valuable feedback from Tribes and Tribal organizations that requested the flexibility for Tribes to form consortia to apply and take advantage of available funding.
	Based on this feedback, DOE successfully modified Program requirements to enable Tribal consortia applications under the provisions of Section 40101(d). Applying as a "Tribal Consortium" will allow resource-constrained Tribes to pool efforts to meet grant requirements, such as managing funds and providing the required reporting.
High reporting burden for small awardees	Grant reporting requirements for BIL -funded projects may be significant, particularly for small awardees. The DOE understood that many small Tribes who receive small funding allocations may not have the administrative capacity to support all the reporting requirements. The program team worked to reduce reporting burden by allowing project impacts to be reported annually instead of quarterly, utilizing a simplified template for Tribes receiving less than \$500,000 in grant allocation in Year 1 or Year 2, and developing pre-populated reporting templates which allow recipients to fill in many responses from a drop-down list.

### 2.5 Technical and Other Assistance

Pursuant to BIL Section 40101(g), GDO provides technical and other assistance to grant recipients, including training, analysis, and guidance on best practices in grid resilience investments, as well as assistance that improves knowledge and practice around grid resilience planning. In addition, GDO supports development of modeling and analytical capabilities to evaluate the extent to which the ability of the power grid to withstand disruptive events has increased as a result of program activities.

Technical and other assistance includes helping grant recipients across all stages of resilience planning:

- 1. <u>Risk assessment</u>: What are the **outage threats** now and in the future? How likely are they? How severe could they be? How does this coincide with other critical infrastructure or services?
- State of the grid assessment: What elements of the electrical system are performing well or poorly against outage threats? What are current expectations about future performance based on asset condition, climate projections, and electrical demand changes? Which entities are finding success, which ones may need more support?
- 3. <u>Resilience strategy tradeoffs</u>: What options are available to enhance grid performance and under what conditions are improvements expected? Does the benefit outweigh the cost? What projects align with grid resilience goals and which projects are feasible within DOE funding parameters? This could include application of distributed energy resources, energy storage, and microgrids.
- 4. <u>Prioritization and valuation</u>: Once the risk, needs, and options are understood, how should projects be selected and prioritized? What are all qualitative and quantitative aspects that should be considered in this decision making? What criteria need to be considered to meet DOE requirements?
- 5. <u>Acquiring resources</u>: Are workforce, funding, and material to invest in grid resilience available? What assistance is needed in applying for and administering grants? What financing is available?
- 6. <u>Data collection and performance tracking</u>: Is the investment providing the expected benefit? What information is needed to calculate this benefit and adhere to DOE requirements? What lessons can be learned for future resilience investment planning?

GDO is working collaboratively with recipients of these funds to develop technical and other assistance offerings that are responsive to their needs. Grant recipients may submit grid resilience assistance requests directly to GDO.<sup>22</sup> This request portal, along with regular check-in meetings with grant recipients, enables GDO to craft technical assistance that is informed by stakeholder needs.

On October 7, 2022, GDO issued a Request for Information (RFI) to industry and university stakeholders seeking information on the existing tools and resources available to bolster the capabilities of states, territories, and Tribes to execute plans to enhance the resilience of their electric grids. Based on unique institutional responses from universities, industry, and other energy stakeholders, DOE identified several opportunities to utilize existing models and

<sup>&</sup>lt;sup>22</sup> U.S. Department of Energy - Grid Deployment Office, 2023. <u>Request Grid Resilience Assistance | Department of Energy</u>.

methodologies, fill critical gaps in the development of tools and data, and support key areas where advancements in grid resilience planning may be beneficial to grant recipients.

Informed by this ongoing outreach and engagement, GDO has developed a strong portfolio of technical and other assistance offerings to support 40101 grant recipients in effectively enhancing grid resilience. GDO leverages partnerships with the National Laboratories, as well as national associations (e.g., National Association of State Energy Offices (NASEO); National Association of Regulatory Utility Commissioners (NARUC): National Governors Association (NGA); National Council of State Legislatures (NCSL)), Tribal organizations, and trade associations to ensure assistance resources are informed by and useful for 40101 grant recipients.

The table below summarizes completed, in progress, and planned technical and other assistance activities during FY 2022 and FY 2023. GDO expects to continue to expand technical and other assistance efforts in FY 2024.

Technical Assistance & Program Support	Status	Description
Resilience Training Workshop	Complete	Southeast regional grid resilience workshop hosted at the Public Service Commission of South Carolina featuring speakers on topics related to causes and impacts of grid outages, best practices for resilient distribution systems, and resilience investment valuation and prioritization.
Webinars and events	Complete	GDO has hosted and participated in numerous webinars and events explaining the 40101(d) funding opportunity and application process to state and territorial energy offices, regional inter-Tribal organizations, Tribal members, public utilities commissions, governors' offices, state legislators, utilities, and other interested stakeholders.
Grant Application Assistance	Complete	GDO provided outreach and grant application assistance on the 40101(d) funding opportunity to eligible Tribal entities.
Resilience case studies	In progress	Three National Laboratories are developing case studies on the following topics: utility planning practices for wildfires, hurricanes, and winter storms; resilience metrics used by utilities; incorporating equity in grid planning practices; resilience investment valuation and prioritization.
Technical summary	In Progress	GDO is working with Argonne National Laboratory to develop electric sector risk profiles summarizing climate risks for Guam, American Samoa, U.S. Virgin Islands, and the Commonwealth of Northern Mariana Islands.
Peer-sharing & learning	In Progress	GDO, in partnership with Argonne National Laboratory, is hosting a year- long climate risk analysis cohort for municipal utilities and rural electric cooperatives.
Database curation	In Progress	Several National Laboratories and national associations are collaborating on a database of grid resilience policies whose objective is to accelerate adoption of informed state legislative, regulatory, and executive actions on grid resilience by expanding states' understanding of grid resilience activities in other states.

**Table 2.4**. Summary of assistance provided to support grid resilience efforts.

Technical Assistance & Program Support	Status	Description
Technical summary	In Progress	GDO and several National Laboratories are compiling summaries of grid resilience technologies along with cost information to help 40101(d) recipients understand the range of investments they may want to consider for a given outage threat.
Peer-sharing & learning	In Progress	NASEO and NARUC are developing a grid resilience needs assessment to be completed in fall 2023. Throughout FY 2024, DOE, NASEO, and NARUC will organize peer-learning cohorts for state lead agencies for 40101(d) funding to discuss the topics identified in the needs assessment.
Workshops	In Progress	GDO in partnership with Lawrence Berkeley National Laboratory and the DOE Office of Electricity, will be hosting three regional workshops on grid resilience for state public utilities commissions in 2023 and 2024.
Fellowships	In Progress	GDO in partnership with the DOE Office of Energy Efficiency and Renewable Energy, will individually support up to 10 Fellows in the 2023 class focused on grid resilience as part of the Clean Energy Innovator Fellowship program, which places recent graduates at Public Utilities Commissions (PUCs), cooperative utilities, and Tribal organizations to support their grid modernization efforts.

## III. Impact of BIL 40101 Grid Resilience Grant Funds

As part of the requirement in BIL Section 40101(i), in addition to identifying project types and costs, Congress has requested an update on "the extent to which the ability of the power grid to withstand disruptive events has increased" with these resilience investments. This section outlines current practices in evaluating impact and the steps DOE is taking to assess the impacts of the funded projects and expected results.

### 3.1 Current Practices in Assessing Performance

Typically, utilities and regulators have utilized a common set of reliability metrics<sup>23</sup> to track the quality of electric service delivered to customers. These metrics are required to be reported to PUCs for distribution systems. Additionally, the Energy Information Administration collects reliability metrics annually from each utility through Form 861.<sup>24</sup>

However, several challenges exist with using these metrics to understand outage performance. First, there is no standard across the industry for how to calculate these metrics; utilities differ in how they set interruption duration thresholds<sup>25</sup> and what types of extreme events may be included or excluded from calculations.<sup>26</sup>

Second, these metrics tend to be reported for an entire service territory over a full year, which does not provide the granularity necessary to consider the effectiveness of individual investments made at different points in the system to increase resilience to specific events, or the range of outage causes experienced.

Finally, even when looking at the reliability trends within a single utility over time, as shown in Figure 3.1, performance improvement associated with investment spending may or may not

<sup>&</sup>lt;sup>23</sup> These metrics include **System Average Interruption Duration Index (SAIDI)** - the average duration in minutes a customer is interrupted considering the full system during a reporting period (the average includes all customers, those who lost power and those who did not); **System Average Interruption Frequency Index (SAIFI)** - The average number of customers who lost power during a reporting period; **Customer Average Interruption Duration Index (CAIDI)** - The average duration in minutes a customer is interrupted considering only the customers who lost power during a reporting period.

<sup>&</sup>lt;sup>24</sup> U.S. Energy Information Administration, 2023. <u>Annual Electric Power Industry Report, Form EIA-861 detailed</u> <u>data files</u>.

<sup>&</sup>lt;sup>25</sup> For example IEEE 1366 defines momentary interruptions as less than 5 minutes (<u>see</u> Teixeria, J. (National Grid), February 19, 2019. <u>IEEE 1366 – Reliability Indices</u>), while the Florida Public Service Commission (PSC) defines momentary interruptions as less than 1 minute (see Florida PSC, August 2023. <u>Review of Florida's Investor-Owned</u> <u>Electric Utilities' Service Reliability Reports</u>).

<sup>&</sup>lt;sup>26</sup> For example IEEE 1366-2001 uses a statistical measure (called the <u>2.5 Beta Methodology</u>) to determine what constitutes as a Major Event Day, whereas the Pennsylvania PUC considers any disruption that impacts 10 percent of a utility's customers for 5 minutes or more is considered a major event (see 52 Pa. Code § 57.192, September 30, 2023. <u>Electric Reliability Standards, Definitions</u>).

lead to an absolute improvement in these annual metrics due to external factors such as changes in weather patterns. Because the annual service quality metrics depend on both the physical state of the grid and on the amount and type of stresses the grid was under that year, it is difficult to isolate the causal impact of resilience investments on these metrics.



Figure 3.1 Variability in Investor-owned utility (IOU) annual reliability performance.

Despite these limitations, there have been efforts made to quantify the impact of various resilience investments. For example, utilities may conduct forensic analyses after specific outage events to determine how assets fared during that specific event.<sup>27</sup> This analysis is often used to prioritize future investments within the utility, by identifying weak points on the system and specific vulnerabilities. Additionally, engineering models are often used to simulate asset fragility and therefore estimate how a system will fare during an outage event.<sup>28</sup> These models can be used to estimate the benefit of potential resilience investments when there is little other data available. Finally, there are existing statistical models based on historic data that take into account system attributes and location-specific weather experienced by utilities when analyzing outage performance to provide generalizable results on the relationship between resilience investments and outage performance.<sup>29</sup>

<sup>28</sup>U.S. Department of Energy – Office of Electricity, 2023. North American Energy Resilience Model

<sup>&</sup>lt;sup>27</sup>Florida Public Service Commission, July 2018. <u>Review of Florida's Electric Utility Hurricane Preparedness and Restoration Actions 2018</u>.; Kwasinski, A., Eidinger, J., Tang, A. & Tudo-Bornarel, C., (2014). <u>Performance of electric power systems in the 2010–2011 Christchurch, New Zealand, earthquake sequence</u>. *Earthquake Spectra, 30*(1), 205-230; U.S. Department of Energy - Office of Electricity Delivery and Energy Reliability, 2013. <u>Comparing the Impacts of Northeast Hurricanes on Energy Infrastructure</u>.; and National Academies of Science Engineering and Medicine, 2017. <u>Enhancing the Resilience of the Nation's Electricity System</u>. 6.

<sup>(</sup>NAERM);Bennett, J. A., Trevisan, C. N., DeCarolis, J. F., Ortiz-García, C., Pérez-Lugo, M., Etienne, B. T., & Clarens, A. F. (2021). Extending energy system modelling to include extreme weather risks and application to hurricane events in Puerto Rico. Nature Energy 6(3), 240–249; and Kabir, E., Guikema, S. D. & Quiring, S. M. (2019). Predicting thunderstorm-induced power outages to support utility restoration. *IEEE Transactions on Power Systems, 34*(6), 4370–4381.

<sup>&</sup>lt;sup>29</sup> M. Abdelmalak, J. Cox, S. Ericson, E. Hotchkiss & M. Benidris, <u>Quantitative resilience-based assessment</u> <u>framework using EAGLE-1 power outage data</u>. *IEEE Access*, *11*, 7682-7697.

To address these challenges in tracking and comparing grid resilience investments, DOE has leveraged previous research and taken the following approach:

- Establish a baseline to understand disruption risk prior to project implementation.
- Ask recipients to estimate impact of disruptive events in their applications.
- **Track investment implementation** in conjunction with outage performance to identify the impact of specific investments.
- Provide a **standard set of metrics** for common project types to choose from which will provide consistency and comparability across a majority of projects, while allowing flexibility in unique cases.
- **Track location** of project implementation to understand location-specific factors and how that could impact disruption performance.
- Track location of **project beneficiaries** to be able to quantify and qualify improvements for the surrounding community.
- Use 40101 assistance funding to **study** how **previous resilience investments** improved system performance.

# 3.2 Expected Impact of Current Grid Resilience Funding Portfolio

DOE began awarding funds under the Grid Resilience State and Tribal Formula Grant Program in May 2023, and announced the full cohort of competitive Grid Resilience Utility and Industry grant awards in October 2023. Given the early stage of program implementation, no specific resilience projects have been completed. Nevertheless, this section describes examples of the expected impact for projects as outlined in selected applications.

With respect to the Grid Resilience State and Tribal Formula Grants, DOE awarded over \$750 million to states, Tribes, and territories by October 2023 with remaining FY 2022 and FY 2023 awards planned throughout winter 2023 and spring 2024. DOE expects that many grant recipients will begin identifying and selecting grid resilience investment opportunities in this timeframe, with project implementation beginning in 2024.

While states, Tribes, and territories were not required to identify specific resilience projects in their applications for formula grant funding, DOE invited formula grant recipients to outline the method they will use to solicit subaward proposals and the criteria they will use for evaluating

Larsen, P., Lawson, M., LaCommare, K.H., &Eto, J.H. (2020). <u>Severe weather, utility spending, and the long-term</u> reliability of the U.S. power system. *Energy*, *198*, 117387.

Bohman, A. (2023). <u>Investing in power system resilience: A mixed methods approach to assessing the tradeoffs of resilience strategies</u>. Carnegie Mellon University. Thesis.

potential resilience projects. Many formula grant recipients indicated that they plan to use competitive solicitations to select individual resilience projects.

Although competitive solicitation designs are likely to differ due to individual state procurement requirements, an initial review of proposed criteria suggests common priorities to include projects that:

- Reduce the frequency, duration, and/or impacts of outages due to disruptive events.
- Support workforce development and labor protections.
- Are located in a disadvantaged community<sup>30</sup> or provide benefits to disadvantaged communities.
- Include specific technologies or project types (e.g., microgrids, resilience hubs, black start capability, local government, non-profits).
- Impact areas at heightened risk of disruptive events (e.g., floodplain, worst performing circuits, major storm risk).
- Further state clean/climate energy goals are consistent with state resilience plans or build on feasibility studies.
- Offer "non-energy" benefits in addition to resilience benefits (e.g., improved public health, economic development, reduced energy burden).
- Can be completed within a short timeframe (e.g., 24 months).

As noted above, DOE also conditionally awarded 16 competitive Grid Resilience Utility and Industry Grant awards totaling approximately \$919 million in Federal funding. If these projects meet their goals, over 17,000 distribution poles will be hardened, almost 800 miles of power lines (including advanced or covered conductors) will be installed, over 100 miles of power lines will be undergrounded, multiple battery systems will be installed, eight or more microgrids will be operated to enhance community resilience, and over 4,000 fuses and switches will be installed to minimize outages from extreme events. Specific examples of selected resilience projects include:

 Disadvantaged communities within a utility's service territory across California, Oregon, and Utah are expected to see a five-minute improvement in System Average Interruption Duration Index (SAIDI), reduction of 50 percent outages per mile per year, elimination of ignition risks from overhead distribution lines in the area and ceased flood-related outages impacting the Yurok Tribal community. This project is also

<sup>&</sup>lt;sup>30</sup> Pursuant to E.O. 14008 and the Office of Management and Budget's Interim Justice40 Implementation Guidance M-21-28 and M-23-09, DOE recognizes disadvantaged communities as defined and identified by the White House Council on Environmental Quality's Climate and Economic Justice Screening Tool (CEJST), which can be located at <a href="https://screeningtool.geoplatform.gov/">https://screeningtool.geoplatform.gov/</a>.

expected to introduce over 400 pre-apprentice graduates into the workforce in those communities.

- In Louisiana, a community of over 1,300 customers will benefit from increased resilience due to the deployment of a system hardening project and a microgrid incorporating a battery energy storage system. The investment is expected to result in more than 609 million minutes of avoided customer service interruptions. Technologies deployed will include hardening of transmission and distribution structures by replacing over 90 towers with a wind design rating of 150 mph, hardening more than 350 distribution structures with higher-wind-rated poles and pole tops with a wind design rating of 140 mph, and installation of a 30.8 MWh battery capable of 7.7 MW full load discharge for a four-hour period that will be charged by the nearby solar station.
- A community in Michigan is expected to see an estimated six- to seven-minute improvement of SAIDI and a lower frequency of outages by installing automation loops, which limit customers affected by an outage and automatically transfer other customers to another source during a fault. Certain disadvantaged communities will particularly benefit during a storm event, because sectionalization of targeted portions of the system will limit the number of customers affected by any single outage. Additionally, the utility will be able to more closely monitor and respond to a range of incidents such as downed wires, pole accidents, and deteriorating pole conditions.

Overall, the portfolio of resilience investments will benefit hundreds of communities across the country and help address risks that are unique to their local circumstances. The selected projects employ a diverse set of technologies that when combined, are expected to provide improved power restoration services, reduced ignition risks for wildfire mitigation, increased outage monitoring capability, and increased energy storage capacity, among other benefits.

### 3.3 Future Reports

After grid resilience projects funded under the competitive and formula grant programs begin implementation, future Reports to Congress will aggregate project impacts based on the data collected. GDO published a Guidance for Bipartisan Infrastructure Law Grid Resilience Formula Grant Metrics<sup>31</sup> to advise recipients on appropriate data collection throughout the project duration.

This guidance document asks recipients to consider their resilience goals when considering metrics including the outage types they wish to mitigate and the communities they want to

<sup>&</sup>lt;sup>31</sup> U.S. Department of Energy – Grid Deployment Office, August 2023. <u>Guidance for Bipartisan Infrastructure Law</u> <u>Grid Resilience Formula Grant Metrics</u>.

benefit. Such information could help DOE identify trends in which project types are favored and for which outage causes. This can help identify not only hazard specific mitigation strategies but also investments that can be beneficial in multiple outage scenarios.

Additionally, each grant recipient will be asked to establish a 5-year baseline on the metrics they deem the most appropriate for the project(s) they are implementing. Recipients will track the same metrics throughout the duration of the project and will be encouraged to track the same metrics post-implementation. Because of the difficulties in tracking outage performance outlined in Section 3.1, there may also be variability in the metrics tracked, and some changes in performance may be caused by random variability in outage types year to year. Nevertheless, these baseline data will help in evaluating the impacts of the of grid resilience investments funded by BIL Section 40101 for future Reports.

### 3.4 Validating Resilience Improvements

In addition to the analysis that DOE will conduct on resilience projects funded by BIL Section 40101 grants, DOE is also looking to existing studies and tools to identify the impact of various grid investments. For example, DOE has funded advancements in large scale resilience modelling<sup>32</sup> which not only identify system vulnerabilities during large scale outage events but can also identify potential mitigation strategies.

Additionally, GDO is funding case studies on previous successful resilience investments and summaries of the tradeoffs (costs and benefits) of eligible resilience project types to aid recipients in considering impactful projects. GDO is also funding efforts to better understand historical outage performance considering both the number of customers impacted, as well as the time to restore power to customers. These performance baselining efforts will allow recipients to better identify where to target resilience investments and help DOE establish an expectation for disruption performance for recipients to target.

Finally, GDO is also considering further analysis on the benefits of avoiding large disruptive events to better understand the return on investment. These technical assistance efforts will enable DOE to provide context to the impacts that 40101-funded investments will have on the electric grid.

# **IV.** Conclusion

The Nation's electric grid continues to face immediate, ongoing challenges and growing demands with climate change threats and increasing electrification needs. As of October 2023, the grid resilience funding programs administered by DOE GDO awarded over \$1.6 billion in

<sup>&</sup>lt;sup>32</sup> U.S. Department of Energy – Office of Electricity, 2023. <u>North American Energy Resilience Model (NAERM)</u>.

funding through a combination of competitive industry grants and formula grants to support grid resilience projects across the Nation.

Strong interest and application pressure for competitive utility and industry grants, ultimately resulted in funding for 16 high impact resilience projects supported by \$919 million in Federal funding. Similarly, nearly all states and territories, and over 230 Tribes have applied for more than \$814 million in formula grants to develop grid resilience projects that will provide the greatest benefit to the communities within their jurisdictions.

The high level of interest for grid resilience funding from both public and private sector grant recipients demonstrates the urgency and value of Federal funding to modernize and improve the existing electric grid infrastructure.

DOE is committed to providing continued technical and other assistance to awardees and eligible entities to support cost-effective use of funds, monitor the impact of the grid resilience projects, and enhance future grid resilience planning. DOE continues to work with states, Tribes, territories, utilities, and industry in addressing the challenges they face with applying for and implementing grid resilience projects.

Given the early stage of grid resilience funding awards under these programs, DOE will provide additional details about the specific projects being implemented and their resilience benefits in future Reports. DOE is confident that the funding and assistance these programs provide will lead to improved grid resilience for hundreds of communities across the Nation.