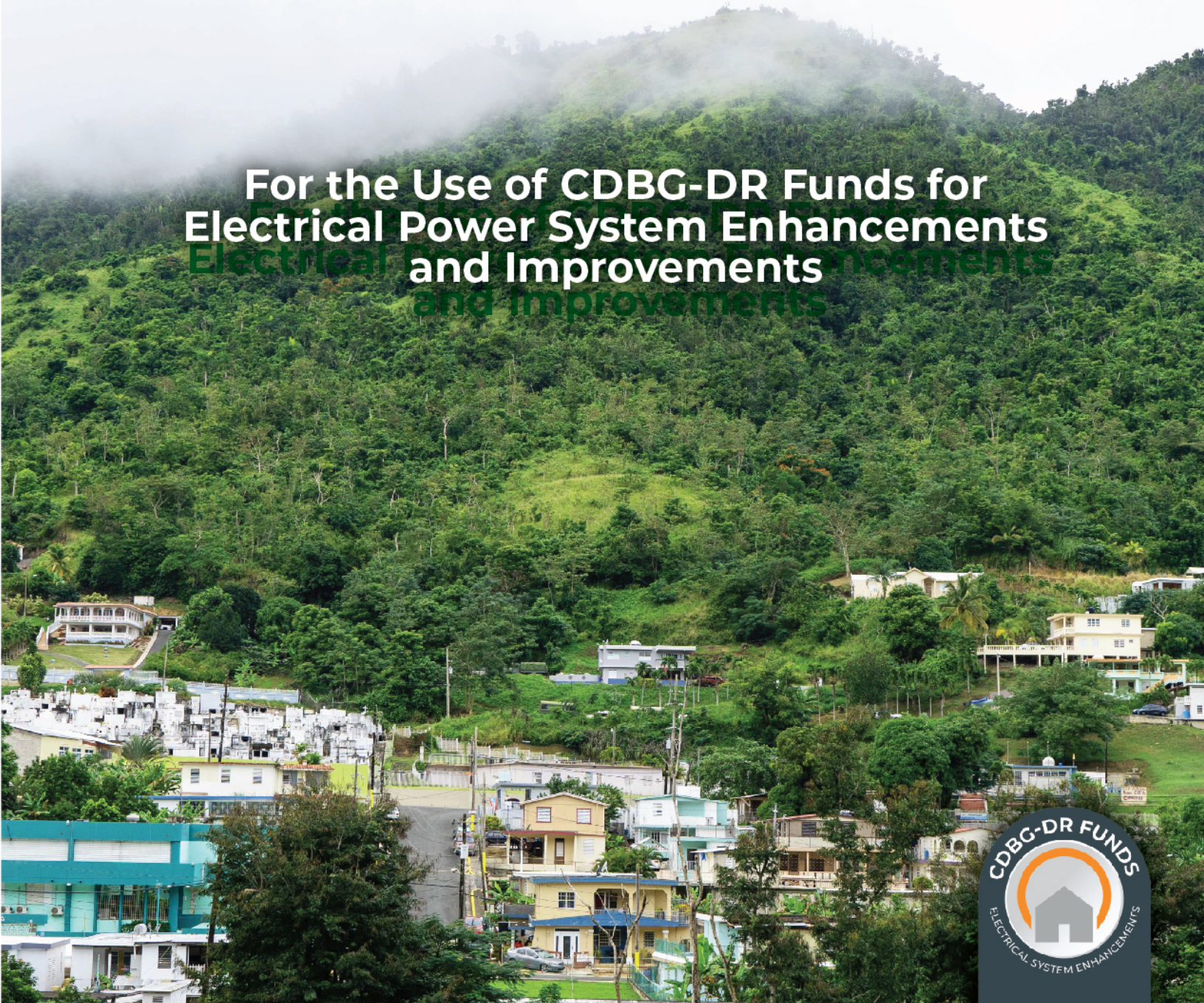
DEPARTMENT OF HOUSING

PUERTO RICO

Disaster Recovery Action Plan

For the Use of CDBG-DR Funds for Electrical Power System Enhancements and Improvements



[This page was intentionally left blank.]

Table of Contents

EXECUTIVE SUMMARY ..... **i**

HUD CDBG-DR Allocation ..... *i*

Unmet Needs Assessment ..... *ii*

Note on Language ..... *iii*

Summary of Key Reports ..... *iii*

Energy Resilience Solutions for the Puerto Rico Grid, Final Report, June 2018, United States Department of Energy, Washington, DC DOE 20585 iii

Puerto Rico Electricity Grid Recovery - United States Government Accountability Office, Report to Congressional Requesters, GAO-20-141 iii

PREPA's 10-Year Infrastructure Plan - June 2021 Update iv

2021 Fiscal Plan for the Puerto Rico Electric Power Authority (As certified by the Financial Oversight and Management Board for Puerto Rico on May 27, 2021) iv

Transmission and Distribution Roadmap (Sargent & Lundy, May 29, 2020) iv

Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico (Sandia National Laboratories) v

Stakeholder Engagement Process ..... *v*

Electrical System Enhancements and Improvements Programs ..... *vi*

UNMET NEEDS ASSESSMENT **2**

Background of the Puerto Rico Electrical Power System *2*

Conditions of the Puerto Rico Electric System before the Impact of 2017 Hurricanes Irma and María *5*

Electrical Power System Key Performance Indicators *8*

Generation 9

Transmission and Distribution 10

Power System Interdependencies *12*

Financial Impact *14*

Disasters Throughout the Years *15*

Effects of the COVID-19 Pandemic on the Electric Power Industry *24*

PREPA Asset Risk, LMI, and Vulnerability Assessment *25*

Power Plants *26*

Power Sub-Stations *28*

Power Transmission Centers *31*

Hurricane Impact *33*

Damage to the Electrical System 33

Electrical System Impact on the Healthcare System 38

Electrical System Impact on the Educational System 41

Demographic Profile 42
Demographic Profile of Impacted Area 42
Vulnerable Populations and Protected Classes 44
Remote Communities 51
Initial Recovery of the Puerto Rico Electric Power System 52
Electrical System Current Situation 53

Unmet Needs Assessment 54
PREPA and LUMA Unmet Needs 55
Puerto Rico Aqueduct and Sewer Authority (PRASA) Unmet Needs 59
Non-PRASA Unmet Needs 62
Focus on Renewable Energy 66
Electric Vehicle Provision 69
Summary of Unmet Need 70

REGULATORY FRAMEWORK 76

Applicable Puerto Rico Law 76
Act 416-2004, known as the Environmental Public Policy Act 76
Act 82-2010, known as the Public Policy on Energy Diversification by Means of Sustainable and Alternative Renewable Energy in Puerto Rico Act 76
Act 83-2010, known as the Green Energy Incentives Act of Puerto Rico 77
Act 57-2014, known as the Puerto Rico Energy Transformation and RELIEF Act 78
Act 120-2018, known as the Puerto Rico Electric Power System Transformation Act 78
Act 17-2019, known as the Puerto Rico Energy Public Policy Act 79
Act 33-2019, known as the Puerto Rico Climate Change Mitigation, Adaptation, and Resilience Act 79

Applicable Federal Law 80
Pub. L. 115-123, Bipartisan Budget Act of 2018 81
Disaster Recovery Reform Act of 2018 (DRRA) 81
National Environmental Policy Act of 1969 (NEPA) 82
Davis Bacon Act of 1931 82

Electrical Power System Industry Standards 83

Oversight Structure 84

PROGRAM REQUIREMENTS 88

Technical Consultation Team (TCT) Consultation 88

National Objectives 89

Eligible Activities 92

Duplication of Benefits 93

Feasibility, Cost-Effectiveness, and Long-Term Financial Viability 95

Pre-Agreement Costs 95

Program Income 96

Minimizing or Addressing Displacement 96

Construction and Resiliency Standards *97*
Elevation Standards *97*
Operation and Maintenance Plans *98*
Application Status Updates *99*

METHOD OF DISTRIBUTION **102**

Recovery Programs *102*
Grantee 102
Beneficiary 102
Subrecipients 102

ELECTRICAL POWER SYSTEM IMPROVEMENTS PROGRAMS **105**

Best-Fit Approach and Leveraging of Funds *105*
Summary of Budgets *109*
Energy Grid Rehabilitation and Reconstruction (ER1) Cost Share Program *111*
Hurricane Impact 111
Eligible Activities 112
Electrical Power Systems Improvements Activity 112
Electrical Power System Improvements 113
Ineligible Activities 113
National Objective 113
Eligibility Criteria 114
Environmental Review 114
Method of Distribution 114
Program Objective & Description 114
Electrical Power Reliability and Resilience Program (ER2) *116*
Hurricane Impact 116
Eligible Activities 116
Ineligible Activities 117
National Objective 117
Program Objective and Description 118
Method of Distribution 120
Eligible Applicants 120
Eligibility 121
Program Priority 121
Threshold 121
Prioritization 121
Award 122
Regulatory Review 122
Environmental Review 122
Flood Insurance 123
Application Status 123
Quality Construction and Green Building Standards 123
Elevation Standards 123
Duplication of Benefits (DOB) 124

CITIZEN PARTICIPATION AND STAKEHOLDER ENGAGEMENT 126

Citizen Participation 126
Methods for Citizen Participation 126
Communication for Individuals with Disabilities 127
Citizen Involvement in the Original Action Plan 128
Citizen Involvement in the Substantial Amendment Process 129
Consideration of Public Comments 130
Communication via the internet 130
Performance Report 131
Individuals with Limited English Proficiency 131
Technical Assistance 132
Accessibility of Information and Transparency Portal 132
Citizen Complaints 134
Anti-Fraud, Waste, Abuse or Mismanagement 135

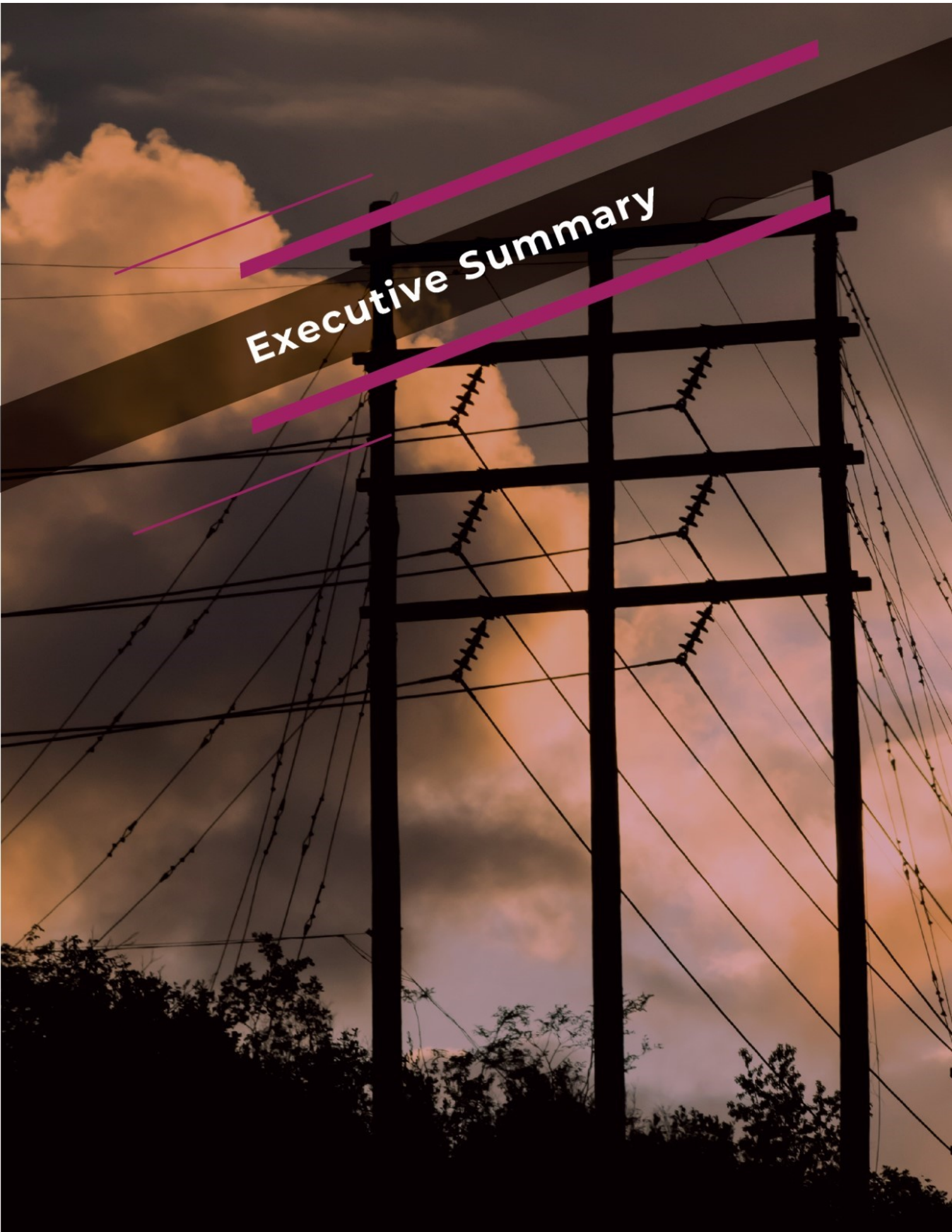
Stakeholder Engagement Description 136

Stakeholder Engagement 136

ACTION PLAN CERTIFICATIONS 139

LIST OF TABLES 142

LIST OF FIGURES 143



Executive Summary

EXECUTIVE SUMMARY

More than four (4) years have passed since Hurricanes Irma and María struck Puerto Rico in September of 2017. However, the impact on the power grid remains ever present in the daily lives of Island residents. Power outages are common and unpredictable, electricity prices continue to rise, and rolling blackouts due to insufficient generation have been common. The impact of the hurricanes on the power system was devastating and led to the longest sustained blackout in modern United States (**U.S.**) history. Without power, residents were unable to gain access to healthcare, communication, refrigeration, water, cooling, and security. With sustained systemic insecurity, residents continue to feel many of the same impacts, economic recovery is hampered, and the cycle of recovery cannot be completed. **Energy remains the single most comprehensive and critical factor to the future of the Island.**

The Electrical Power System Enhancement and Improvements Action Plan is not a specialized blueprint on the components of the electrical power system in need of repairs. Several extensive studies have already been conducted by Puerto Rico and U.S. governmental agencies, including the Puerto Rico Electric Power Authority (**PREPA**) 10-Year Infrastructure Plan[1], the Grid Modernization Plan for Puerto Rico conducted by the Central Office for Recovery, Reconstruction and Resiliency (**COR3**)[2], the 2021 Fiscal Plan for PREPA as Certified by the Financial Oversight and Management Board for Puerto Rico[3], and key studies by the U.S. Department of Energy (**DOE**). This Action Plan seeks to adjust critical findings from these reports and identify the remaining unmet need for communities that stand vulnerable to the impacts of power insecurity. It aims to discern resilience opportunities for long-term system enhancement for the benefit of all residents.

HUD CDBG-DR Allocation

On April 10, 2018, the U.S. Department of Housing and Urban Development (**HUD**) allocated nearly $28 billion in Community Development Block Grant disaster recovery (**CDBG–DR**) funds appropriated by the Further Additional Supplemental Appropriations for Disaster Relief Requirements Act of 2018 (Public Law 115–123, approved February 9, 2018). Of those $28 billion, HUD allocated $10.03 billion to address unmet needs from disasters that occurred in 2017; $2 billion for enhanced or improved electrical power systems in Puerto Rico and the U.S. Virgin Islands; and $12 billion for mitigation activities. The amount of funds for mitigation activities was later increased to $15.9 billion after HUD completed an assessment of unmet needs and awarded funding to a total of eighteen (18) grantees through a newly created Community Development Block Grant - Mitigation (**CDBG-MIT**) Program.

---

[1] Puerto Rico Electric Power Authority. (2021). *The Puerto Rico Electric Power Authority 10-years Infrastructure Plan.* https://aeepr.com/es-pr/Documents/20201207_PREPA%2010-Year%20Infrastructure%20Plan_vF.pdf

[2] COR3. (2019). *The COR3 Grid Modernization Plan for Puerto Rico.* https://recovery.pr/documents/Grid%20Modernization%20Plan_20191213%20(2).pdf

[3] Puerto Rico Electric Power Authority. *The Puerto Rico Electric Power Authority Certified Fiscal Plan for the Puerto Rico Power Authority*. https://oversightboard.pr.gov/fiscal-plans-2/ and https://drive.google.com/file/d/1dXFJldZpOIsAObMZDBd7T2P3j2xMPaaI/view

On June 22, 2021, HUD published Federal Register Vol. 86, No. 117 (June 22, 2021), **86 FR 32681**, which governs the use of the $2 billion CDBG–DR allocation for enhanced or improved electrical power systems in Puerto Rico and the U.S. Virgin Islands. Of those $2 billion, $1,932,347,000 was allocated to Puerto Rico to enhance the Puerto Rico electrical power system.

The Puerto Rico Department of Housing (**PRDOH**) is the grantee for the CDBG-DR and CDBG-MIT funds; as such, it serves as the entity responsible for administering the funds in compliance with applicable regulations and timeframes.

FEDERAL REGISTER (FR)	ALLOCATION
83 FR 5844	$1.5 billion (CDBG-DR)
83 FR 40314	$8.2 billion (CDBG-DR)
85 FR 4681	$277 million (CDBG-DR Infrastructure)
86 FR 32681	$1.9 billion (CDBG-DR Energy)
85 FR 4676	$8.2 billion (CDBG-MIT)

Figure 1 - CDBG-DR and CDBG-MIT Allocations for Puerto Rico related to Hurricanes

Unmet Needs Assessment

PRDOH developed an unmet needs assessment to inform the use of CDBG–DR funds for electrical power system improvements. This Action Plan includes an estimate of unmet needs based on planned electrical power system improvements and considering mitigation and resilience measures that are not likely to be addressed by other sources of funds. PRDOH accounted for the various forms of assistance available to, or likely to be available for such improvements, using the best available data to estimate the portion of need unlikely to be addressed by insurance proceeds, other Federal assistance, or any other funding sources (thus producing an estimate of unmet need). PRDOH cited data sources for the assessment. The unmet needs assessment: (i) evaluated all aspects of the electrical power system that were damaged by the disaster and that are at greatest risk from future disasters; (ii) estimated unmet needs to ensure that CDBG–DR funds are planned for uses that meet electrical power system needs that are not likely to be addressed by the Federal Emergency Management Agency (**FEMA**) or other sources of funds by accounting for the various forms of assistance available to, or likely to be available to, PRDOH or its subrecipients (obligated and projected FEMA funds, public utility resources, other grantee funds); and (iii) accounted for, the costs of incorporating mitigation and resilience measures to protect against the anticipated effects of future extreme weather events, other natural hazards and long-term risks; and the costs of incorporating improvements to address long term carbon reduction goals.

Note on Language

There are many reports and studies regarding the electrical power system in Puerto Rico, including long-term plans, technical documents, legal and regulatory briefs, and other analyses. In order to encourage citizen participation across the broader population, this document includes summaries of regulations and reports in both technical and non-technical terms, including tables and graphics wherever possible. Where technical reports or studies are referenced, PRDOH attempts, through this document, to provide summaries of relevant elements. Complete referenced materials are cited as part of this Action Plan package. Interested parties are encouraged to access those materials for more detailed scientific evaluation.

Summary of Key Reports

The following are some of the key reports referenced herein:

Energy Resilience Solutions for the Puerto Rico Grid, Final Report, June 2018, United States Department of Energy, Washington, DC DOE 20585[4]

This report contains an objective analysis of the Puerto Electric Power System condition from a technical perspective. It incorporates resilience recommendations for the Government of Puerto Rico to consider integrating into its recovery plans. Also, provides valuable insights for the disbursement of any federal appropriations intended to rebuild or improve the energy infrastructure of Puerto Rico.

The report includes investment-grade suggestions regarding the design and specification of the electric grid to ensure that it may be designed, built, managed, and maintained in such a way as to withstand environmental and man-made disasters. The report also includes recovery and resiliency recommendations for strengthening the electrical power system to ensure a shorter period of downtime after a catastrophic event.

Puerto Rico Electricity Grid Recovery - United States Government Accountability Office, Report to Congressional Requesters, GAO-20-141[5]

As part of an audit, this report describes the role of federal agencies (e.g. DOE, FEMA), HUD -among others- in supporting electricity grid recovery in Puerto Rico in response to the 2017 hurricane season. In addition, evaluates the status of federal support and the challenges affecting progress on grid recovery efforts.

The report identifies FEMA and HUD's disaster recovery programs that serve as primary resources for the electric power system recovery of Puerto Rico. These programs provide opportunities to integrate resilience into disaster recovery efforts. It also contains recommendations for enhancing the coordination between state and federal entities.

---

[4] U.S. Department of Energy. (2018). *Energy Resilience Solutions for the Puerto Rico Grip Final Report.* https://www.energy.gov/sites/prod/files/2018/06/f53/DOE%20Report_Energy%20Resilience%20Solutions%20for%20the%20PR%20Grid%20Final%20June%202018.pdf

[5] U.S. Government Accountability Office. (2019). *Puerto Rico Electricity Grid Recovery Report to Congressional Requesters.* https://www.gao.gov/assets/gao-20-143.pdf

PREPA's 10-Year Infrastructure Plan - June 2021 Update[6]

This document addresses PREPA's plans for Section 428-obligated funds[7] ($10.5 billion), and presents PREPA's proposed investments in Puerto Rico's electrical power system over the next ten (10) years. FEMA only required a ninety (90)-day plan, but PREPA opted to present a 10-year plan.[8]

The Plan serves as a reference to determine the principal unmet needs of Puerto Rico's electrical power system and includes cost estimates by asset categories. Moreover, contains the prioritized improvements for the electrical power system, classifying them as short, mid, and long term. The Plan is based and focused on the following investment areas:

- Reliability and system resilience;
- Renewable integration;
- Codes;
- Standards and regulatory compliance; and
- Automation and modernization and hazard mitigation

2021 Fiscal Plan for the Puerto Rico Electric Power Authority (As certified by the Financial Oversight and Management Board for Puerto Rico on May 27, 2021)

The Fiscal Plan illustrates PREPA's fiscal situation and presents vital facts about PREPA as compared to similar electric public utilities in the U.S. Also, contains valuable data and graphics that help better understand the operation and composition of Puerto Rico's electrical power system.

The Plan describes the status of the different components of the electrical power system and the main challenges to be addressed and focuses on PREPA's financial condition. In addition, presents a chronological comparison of PREPA's FY2014 to FY2020 Statement of Net Position and PREPA's operational deficits from FY2000 to FY2016, reflecting the changes in financial conditions affecting Puerto Rico's electrical power system.

Transmission and Distribution Roadmap (Sargent & Lundy, May 29, 2020)

The Roadmap report contains an assessment performed by Sargent & Lundy in 2018—an entity procured by PREPA—which includes recommendations on how to rebuild and modernize the Puerto Rico electrical grid. This assessment consisted of a visual inspection of over 2,200 transmission and distribution (**T&D**) structures and eight-five (85) transmission centers and substations across the Island.

The report served as a platform to develop a 10-year capital investment plan. This plan focused on improving the reliability of the overall system through capital investment programs to replace aging infrastructure. As a result, Sargent & Lundy developed a T&D

---

[6] Puerto Rico Electric Power Authority. (2021). PREPA 10-Year Infrastructure Plan. https://energia.pr.gov/wp-content/uploads/sites/7/2021/07/20210706-Joint-Motion-Submitting-Updated-10-Year-Infrastructure-Work-Plan.pdf
[7] Section 428 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. §5189f) authorizes alternative procedures for the FEMA's Public Assistance (PA) Program under sections 403(a)(3)(A), 406, 407 and 502(a)(5) of the Act
[8] FEMA comment to PRDOH provided as technical feedback via email on October 19, 2021.

Roadmap (**TDR**) for planning the implementation of capital investments. The TDR documented the near-term plan, methods, requirements, and considerations needed to successfully implement the proposed projects to fulfill the goal of providing reliable, resilient, and financially viable power to the Puerto Rico electrical grid.

Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico (Sandia National Laboratories)[9]

The Microgrid report identified clusters of critical infrastructures to inform 159 microgrid options across the Island. In addition, described how those microgrids could impact critical service provision during a power outage, therefore providing much-needed resilience for targeted communities. The report outlines Sandia National Labs' use of a social burden metric to "gain quantitative insight into how grid improvements impact the community, especially those in the population that have fewer means to acquire services even on a blue-sky day."[10] The report contemplates the percentage of families below the poverty line, the burden to acquire infrastructure services, critical infrastructure overlaid to FEMA flood plains, and several other factors.

Stakeholder Engagement Process

The stakeholder engagement process can be summarized in two (2) phases: the efforts undertaken as part of the Action Plan draft development process; and the outreach and public input activities conducted as part of the Action Plan public comment period. The affected Municipalities, **PREPA** (owner of the Transmission and Distribution Grid), Puerto Rico Aqueduct and Sewer Authority (**PRASA**), and LUMA Energy, LLC (**LUMA**) (operator of the Transmission and Distribution Grid), were considered critical stakeholders for the development of the plan, as they would be the partners that support the implementation of key elements of the program. COR3, the local agency with designated FEMA coordination authority who currently oversees the development of FEMA's energy funded projects, is also the administering entity for the Hazard Mitigation Grant Program (**HMGP**) related to Hurricane María and houses the State Hazard Mitigation Officer (**SHMO**).

In addition, federal agencies are required by 86 FR 32681 to participate in the preparation of the Electrical Power System Enhancement and Improvements Action Plan providing guidance and comments through periodic meetings and formal interaction with PRDOH. The DOE is the leading federal agency responsible for coordinating with other agencies like FEMA, U.S. Army Corps of Engineers (**USACE**), and U.S. Environmental Protection Agency (**EPA**) through the creation of an Energy Technical Coordination Team (**TCT**). Importantly, citizens and other affected entities will also participate and provide valuable feedback on the Action Plan draft.

[9] Jeffers, R.F. *et al.* (2018). Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico. United States. https://doi.org/10.2172/1481633
[10] Id., p. 15.

Electrical System Enhancements and Improvements Programs

Hurricanes Irma and María devastated 80% of the Islands' electric power system. For that reason, the initial immediate recovery process was implemented in such a way as to provide electric service to the people of the Island in the fastest possible way.[11] This meant that expedience reigned instead of the deep reconstructive approach that would have taken much longer and for which funding and resources were not immediately available. Because of this, the people of Puerto Rico face a lack of continuity of electric power service in great part due to the system's weakness. The need for permanent solutions to ensure system resiliency and sustainability must be a priority moving forward.

The U.S. Department of Energy aptly points out, "Maintaining and enhancing the resilience of the electric grid at fair and reasonable costs can provide service and value to Puerto Rican communities. Yet, **no single investment in energy infrastructure at one point in time will achieve resilience**."[12] (Emphasis added) One of the goals set by PRDOH is to maximize the appropriated use of the funds of the CDBG-DR Program, which will result in the coordination and engagement of governmental and non-governmental stakeholders in order to detail and successfully identify unmet needs.

PRDOH has developed the Electrical System Enhancements and Improvement Programs founded on the allocation requirements, as well as, on the identified unmet needs. Along with incorporating input from disaster-impacted municipalities, utilities, and other stakeholders.

HUD defines an electrical power system in a broad way. Bringing together the many components that contribute to the proper functionality of the grid, including physical assets for generation, transmission, and distribution, as well as technology and administrative components. Specifically, the definition is stated in 86 FR 32681, 32692:

> "An electrical power system shall be defined as an interconnected or autonomous set of transmission lines, distribution lines, substations, central power generation stations, other sources of power, distributed energy resources, or enabling technologies and services, such as industry standard billing, accounting information technology, cybersecurity enhancements, microgrids and fuel transfer delivery systems, that are necessary for the provision of reliable, resilient, stable, and cost effective electrical service."[13]

The main objective of the CDBG-DR Program is to support the economic and social development of the communities of Puerto Rico, bringing quality of life, safety, security, and growth opportunities for the future of all residents. The availability of CDBG-DR funds provides a unique opportunity to improve quality of life in the island and strengthen the

[11] U.S. Army Corps of Engineers. (2018). *Puerto Rico Grid Restoration.* https://www.energy.gov/sites/prod/files/2018/03/f49/Puerto%20Rico%20Grid%20Restoration%20COL%20J%20Lloyd.pdf.
[12] U.S. Department of Energy. (2018). *Energy Resilience Solutions for the Puerto Rico Grid.* https://www.energy.gov/sites/prod/files/2018/06/f53/DOE%20Report_Energy%20Resilience%20Solutions%20for%20the%20PR%20Grid%20Final%20June%202018.pdf
[13] 86 FR 32681, https://www.govinfo.gov/content/pkg/FR-2021-06-22/pdf/2021-12934.pdf.

economy through electric power system enhancements. Lessons learned from the catastrophic events of Irma and María will give Puerto Rico the choice to be more resilient, more robust, wiser, and to rise in a sustainable manner.

The state of emergency caused by Hurricanes Irma and María is felt every day and still very present in Puerto Rico. The current condition of the electrical power system is critical. Without the execution of transformative mitigation and resilience phases, the system will remain extremely weak and susceptible to collapse from any future major event, in which vulnerable communities will suffer the most, once again. Every community in Puerto Rico deserves to enjoy a strong, reliable, and resilient electrical power system that ensures the tranquility of the people and a better quality of life for its residents.

Unmet Needs Assessment

UNMET NEEDS ASSESSMENT

Background of the Puerto Rico Electrical Power System

The history of Puerto Rico's electrical power system must be taken into consideration in order to achieve perspective for its future. PREPA has compiled the history of its background and creation in a document that is available to the public.

According to the history compilation, Puerto Rico's first power plant system was installed in 1893 by Don José Ramón Figueroa in the municipality of Villalba. Subsequently, news broke out of a royal visit from Spain, which sparked the first installment for public lighting in the capital city of San Juan. After that, and within four (4) years, Mayagüez, Utuado, and Ponce followed by installing their own electrical power systems, which provided power and electricity to these cities.[14]

On September 18, 1908, the South Coast Irrigation Service was created as a result of the Puerto Rico Public Irrigation Law.[15] This Service aimed to develop a system that could provide water to the agricultural sector to achieve maximum agrarian potential. The South Coast Irrigation Service created the Carite #1 Hydroelectric Plant, which used water from Lake Carite to service the canals of the irrigation system in the area. This system was the first-ever hydroelectric power station in Puerto Rico. Following the success of the Carite #1 Hydroelectric Plant, the South Coast Irrigation Service created the Carite Hydroelectric Plant #2 in 1922.[16]

With the construction of artificial lakes to develop Hydroelectric Plants to provide energy and power across the island, the government created the Utilization of Fluvial Sources Agency in 1927. This agency was tasked with the development of the Toro Negro and Carite #3 Hydroelectric Plants. Later, in 1941, construction for Garzas Hydroelectric Plants #1 y #2 was completed and construction of the Dos Bocas Hydroelectric Plant was initiated. In 1942 the Dos Bocas Plant began operating. See Figure 2 (Dos Bocas Hydroelectric Plant).

[14] PREPA. *Pinceladas de Nuestra Historia*. https://aeepr.com/es-pr/QuienesSomos/Paginas/Historia.aspx.
[15] Puerto Rico Irrigation Act of September 18, 1908.
[16] Id.

Figure 2 - Dos Bocas Hydroelectric Plant[17]

The rapid growth and rising demand for electric power fast-tracked the creation of a new independent government agency called the Puerto Rico Water Resources Authority (**PRWRA**) by Act No. 83, of May 2, 1941. In 1945, the PRWRA acquired the Puerto Rico Railway Light and Power Company, and the Mayagüez Light Power and Ice Company. In this way, the main electrical power systems that operated on the island were unified into a single company.[18]

Over the years, the Hydroelectric Plants had generation capacity deficiency problems that started because of the growing demand for electric power.

The growing demand for electrical power and problems arising in the hydroelectric plants required other alternatives to produce electrical energy. In 1946, PRWRA acquired a 30,000-kilowatt floating plant framed in a ship named The Sea Power. This action started the strategy to solve the generation deficiency problem because of the increasing demand for electric power.

In the same year (1946), the construction of the Monacillos Tower started. Finally, with the latest sophisticated computerized system, it became the brain that supervised and controlled the production, transmission, and distribution of electrical energy throughout the island.

Thermoelectric technologies raised and led to petroleum distillates fuel becoming the primary fuel. In 1950, PRWRA inaugurated the Thermoelectric Power Plant of San Juan,

[17] https://aafaf.pr.gov/press-room-articles/el-gobierno-busca-operador-para-hidroelectricas/
[18] PREPA. *Pinceladas de Nuestra Historia*. https://aeepr.com/es-pr/QuienesSomos/Paginas/Historia.aspx.

marking the beginning of large-scale electricity production in Puerto Rico based on oil fuel.

Between 1960 and 1970, PRWRA built the Palo Seco Thermoelectric Power Plant in Toa Baja and the South Coast Power Plant in Guayanilla. Later, in 1974, the Aguirre Thermoelectric Power Plant was inaugurated. Over 98% of the electricity consumed by this point was from petroleum derivatives. In comparison, the other 2% came from hydroelectric plants.

Through Act No. 57 of May 30, 1979, PRWRA changed its name to the Puerto Rico Electric Power Authority (**PREPA**) because the fluvial sources no longer constituted the primary energy source that supplied electricity to Puerto Rico.

The EcoEléctrica Natural Gas Combustion Plant in Peñuelas began operations in 2000 and currently has the capacity to produce 540 MW, equivalent to 17% of Puerto Rico's demand. In 2002, the AES coal-fired thermal plant was inaugurated with a capacity of 500 MW, contributing to an increase in electricity generation of 15% for PREPA. When these Power Plants came into service, the electricity generation system reduced dependence on crude oil from 98% to 67%; this meant a significant step towards diversifying fuels and taking steps toward a cleaner environment.[19]

In 2012, AES built the Island's first grid-scale solar installation, AES Ilumina, with a 24 MW capacity.[20] For subsequent years, the capacity for electricity generation with renewable energy increased. The Santa Isabel Wind Farm was established in 2012 with a total of 101 MW capacity. Santa Isabel Wind Farm was the first wind farm in Puerto Rico and it is, currently, the largest.[21] In 2013, the Punta Lima Wind Farm began operations in Naguabo with a total capacity of 23.4 MW.[22] In addition to the wind farms, five (5) photovoltaic plants (**PV**) were established in different locations across Puerto Rico. Over the years, the electrical generation in residences has also been increasing mainly through solar energy.

PREPA became one of the largest public utilities in the U.S., ranking number one in clients, number one in revenues, sixth in kWh sales, and seventh in kWh generation.[23] PREPA finances have been considerably declining over the last two (2) decades because of increased debt and insufficient capacity to pay its lenders. Electricity sale projections did not meet objectives, and the revenues were not enough to sustain the utility's operation and maintenance in a sustainable way.

On July 2, 2017, due to its critical financial condition, PREPA filed a petition in the U.S. District Court for the District of Puerto Rico for relief under Title III of the Puerto Rico Oversight, Management, and Economic Stability Act (**PROMESA**).

---

[19] Pederson, J. P. (2002). *International Directory of Company Histories* (47). St. James Press.
[20] AES. *Out History*. https://www.aespuertorico.com/en/our-history.
[21] Pattern Energy. *Santa Isabel Wind*. https://www.patternenergy.com/learn/portfolio/santa-isabel-wind.
[22] Southern Alliance for Clean Energy. (2014). https://www.patternenergy.com/learn/portfolio/santa-isabel-wind and https://www.cleanenergy.org/wp-content/uploads/Puerto-Rico-Elevated-Opportunities-Wind-Technology-for-the-South.pdf.
[23] PREPA. *Investors and Financial Community Portal*. https://aeepr.com/en-us/qui%C3%A9nes-somos/portal-inversionistas.

The Puerto Rico Public-Private Partnerships Authority (**P3A**) contracted out the customer service, billing process, transmission and distribution, operation and maintenance, and general administration. LUMA Energy was selected as the awarded vendor. LUMA is a consortium composed of ATCO and Quanta Services. Quanta is a North American specialty contractor, which provides infrastructure solutions for electric power, underground utilities, and communications founded in 1997, with headquarters in Houston, Texas.[24] ATCO is a Canadian company with headquarters in Alberta, Canada, established in 1947 and provides electric services in Calgary, Alberta, Canada.[25]

As part of the contract agreement, the Government engaged LUMA to modernize the PREPA transmission and distribution system in Puerto Rico. According to this agreement, PREPA will maintain ownership of the electric power infrastructure assets, the operation and maintenance of the power generation plants, and the irrigation system, including the water channels and the dams.

On July 1, 2021, after a one (1)-year transition period, LUMA took over the processes according to the operations and maintenance agreement with P3A.

Conditions of the Puerto Rico Electric System before the Impact of 2017 Hurricanes Irma and María

According to the PREPA Fiscal Plan, before the passage of Hurricanes Irma and María through Puerto Rico, the Island's electricity demand had declined since 2005, when it reached 3,685 MW. The electricity demand in the months before the hurricane did not exceed 3,000 MW, representing a decline in electricity consumption across all sectors (residential, commercial, and industrial).[26] This reduction in electricity demand was partly attributable to the economic crisis on the Island. See Figure 3 (Puerto Rico Economic Activity Index, from the Government Development Bank of Puerto Rico). At the same time, the integration of renewable energy systems has been accelerating, supported by net metering options and enthusiasm for distributed power generation.[27]

[24] Quanta Services (PWR). *Forbes.* https://www.forbes.com/companies/quanta-services/?sh=2ba2a245108b.
[25] ATCO. *Our History*. https://www.atco.com/en-ca/about-us/history.html.
[26] PREPA. (2017). *Puerto Rico Electric Power Authority Fiscal Plan*. https://drive.google.com/file/d/13lij1bNoa7lRUANLtuHS67scYa7cj4ZN/view
[27] Id.

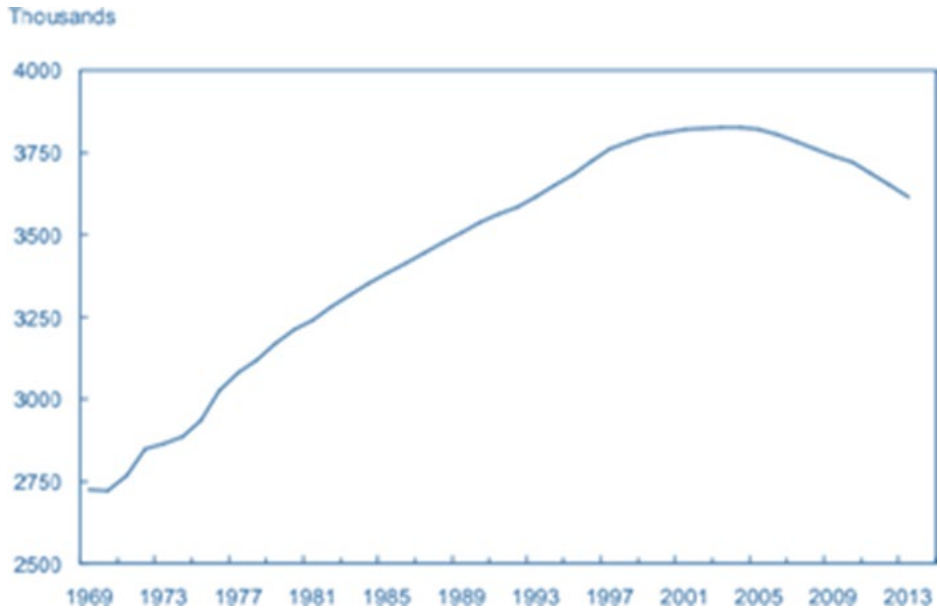


Figure 3 - Puerto Rico Economic Activity Index, from the Government Development Bank of Puerto Rico (Source: U.S. Department of Energy; Energy Resilience Solutions for the Puerto Rico Power Grid, Final Report, June 2018).

At the time when Hurricane María hit Puerto Rico, the Island's total power generation capacity was 5,839MW[28]. The electric system used a mix of technology primarily based on fuel oil (steam, combustion, natural gas, and diesel) to generate power. See Figure 4. The primary power plants were: Aguirre Steam Power Plant (900MW), Aguirre Combined Cycle Power Plant (592MW); Costa Sur Steam Power Plant (820MW); EcoEléctrica (506MW); and AES (454MW), located in the southern part of Puerto Rico, and Cambalache (247MW); Palo Seco (602MW), and the San Juan Steam Combined Cycle Power Plant (800MW) in the north. This generation capacity represented a system with about 60% of the installed assets dating back fifty (50) years old.

Renewable energy sources (Photovoltaic and Eolic) are also part of the power generation mix in Puerto Rico. There were two (2) leading wind farms operating on the island at the time of the hurricane. The wind farm of Santa Isabel, with an installed capacity of ninety-five (95) MW, is the largest of the two (2). The second wind farm was in Punta Lima, located in the municipality of Naguabo, with an installed capacity of 25 MW. Five (5) utility-scale PV plants were generating about three-quarters of Puerto Rico's solar-powered electricity, with locations in the municipalities of Humacao, Loíza, Isabela, Salinas, and Guayama. In addition, there were 88 MW of PV power generated in a distributed fashion at the locations of 8,500 PREPA's customers.[29] "Distributed generation" is the term used when electricity is generated from sources, often renewable

[28] A. Kwasinski, F. Andrade, M. J. Castro-Sitiriche and E. O'Neill-Carrillo. (2019). Hurricane María Effects on Puerto Rico Electric Power Infrastructure. *IEEE Power and Energy Technology Systems Journal*, 6(1), 85-94. https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8644031.

[29] U.S. Energy Information Administration. (2021). *Puerto Rico Territory Energy Profile*. https://www.eia.gov/state/print.php?sid=RQ.

energy sources, at or near the point of use instead of centralized generation sources from power plants.[30]

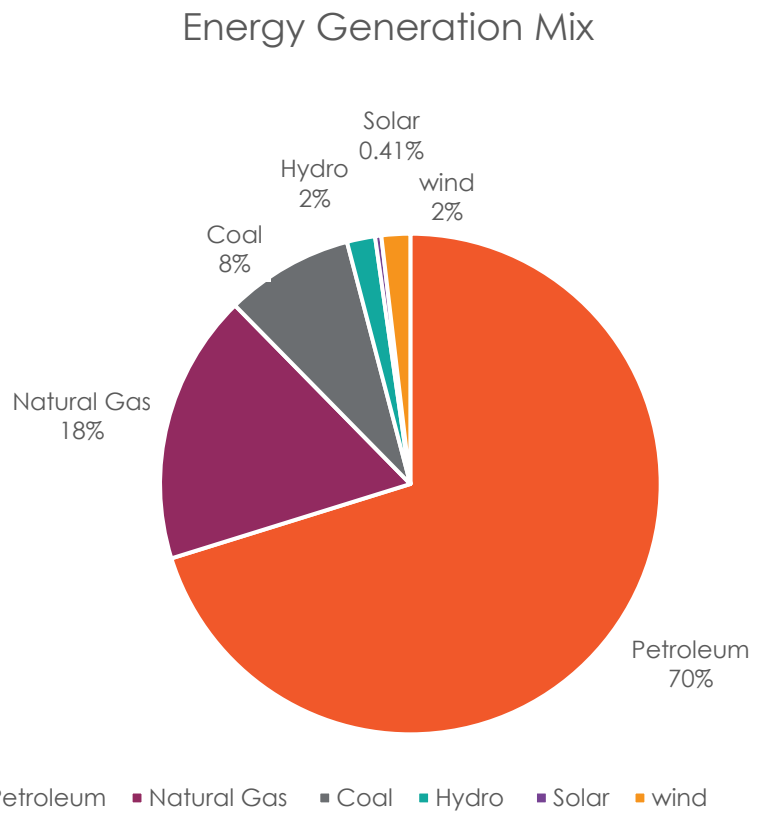


Figure 4 - Existing Generation Mix in Puerto Rico [Pre-storm] (Source: NREL – https://https://www.nrel.gov/docs/fy15osti/62708.pdf)

According to the Department of Homeland Security, the electric power grid of Puerto Rico has 2,585 circuit miles of transmission lines divided into 413 circuit miles of 230 kV lines, 700 circuit miles of 115 kV lines, and 1,472 circuit miles of 38 kV lines. From that system, 37 miles of 115 kV cable, and 63 miles of 38 kV cable are underground, and 55 miles of 38 kV are submarine cables.[31] A total of 392 substations and transmission centers are located in 292 facilities. The transmission and distribution lines are interconnected by substations divided into fifty-three (53) Transmission Centers (**TCs**) and 339 Substations throughout the Island.[32]

Puerto Rico had about 30,000 miles of distribution lines and approximately half a million poles before Hurricanes Irma and María hit the island. The high vulnerability of the transmission and distribution (**T&D**) power lines was evidenced during the passage of

[30] U.S. Office of Efficiency & Renewable Energy. *Renewable Energy: Distributed Generation Policies and Programs*. https://www.energy.gov/eere/slsc/renewable-energy-distributed-generation-policies-and-programs.
[31] Central Office for Recovery, Reconstruction and Resiliency. (n.d.). *Grid Modernization Plan for Puerto Rico: Plan for Puerto Rico*. https://recovery.pr/en/documents/Grid%20Modernization%20Plan_20191213%20(2).pdf.
[32] Department of Homeland Security and Federal Emergency Management Agency. (2020). Damage Assessment, PRJ Report 136271.

Hurricane María. The fact that most of the electrical power in Puerto Rico is produced at the southern part of the Island and is exported to the high-density population metropolitan area makes the transmission network highly vulnerable. The highly mountainous topography inside the transmission lines corridor and dense forest areas represent a real challenge for access and maintenance. Therefore, additional decentralized generation, along with strengthened primary generation, reduces the dependency of the electrical service on transmission lines, which will reduce the outage time during disaster events. This may be achieved by developing micro-grids electrical systems for a decentralized and resilient electrical power service.

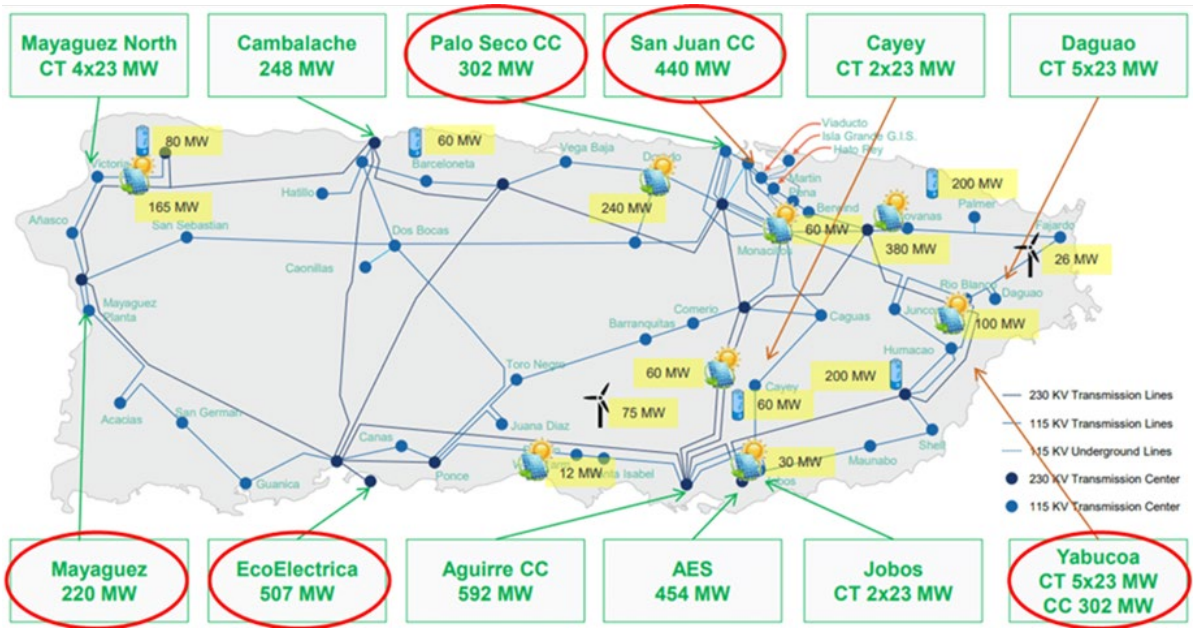


Figure 5 - Map of Puerto Rico main Electric Power Generation and Transmission Infrastructure (Source: Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on June 27, 2019)

Electrical Power System Key Performance Indicators

To quantify the performance of an electric system, the North American Electric Reliability Corporation (**NERC**) defines metrics as a system of parameters or methods of quantitative and periodic assessment of a process that is measured.[33]

Benchmarks and indexes are established to determine the performance goals and the guidelines to operate and maintain a system. A benchmark is a mark or a point of reference by which something is evaluated, compared, and measured. An index is simply a number calculated from a structure of values or amounts.[34]

[33] North American Electric Reliability Corporation. (2007). *Toward Ensuring Reliability: Reliability Performance Metrics*. https://www.nerc.com/docs/pc/rmwg/Reliability_Metrics_white_paper.pdf.
[34] Id.

Generation

The heat rate is the essential parameter within the performance metrics for generation systems with the following combinations: motor and generator, turbine and generator; or boiler-turbine and generator. It establishes the correlation of energy used in the form of fuel for transformation to electrical energy.

The U.S. Energy Information Administration (**EIA**) defines heat rate as one measure of the efficiency of electrical generators/power plants that convert fuel into heat and electricity. The heat rate is the amount of energy used by an electrical generator/power plant to produce one kilowatt hour (kWh) of electricity.[35] The heat rate can be expressed in terms of a percentage. For example, a heat rate of 10,500 Btu/KWh is equivalent to 33%, and a heat rate of 7,500 Btu/KWh is equivalent to 45% efficiency. Thus, the lower the heat rate, the more efficient the equipment.

According to the benchmarks of the public utility systems in the U.S., the thermoelectric steam systems for electricity production based on petroleum derivatives in 2019 have an average heat rate of 10,236 Btu/KWh. The EIA defined the natural gas steam thermoelectric generator heat rate of 10,347 Btu/KWh. The combined cycles that are the most efficient conventional fossil fuel-based systems show an average heat rate of 9,662 Btu/KWh based on petroleum fuel. If this same combined cycle were based on natural gas, it would be even more efficient (7,633 Btu / KWh).[36]

In 2019-2020, PREPA demonstrated an average heat rate that fluctuates between 10,500 and 12,000 Btu / KWh, with its highest peaks in March and April 2020, considering the lock-down effect due to the Covid-19 pandemic. From September to November 2020, the value fluctuated at an average of 10,700 Btu/KWh. See Figure 6. Replacing old generation units with high-efficiency ones and introducing systems that do not require conventional fuels to produce electrical energy, such as renewable energy electric plants, is a crucial step to improve the efficiency of the electrical power system.

[35] U.S. Energy Information Administration. (2021). *Frequently Asked Questions (FAQS), What is the efficiency of different types of power plants?* https://www.eia.gov/tools/faqs/faq.php?id=107&t=3#:~:text=Heat%20rate%20is%20one%20measure%20of%20the%20efficiency,plant%20to%20generate%20one%20kilowatthour%20%28kWh%29%20of%20electricity.

[36] U.S. Energy Information Administration. *Table 8.2. Average Tested Heat Rates by Prime Mover and Energy Source, 2009 – 2019*. https://www.eia.gov/electricity/annual/html/epa_08_02.html.

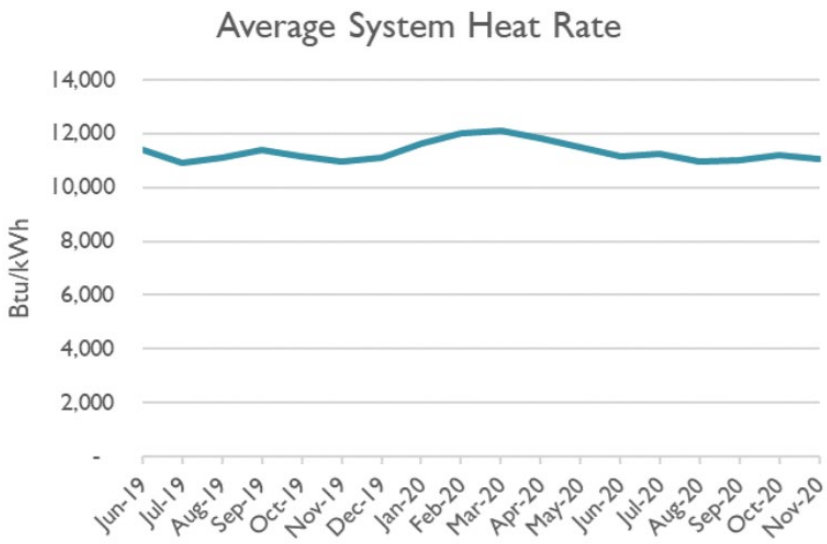


Figure 6 – PREPA Electric System Heat Rate 2019-2020[37]

Transmission and Distribution

Electric utilities have the fundamental requirement of being reliable. Reliability is defined through metrics describing the availability of electrical power or duration of an outage of power, the frequency, and the extent. The utility industry accounts for and manages the reliability to ensure that the system operates within parameters and avoids instabilities or the increase of disturbances.[38]

Typical elements associated with reliability include hardening, investment, and redundancy to prevent service interruption from known and identified hazards.

The Key Performance metrics applied to measure the system performance improvement based on reliability are SAIDI, CAIDI, and SAIFI indicators.

- System Average Interruption Duration Index (**SAIDI**) indicates the total time a service interruption lasts for the average customer in a defined period. Usually, it is calculated on a monthly or yearly basis.
- Average Customer Outage Duration Index (**CAIDI**) refers to the time it takes to restore the service when an outage occurs.
- System Average Interruption Frequency Index (**SAIFI**) means the average of how many times a customer experiences an outage during the year. SAIFI is calculated by dividing SAIDI by CAIDI.[39]

[37] Puerto Rico Energy Bureau. (2021). *Presentation of PREPA's Performance Metrics*. https://energia.pr.gov/wp-content/uploads/sites/7/2021/01/Technical-Conference-Slides_1_19_2021_Final.pdf.
[38] U.S. Energy Information Administration. (2017). *Transforming the Nation's Electricity: The Second Installment of QER*. https://www.energy.gov/sites/prod/files/2017/02/f34/Chapter%20IV--Ensuring%20Electricity%20System%20Reliability%2C%20Security%2C%20and%20Resilience.pdf.
[39] Id.

The Puerto Rico Energy Bureau (**PREB**) established and approved the baseline indexes that LUMA Energy must reach for transmission and distribution operations: SAIDI 1,243 annual minutes (20.72 hours) and SAIFI 10.6 occurrences per customer without major events.[40] Table 1 contains the baselines and benchmarks approved by PREB for transmission and distribution:

TRANSMISSION AND DISTRIBUTION METRICS		
Metric	**Baseline**	**Benchmark**
SAIDI*	1,243 minutes	102 minutes
SAIFI*	10.6 interruptions	1 interruption
CAIDI*	145 minutes	101 minutes
*** Without major events**		

Table 1 – Transmission and Distribution Baselines and Benchmarks41

For Customer Service, the following KPI's were approved by PREB:

CUSTOMER SERVICE METRICS	
Metric	**Benchmark**
Average Speed to Answer	0.4 minutes (25 seconds)
Wait time in commercial offices	30 minutes and 56 seconds
Number of formal customer complaints	6.9 complaints per 100,000 customers
Number of customer calls answered	100% of customer calls answered
Average time to resolve billing disputes	No more than sixty (60) days*
***From the commencement of the initial investigation to the issuance of the determination on the dispute.**	

Table 2 - Customer Service Benchmarks42

[40] *In Re: The Performance of The Puerto Rico Energy Public Authority.* (2021). Resolution and Order. NEPR-MI-2019-0007 (P.R.), https://energia.pr.gov/wp-content/uploads/sites/7/2021/05/Resolution-and-Order-NEPR-MI-2019-0007.pdf
[41] Id.
[42] Id.

Power System Interdependencies

The electric power system supplies energy which is essential to many critical services, such as hospitals, industries, schools, water supplies, communication systems, among others. See Figure 7 (Electric Power Interdependency Examples). A fault in the electric power service could endanger the lives of many individuals, such as patients in a hospital without a reliable backup power system, and negatively affect the operation of commerce and industry. These interdependencies were widely documented after Hurricane María and compounded the long-term impacts on the population. When the electric power system suffers from an outage, connected critical services are hindered or cease to work until the situation is resolved. Having frequent outages can cause a chain reaction, and other essential services could collapse.

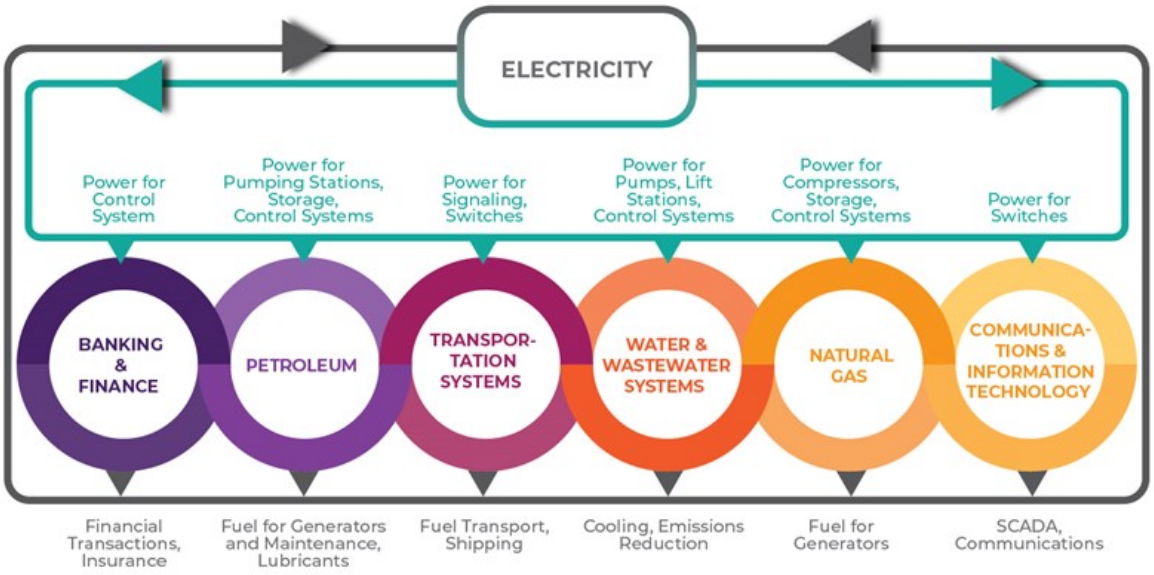


Figure 7 - Electric Power Interdependency Examples (Source: ANL; U.S. Department of Energy: Energy Resilience Solutions for the Puerto Rico Power Grid, Final Report, June 2018; as modified by PRDOH)

Specific critical loads must be considered relevant unmet needs for the entire island of Puerto Rico. These include essential logistics assets needed before and during the disaster recovery process to ensure the materials supply chain and the continuity of production for crucial products. Considering the lessons learned from hurricanes Irma and María, the power supply for those critical loads must be highly reliable and resilient.

As underscored by the DOE, "[t]he Port of San Juan is arguably the single most important cluster of critical infrastructures supporting basic human needs, societal operations, and economic activities across the region. The port is critical to all supply chain categories, facilitating the receipt of virtually all food supplies, half of all fuel supplies (including for electricity generation), and the majority of medical supplies for the island. Its operations are also critical to the flow of supply chains to the U.S. Virgin Islands. The Port of San Juan thus represents a potential single point of failure for critical supply chains and electricity generation on the island. The port's two container terminals each depend on externally-

provided electricity service to power container cranes, which cannot be sustained on available backup generation capabilities. Disruption of service-due to damage at the substations themselves or the aerial power lines connecting them to the terminals-would drastically reduce the ability of the port to receive containerized cargo."[43]

Potential solutions include the use of microgrid systems with underground distribution infrastructure to ensure the electric power supply even in a catastrophic situation. Other critical loads to be considered include, but are not limited to: Centro Médico, Luis Muñoz Marín Airport, San Juan and Ponce Seaports, Mercedita International Airport in Ponce, Northwestern Region Ramey Airport, and Eastern Region Pharmaceutical/Biotechnology Industry, among others.

As outlined previously by PRDOH in the CDBG-MIT Action Plan, during the aftermath of Irma and María, the lack of communication was a factor that delayed the recovery processes and caused high anxiety in the island population. The electrical and communications sectors are highly interconnected. The communications sector provides key monitoring and control services to the electrical sector. In contrast, the electrical sector provides the power necessary for communications sector operations. Due to the interdependency of the two (2) systems, the damage to the electrical grid caused cascading failures across all of Puerto Rico's critical infrastructure systems, including communications. In addition, the logistical challenges (non-operational ports, unpassable roads, etc.) of getting materials to Puerto Rico and the USVI that were necessary for the recovery of the communications system added to the delay. Downed broadcasting antennas, lack of power, a dearth of resources, destroyed telephone poles, and similar factors combined with devastating communications in Puerto Rico for months. The impact on the communications infrastructure caused by Hurricane María disrupted the normal distribution of food products in various ways, including loss of standard communications/Internet capabilities at most of the facilities that comprise the food supply chain, such as warehouses and points of sale. The loss of power and communications incapacitated local disaster response functions. Strategic governmental communication infrastructure such as communication centers and essential antennas are critical loads that must be attended to ensure resilience. Most of the telecommunication assets in Puerto Rico are private. Still, with an improvement of the electric power system, they can be benefitted indirectly.

Additionally, as remarked by the DOE, "there is also a risk that unreliable electricity service over the long term can result in chronic stress on the systems and operations of dependent infrastructure that would impact their resilience. For example, voltage instability, which is a persistent issue across Puerto Rico, may result in the internal equipment and machinery of a dependent water treatment plant or maritime port terminal burning out or being degraded more quickly than anticipated. The need to conduct repair or maintenance, such as replacing fuses, wiring, insulation, or other repairs to equipment and machinery at these plants and ports more frequently as a result, raises the overall operating costs of these assets. Furthermore, the degradations resulting from

[43] Comment received from DOE on October 5, 2021, as part of the TCT consultation to PRDOH.

this chronic stress also increase the dependent infrastructure asset's overall vulnerability to disruptions due to non- electricity service-related issues, including natural hazards."[44]

Financial Impact

The growing financial crisis of PREPA led to a domino effect in its operational structure with direct impact on the quality of service.[45] The combination of lack of materials deteriorated equipment, and the reduced technical manpower delayed the electric power system recovery and continues to impact it. The problem of continued outages due the poor state of the generation facilities and transmission and distribution infrastructure is affecting the reliability of the system, resulting in an unstable and inefficient service for island residents.

Higher electricity rates in Puerto Rico have been another condition that makes stabilizing the economy difficult across all spectrums, but especially in terms of cost burden to vulnerable and low-to moderate-income families. According to the U.S. Energy Information Administration, "[i]n 2019, Puerto Rico's average price of electricity for residential use was higher than rates in 45 of the 50 states. PREPA had to not only rebuild its electricity infrastructure after the hurricanes but also had to restructure its business after operating in bankruptcy protection since 2017."[46] The current condition of the system infrastructure has a direct impact on the social fabric of communities and originated with the long history of limited financial capacity of the utility.[47]

[44] Id.
[45] Allen, G. & Peñaloza, M. (May 7, 2015). Power Problems: Puerto Rico's Electric Utility Faces Crippling Debt, *NPR*. https://www.npr.org/2015/05/07/403291009/power-problems-puerto-ricos-electric-utility-faces-crippling-debt.
[46] U.S. Energy Information Administration. (2020). *Puerto Rico Territory Energy Profile*. https://www.eia.gov/state/print.php?sid=RQ.
[47] Mufson, S. (July 25, 2015). Is it lights out for Puerto Rico? *The Washington Post.* https://www.washingtonpost.com/business/economy/is-it-lights-out-for-puerto-rico/2015/07/24/61c6e51c-29a7-11e5-a250-42bd812efc09_story.html.

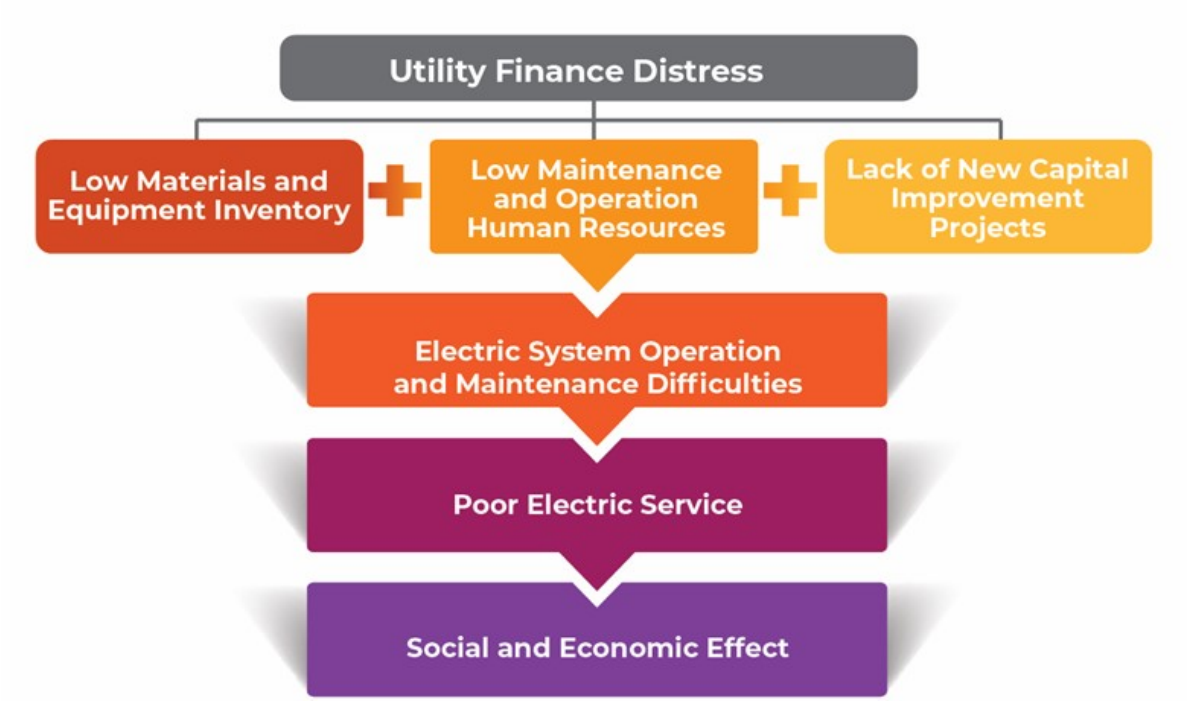


Figure 8 - Chain Effect of the Financial Situation of PREPA (Source: 2020 Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on June 29, 2020)

Disasters Throughout the Years

Due to its geographical location, Puerto Rico is threatened every year by the possibility of tropical storms and hurricanes that can cause severe damage to its infrastructure.

On September 20, 2017, María made landfall in Yabucoa, a town located on the south-east coast of Puerto Rico, bringing widespread hurricane force winds along with extremely heavy rainfall that produced major to catastrophic flooding, and flash flooding, especially across the northern half of Puerto Rico. María's center moved over the coastal waters of northwestern Puerto Rico early that afternoon. Even though hurricane force winds started to diminish once the system moved offshore, tropical storm force winds continued causing damage well into the evening and overnight hours across mainland Puerto Rico. See Figure 9. Like all hurricanes, additional damaging actions included storm surge in coastal areas and torrential rains. Unprecedented destruction was reported to Puerto Rico's infrastructure, making María by far the most destructive hurricane to hit Puerto Rico in the last eighty (80) years and one of the deadliest in our modern times.

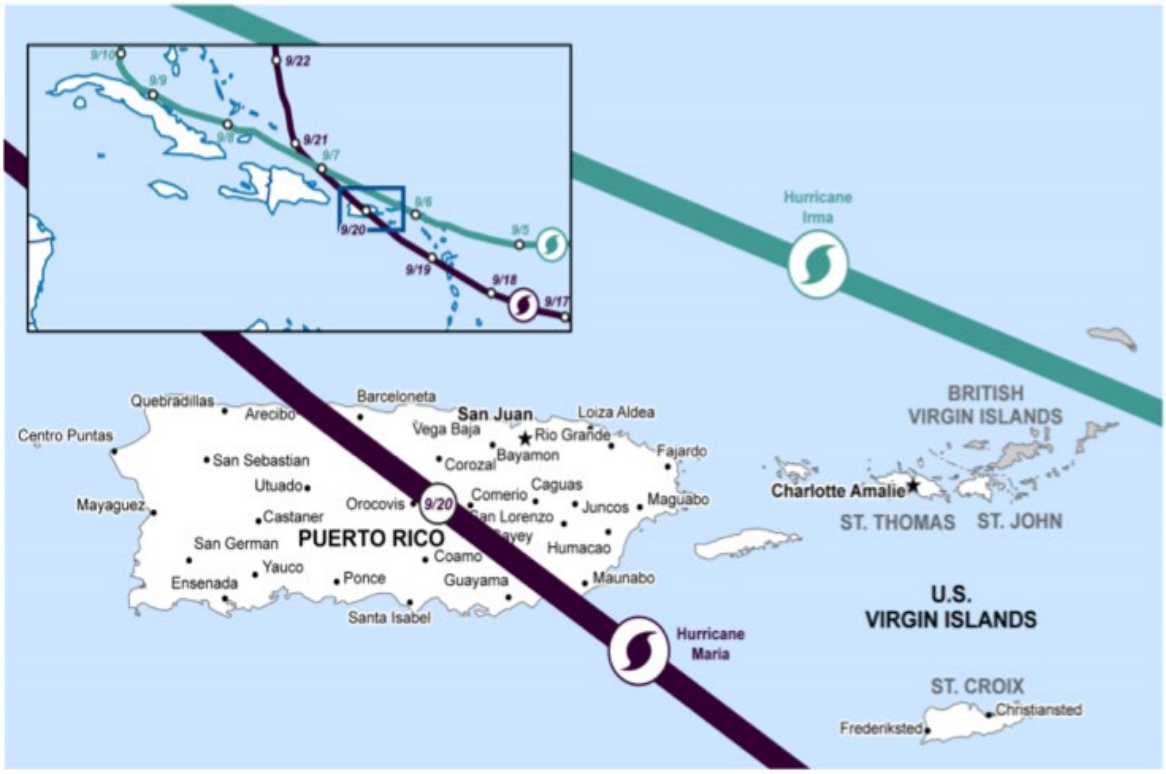


Figure 9 - Path of Hurricanes Irma and María passed through Puerto Rico, September 2017 (Source: GAO Analysis of National Oceanic and Atmospheric Administration data: Map Resources / GAO-20-221)

María caused unprecedented devastation in Puerto Rico and became the most destructive hurricane in modern times, with agriculture, housing, electricity, commerce, industry, and communications being the most affected sectors. Puerto Rico's electrical system required almost a year of nonstop repair efforts to regain basic electric service for all inhabitants.[48]

Additionally, all main economic sectors of Puerto Rico felt the adverse effects caused by the hurricanes. The sequence of events of September 2017 complicated the economic scenario, especially when considering that María made landfall on the Island just a week apart from Hurricane Irma, and disaster recovery efforts related to Hurricane Irma had just begun.

As a response due to the catastrophic destruction caused by Hurricane María, the President of the U.S. issued a Major Disaster Declaration, FEMA-4339-DR, for fifty-four (54) municipalities of Puerto Rico. However, funds from the program of Individual Assistance (**IA**) and Public Assistance (**PA**) were assigned and accessible for all municipalities.

The damage caused by Hurricane María to Puerto Rico's electric infrastructure was severe. Considering the pre-existing vulnerabilities, the magnitude of the impact, lack of the necessary materials for repairs, available workforce and difficulties related to the

[48] U.S. Army Corps of Engineers. (2018). *Puerto Rico Grid Restoration*. https://www.energy.gov/sites/prod/files/2018/03/f49/Puerto%20Rico%20Grid%20Restoration%20COL%20J%20Lloyd.pdf

topography and logistics of the Island, the immediate response efforts were difficult and slow. During this recovery period, thousands of Puerto Ricans moved off the Island; others lost their homes or suffered critical damage to their private properties, which made living conditions intolerable. These scenarios had severe adverse effects on the Island's already weak economy and demographic/social conditions.

The rural population in the highly impacted central corridor lived through some of the worst conditions primarily because of the difficulties encountered to access essential services, recover and repair the electric power infrastructure, and access potable water. Vulnerable communities reported suffering from strong anxiety caused by the conditions in which they lived, and these conditions worsened as time passed by and essential services remained lacking. This situation added to the post-traumatic stress of the aftermath of Hurricane María and resulted in an intense fear of future events that could threaten the Island.[49]

In the months following Hurricane María, 1.5 million Puerto Ricans were living without power. Around 4% of the population migrated[50] from the Island, and thousands died as a result of the storm. Also, it left mental healthcare providers scrambling to address post-traumatic stress disorder (PTSD), depression, and other psychological effects.

Figure 10 – Residents of Carolina seeking fuel for emergency generators after Hurricane María

[49] Abrams, Z. (2019). Puerto Rico, two years after Maria. *American Psychological Association*. 50(8). https://www.apa.org/monitor/2019/09/puerto-rico.
[50] Id.

The electrical grid was not the only essential service that felt the adverse effects brought by María. Potable water systems were also hit hard. Damages were reported to 70% of the potable water treatment and supply system; of 714 pumping stations, 220 were affected. Regarding the sewage systems, 51 treatment plants were shut down.[51] Additionally, the agriculture of the Island was decimated by María, as more 80% of the local harvest suffered considerable damages. The estimates of agricultural sector losses surpassed $2 billion.[52]

Furthermore, the communications sector was heavily affected, and Puerto Rico was isolated from the world due to the extensive damage the telecommunications infrastructure suffered. According to the Federal Communication Commission (**FCC**), 90% of the Island's cell phone towers were down, and most cables, telephone lines, and fiber optic systems were out of service.[53] There were also significant interdependencies between electrical service and critical lifelines, with the lack of electricity directly impacting other systemic capabilities. PRDOH conducted a comprehensive analysis of systemic interdependencies in its CDBG-Mitigation (CDBG-MIT) Action Plan approved by HUD on April 19, 2021, and readers are encouraged to consult it by going to https://cdbg-dr.pr.gov/en/cdbg-mit/ (English), and https://cdbg-dr.pr.gov/cdbg-mit/ (Spanish)

Figure 11 illustrates Hurricane María's effect on the electric system comparing the illumination in a satellite photo of Puerto Rico before and several days after the event as provided by the National Oceanic and Atmospheric Administration (NOAA).

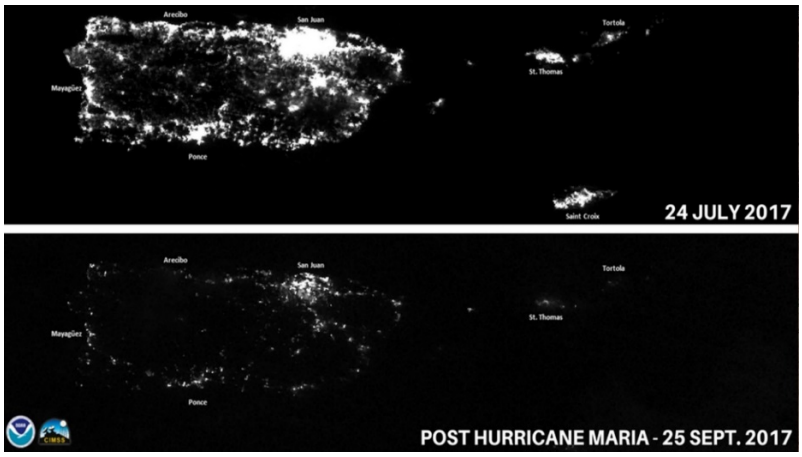


Figure 11 - Puerto Rico illumination comparison before and after Hurricane María.[54]

[51] Instituto Nacional de Energía y Sostenibilidad Isleña. *(2018). Estado de Situación Energética de Puerto Rico, Informe Anual 2017.* https://static1.squarespace.com/static/5b6c67d071069910870c6820/t/5cbd046be5e5f0648a778456/1555891502310/%282018%29+Oeppe%2C+Estado+de+situacio%CC%81n+energe%CC%81tica+de+Puerto+Rico+%282017%29.pdf.

[52] Id.

[53] Becker, R. (2017). Trying to communicate after the hurricane, 'It's as if Puerto Rico doesn't exist'. *The Verge*. https://www.theverge.com/2017/9/29/16372048/puerto-rico-hurricane-María-2017-electricity-water-food-communications-phone-internet-recovery:

[54] NOAA Satellites captured images of Puerto Rico after Hurricane María knocked out the power grid and left millions without electricity by https://www.nesdis.noaa.gov/news/noaa-shares-first-satellite-images-of-puerto-rico-after-hurricane-maria.

The electric power grid was utterly destroyed by the hurricane, leaving millions without electricity. The Government of Puerto Rico estimated that María caused at least $90 billion in damage. As of September 26, 2017, 95% of the island was without power. On October 6th, a little more than two (2) weeks after the hurricane, 89% still had no power. One month after the storm, 88% of the island was without power, almost 3 million people. Three (3) months after the hurricanes, 45% of Puerto Ricans still had no power, over 1.5 million people.

Figure 12 shows Hurricane María's path across Puerto Rico and the location of large-scale electric power generating facilities. The Cambalache power generating facility in Arecibo was the facility most impacted due to the pathway of the hurricane.

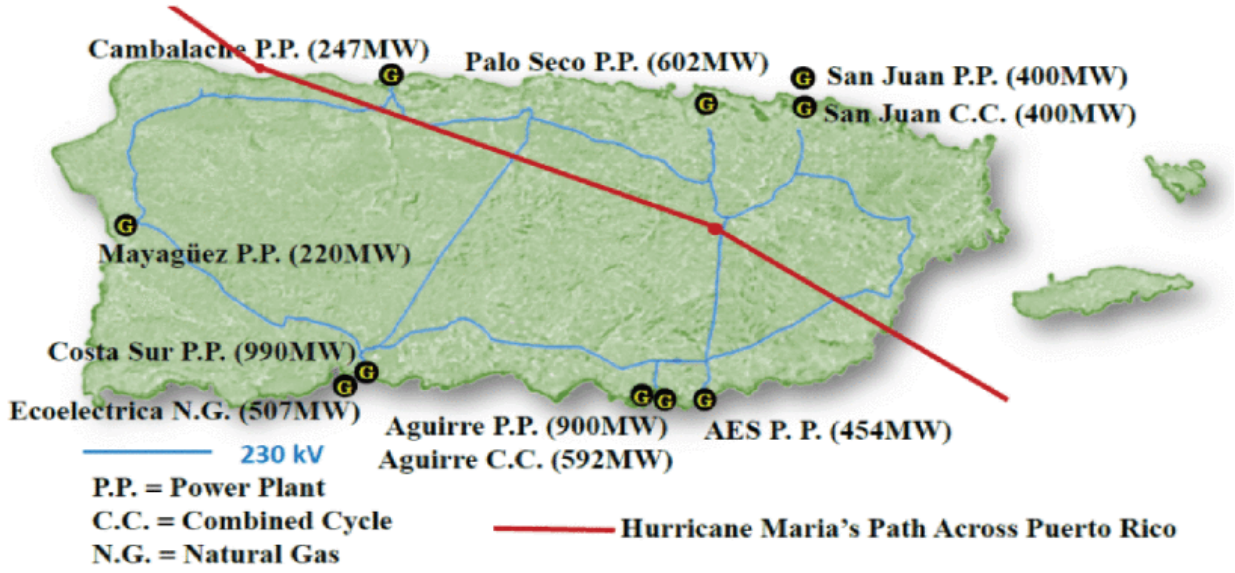


Figure 12 - Hurricane María's path across Puerto Rico and the Main transmission and generation assets of Puerto Rico's power grid (Source: Hurricane María Effects on Puerto Rico Electric Power Infrastructure- IEEE)

The Puerto Rico Electrical Power System has had several historic outages that have left many regions, or the entire Island, without power. In August 2012, tropical storm Isaac left over 14,000 residents without power. On September 20, 2016, a fire began at the Aguirre Power Complex, causing a power outage that left an estimated 1.5 million people without electricity for three (3) days. At the start of September 2017, Hurricane Irma passed through the north of the island. See Figure 9. This hurricane left more than 1 million people without power. Ninety-eight percent (98%) of the electricity was restored before Hurricane María made landfall. Then, on September 20, 2017, Hurricane María struck Puerto Rico (see Figure 9), leaving Puerto Rico entirely without power. Hurricane María was so powerful that it's path disabled radars, weather stations, and cell towers across the Island. Six (6) weeks after Hurricane María made landfall, only 30% of the power had been restored; two (2) months after only 50% of the power had been restored.

During the recovery phase, PREPA had a shortage of materials because the inventory was insufficient to attend both emergencies. When María impacted the Island's electric

infrastructure, PREPA experienced a delay in the recovery process due to the lack of principal materials such as poles, cables, and electric insulators, among others.

Hurricane María left enormous amounts of rain on the islands over which it swept. In Puerto Rico, one location had a storm total of nearly thirty-eight (38) inches.[55] River discharges in many areas of the Island were at record or near-record levels. Severe flooding and mudslides affected most of the Island, with the most significant flooding associated with the La Plata River. In some areas, the river flooding was unprecedented, especially in the northern portion of Puerto Rico. Toa Baja was partially flooded by La Plata River, and hundreds of families needed to be rescued from their rooftops.[56]

Figure 13 shows that Hurricane Wind Hazard Occurrences from 1989 through 2018 mainly affected mostly the northeast part of Puerto Rico (19-21 events). Also, Figure 11 demonstrated the Hurricane María effect on the electric power system comparing the illumination in a satellite photo of Puerto Rico before and after the catastrophic event.

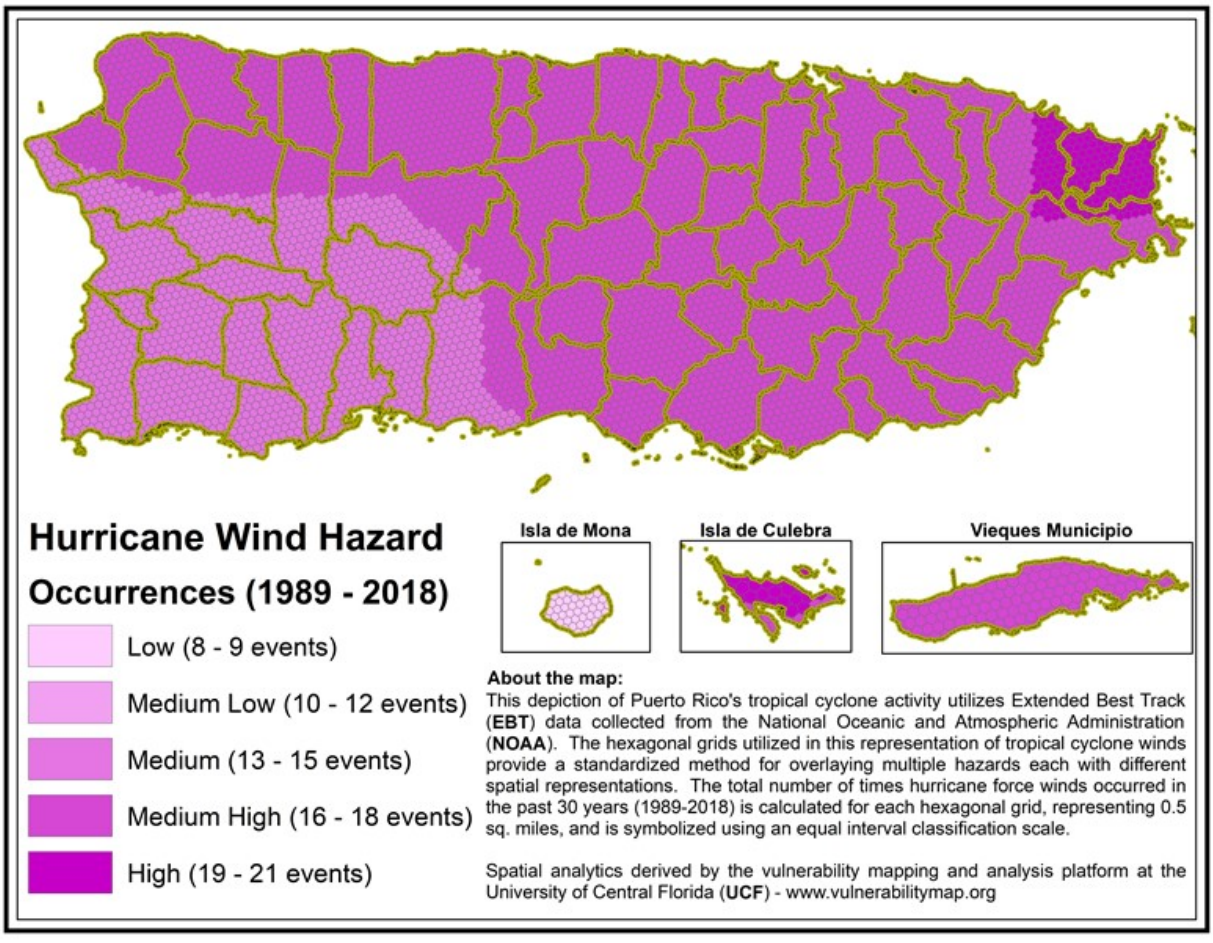


Figure 13 - Hurricane Wind Hazard Occurrences (1989-2018)

[55] Pasch, R.J., Penny. A.B., and Berg, R. (2019). *Hurricane Maria* (AL152017). National Oceanic and Atmosphere Administration (NOAA). https://www.nhc.noaa.gov/data/tcr/AL152017_María.pdf.
[56] Id.

In the months after the immediate crisis related to the hurricanes was still being resolved, on April 18, 2018, a transmission line was knocked out by accident, leaving almost the entire island without power. By the end of this day, 97% of the power was restored while 40,000 residents remained without service. At the start of June 2018, there were still over 11,000 residents without power, possibly for two (2) more months.

On January 7, 2020, a 6.4 magnitude earthquake, the mainshock of the 2020 Southwest Puerto Rico earthquake sequence, was felt across the Island. This early January earthquake led to a confirmed fatality and island-wide power outages.[57] The earthquake sequence displaced thousands of Puerto Ricans from their homes. It resulted in extensive damage to the Island's built environment, including individual homes and critical infrastructure.

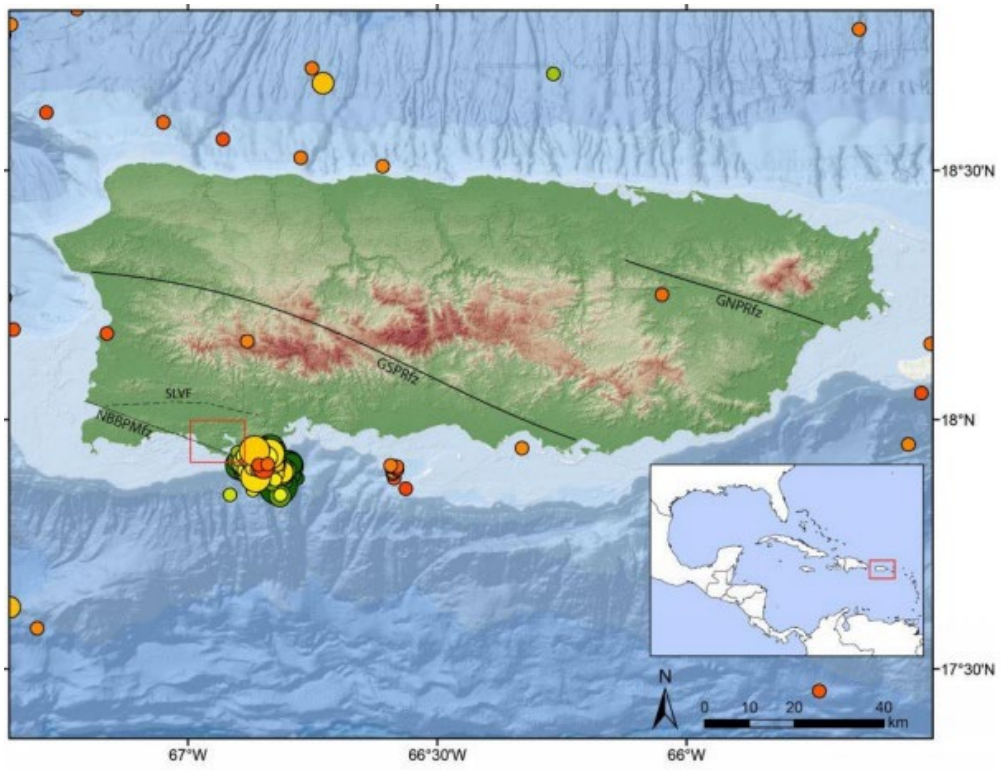


Figure 14 - Events larger than M 2.5 detected by the Puerto Rico Seismic Network between December 8, 2019 to January 7, 2020 (Source: Puerto Rico Seismic Network)

The earthquake caused significant damage to the Costa Sur power plant in the south of Puerto Rico. As outlined by FEMA, "Costa Sur is the largest of four (4) power plants on the Island and provides about a quarter of the electric power throughout Puerto Rico. The facility suffered extensive structural damage from the earthquakes in January, which

[57] Puerto Rico Department of Housing, CDBG-DR (Earthquake Allocation) Action Plan, available at: https://cdbg-dr.pr.gov/en/seismic-home-rehabilitation-and-reconstruction-action-plan/ (English) and https://cdbg-dr.pr.gov/plan-de-accion-para-la-rehabilitacion-y-reconstruccion-de-hogares-por-sismos/ (Spanish).

resulted in compromised foundations, walls, and support structures. The damage caused island-wide power outages, leaving over 327,000 residents without power."[58]

The probability of a tsunami, a large ocean wave, in Puerto Rico is possible. In the past, in 1867 and 1918, tsunamis occurred that affected the coastal region, causing death and destruction.[59] In the 1867 tsunami, no human losses were registered, but in 1918, 116 deaths occurred.[60] A 7.3 magnitude earthquake caused the 1918 tsunami. The causes of these tsunamis had been earthquakes. However, a tsunami can also be generated by other sources like an underwater landslide, a volcanic eruption, or the impact of a meteorite. In addition to affecting coastal communities, tsunamis can also affect the electrical infrastructure of generation, transmission, and distribution in these areas. Due to design requirements, almost all generation units are in the coastal zone, which represents a high risk from tsunamis for the electricity generation infrastructure. See Figure 15.

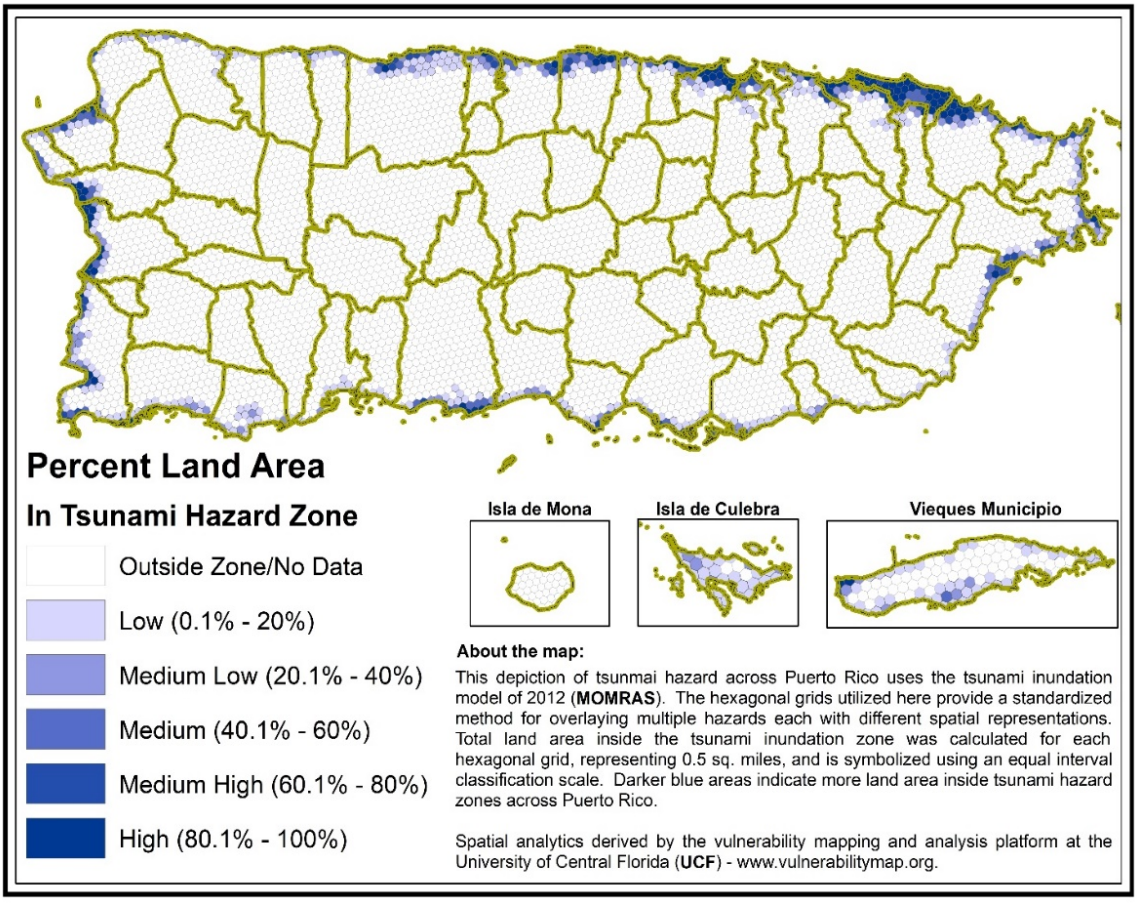


Figure 15 – Percent Land Area in Tsunami Hazard Zone

[58] FEMA. (2020, October 13). FEMA obligates over $238 Million to PREPA for Earthquake Damage. https://www.fema.gov/press-release/20201013/fema-obligates-over-238-million-prepa-earthquake-damage.

[59] Red Sísmica de Puerto Rico. (n.d.). *Programa de Tsunami de Puerto Rico*. http://redsismica.uprm.edu/Spanish/tsunami/programatsunami/prc/

[60] Red Sísmica de Puerto Rico. (n.d.). *Información Sísmica*. http://redsismica.uprm.edu/Spanish/informacion/terr1918.php

Another of the effects caused by earthquakes is liquefaction, and it is defined as a process by which the water-saturated sediment temporarily loses strength and acts as a fluid in response to ground vibrations.[61] In Puerto Rico, liquefaction susceptibility studies have been carried out. Among the most important findings was that San Juan and Bayamón are in very high-risk areas,[62] specifically along the coastal plain of Bayamón and the edges of San Juan Bay and San José Lagoon.[63]

When selecting a site to design and construct structures and underground improvements, it is imperative to consider liquefaction in high and very high-risk areas. Site studies and investigations must be carried out, and engineering solutions must be considered to mitigate the potential effects of liquefaction.[64]

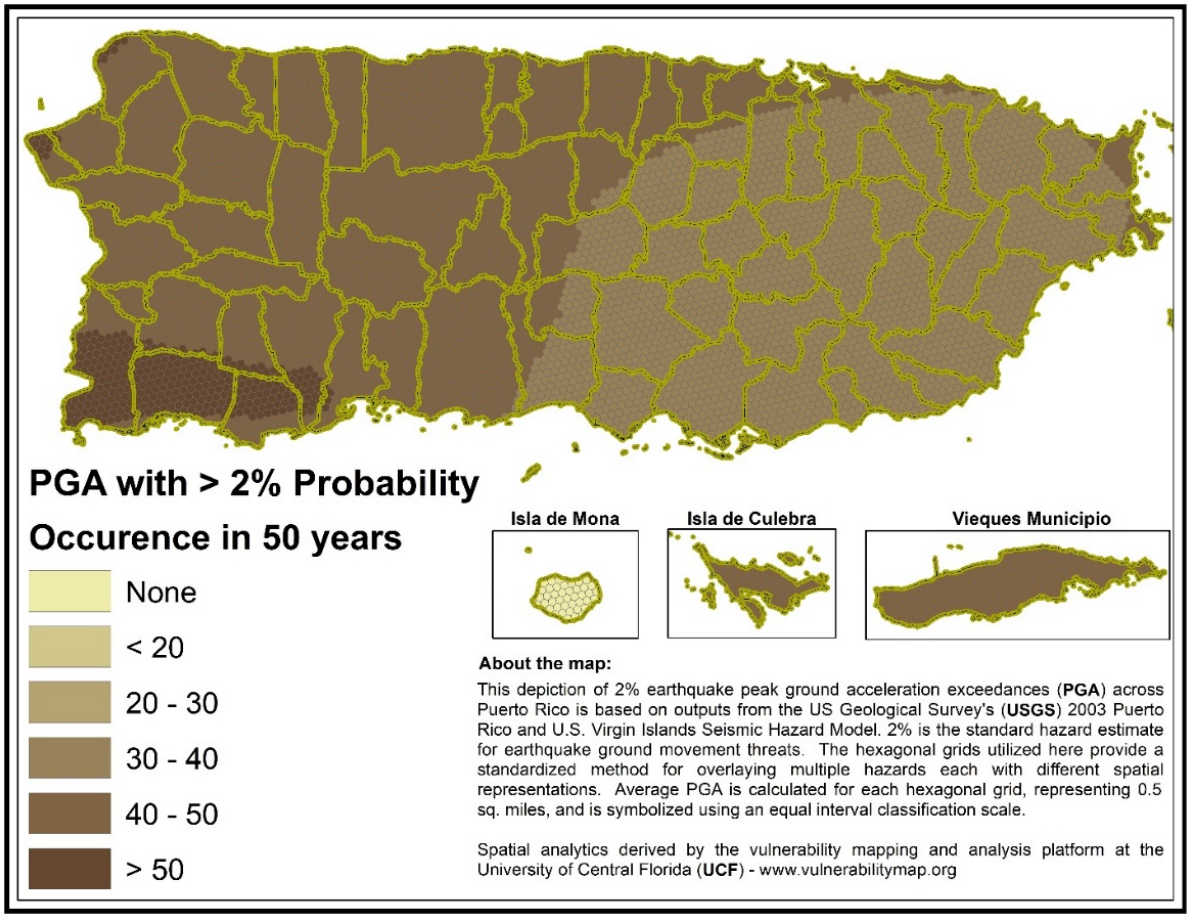


Figure 16 - Earthquake Hazard Areas

[61] U.S. Geological Survey. (n.d.). *What is liquefaction?* www.usgs.gov/faqs/what-liquefaction.
[62] Santiago, M. and Rodríguez-Martínez, J. (2001). *A digital liquefaction susceptibility map for the HAZUS earthquake loss estimation of the San Juan metropolitan area, Puerto Rico*. U.S. Geological Survey. https://pubs.usgs.gov/of/2000/0275/report.pdf.
[63] Bachhuber, J.L., Hengesh, J.V., and Sudermann, S.T. (2008). *Liquefaction Susceptibility of the Bayamon and San Juan Quadrangles, Puerto Rico*. U.S. Geological Survey. https://earthquake.usgs.gov/cfusion/external_grants/reports/03HQGR0107.pdf.
[64] Id.

Although there have been significant efforts to restore the electric power system of Puerto Rico, the crisis of Hurricanes Irma and María is not over yet. The electric power infrastructure remains unsuitable to face a new atmospheric event. It continues to have rolling power outages related to generation issues. The people of Puerto Rico have continued to report feelings of uncertainty, frustration, and fear of going through the same or worse conditions with a new catastrophic event.[65]

Effects of the COVID-19 Pandemic on the Electric Power Industry

The COVID-19 pandemic affected the electric power sector during 2020. As per the Congressional Research Service, the principal impacts were illnesses and deaths of workers and reduced electricity sales. The electricity demand was significantly reduced due to the economic effects of the pandemic.[66] Other impacts from the pandemic were increased electrical reliability risks, a reduction in timely utility bill payments, and reduced or delayed investment activity in the industry.[67]

Governments worldwide were forced to reduce business activity to curtail the threat of the coronavirus.[68] The Coronavirus Aid, Relief, and Economic Security Act, also known as the CARES Act, is a $2.2 trillion economic stimulus bill passed by the 116th U.S. Congress in March of 2020 to assist businesses, individuals, and local governments in withstanding the economic impact.

However, COVID-19 has changed lifestyles globally, with most people staying at home and working remotely, if and when possible. Therefore, there was a significant increase in the demand for residential electrical loads. At the same time, there was a substantial decrease in commercial and industrial loads.[69] According to analysis on the COVID-19 impact on the power sector, "[t]his devastating situation create[d] new challenges in the technical and financial activities of the power sector."[70]

In addition to the impacts of the previously mentioned pandemic in Puerto Rico, the electrical system was affected since maintenance and repairs of generating units were reduced during this period. In addition, the employees of the generating units worked isolated to avoid contagion. The COVID-19 protocol for electricity workers reduced the effective work time and created the potential for maintenance delays and recovery time after an outage. This new reality has changed the work conditions in Puerto Rico and has affected the lead time for materials and equipment, complicating the scope of work and repair schedules.

---

[65] Martínez-Rivera, C. (2020). Health and Resiliency of Physical Education Teachers in Puerto Rico Post-Hurricane María. [Doctoral dissertation, Ohio University] https://etd.ohiolink.edu/apexprod/rws_etd/send_file/send?accession=osu1586970846251129&disposition=inline.

[66] Congressional Research Service. (2020). *COVID-19: Potential Impacts on the Electric Power Sector*. Insight. https://crsreports.congress.gov/product/pdf/IN/IN11300.

[67] Id.

[68] R. Madurai Elavarasan, *et al*. (2020). *COVID-19: Impact analysis and recommendations for power sector operation*. Applied Energy. 279.www.ncbi.nlm.nih.gov/pmc/articles/PMC7458120.

[69] Id.

[70] Id.

PREPA Asset Risk, LMI, and Vulnerability Assessment

PREPA Assets, namely power plants, power substations, power transmission centers, and power transmission lines (38KV, 115KV, and 230KV), although widely disbursed across Puerto Rico, have also been built in places with flood risk, different vulnerabilities, and a range of LMI conditions. Assessing PREPA asset locations in relation to risks, incomes, and underlying social vulnerabilities provides a standardized, replicable, and empirical method resulting in valuable planning information.

Several steps were taken to align available datasets with LMI, flood zone, and social vulnerability information utilized in previous CDBG-DR planning efforts. First, geospatial data, in the form of polygon representations of power plants, power substations, and power transmission lines was connected with municipality data to enable creation of summary tables by municipality. Then, each PREPA asset location was spatially assessed in relation to areas of high social vulnerability, current flood 100-year flood zones, and advisory 100-year and 500-year flood zones.

Assessing the locations of power transition lines required a more nuanced analytic process to gain perspective on where and "how much" of these assets are in at risk, low-income, or vulnerable areas. Here, the geospatial representations of three (3) differently sized transmission lines (38KV, 115KV, and 230KV) are typically provided in Geographic Information System (GIS) "line" format with one (1) beginning vertex (latitude/long), one (1) ending vertex (latitude /long), and additional vertices (latitude /long) representing places where the line changes direction. Because transmission lines are not installed in a uniform way in terms of the distance between support poles locations, these "lines" were first converted to sets of points equally spaced at 1-meter intervals. This method turns each transmission line into a set of representative points that are easily overlaid with other spatial data, such as LMI information at the block group, social vulnerability information at the census tract, and the variety of risk data that should be considered when attempting to rebuild and restore Puerto Rico's power systems in resilient ways. Figure 17A shows the 230KV power transmission lines as GIS "line" features, and Figure 17B shows the same transmission lines represented at points spaced 1-meter apart. The line features are more useful for generalized mapping. Their lack of uniform precision makes them difficult to analyze in relation to other spatial features. Once converted to points, these power line representations lend themselves well to geospatial analysis and summary statistics.

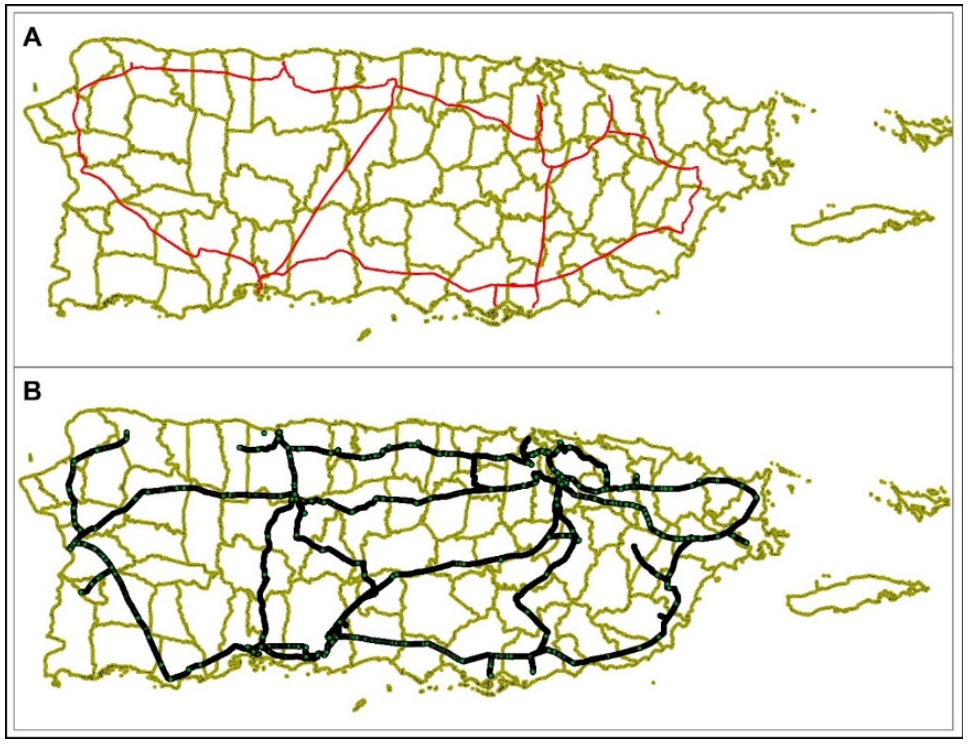


Figure 17 - Representation of PREPA 230KV power transmission lines as a GIS "line" features and B.1-meter spaced GIS "point" features

The converted 1-meter spaced powerline points were then assessed in terms of their location in relation to municipality, high social vulnerability census tracts, high LMI block groups, current flood risk areas, and FEMA advisory 100- and 500-year flood zones. Mapping these assets and summarizing the results at the municipality level provides a detailed assessment of not only where these assets intersect risky and vulnerable areas, but also provides the quantity of at-risk or vulnerable assets.

Power Plants

Power Plants are arguably one of the most critical parts of the power grid. Power generation station locations should be in areas with low hazards and should provide equal service to all segments of society. After a disaster, deciding which of these stations is repaired, rebuilt, or made more resilient should include an assessment of marginalized, low-income, or socially vulnerable populations in both the immediate location and service area associated with each plant. Unfortunately, service area representations for these PREPA assets are not readily available. Therefore, in order to evaluate the PREPA asset location in the context of risk and population, an accounting of each power plant's physical location was assessed in terms of socially vulnerable areas, flood zones (current and advisory) and LMI areas. Figure 18A provides a spatial view of these assets across Puerto Rico, and Figure 18B those stations in vulnerable, low-income or at-risk areas. Table 3 summarizes these at the municipal level in relation to the above-mentioned risks and vulnerabilities.

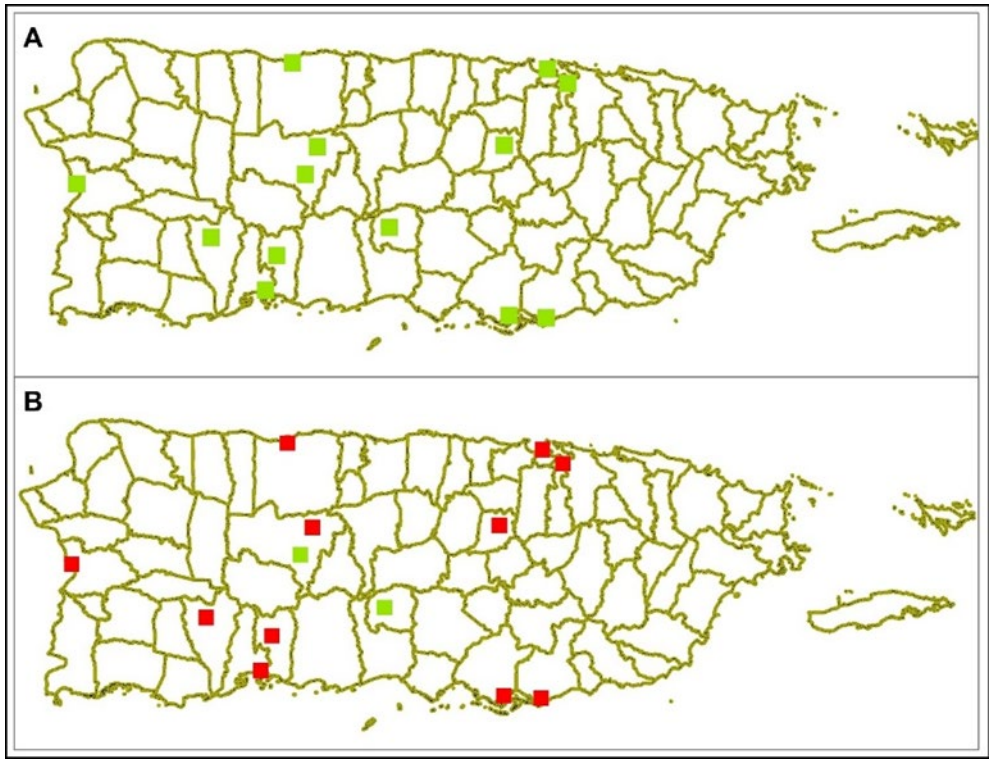


Figure 18 - A. Power Generation Stations across Puerto Rico and B. Red squares indicate stations located in at risk or vulnerable areas

Another factor to consider in the long term is the climate change consequences for Puerto Rico. The sea level has risen by about four inches relative to Puerto Rico's shoreline since 1960, and it is likely to increase by one (1) to three (3) feet in the next century, according to the U.S. Environmental Protection Agency (**EPA**).[71] That means that the power infrastructure located around the coastline is more vulnerable and needs to address mitigation elements for future projects.

Municipality	Total Power Plants or Portions of Power Plants (Those crossing municipalities boundaries)	High Social Vulnerability Census Tract	LMI Block Groups	Current 100-Year Flood Zone	Advisory 100-Year Flood Zone	Advisory 500-Year Flood Zone (includes 100 Year Flood Zone)
Arecibo	1			1	1	1
Guayama	1			1	1	1
Guayanilla	1	1		1	1	1
Mayagüez	1			1	1	1
Naranjito	1	1			1	1
Peñuelas	2	1		1	2	2
Salinas	1			1	1	1
San Juan	1			1	1	1

[71] U.S. Environmental Protection Agency. (2016). *What Climate Change Means for Puerto Rico.* https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100QVB4.txt.

Municipality	Total Power Plants or Portions of Power Plants (Those crossing municipalities boundaries)	High Social Vulnerability Census Tract	LMI Block Groups	Current 100-Year Flood Zone	Advisory 100-Year Flood Zone	Advisory 500-Year Flood Zone (includes 100 Year Flood Zone)
Toa Baja	1			1	1	1
Utuado	2	1		1	2	2
Villalba	1			1	1	1
Yauco	1					1
Total	**14**	**4**		**10**	**13**	**14**

Table 3 - Number of Power Plants by Risk/Vulnerability

The flooding caused by a storm surge is one (1) of the most devastating effects of a hurricane. Surge flooding is the term used to refer to the height of the storm surge above ground level. The National Hurricane Center (NHC) is charged with making public storm surge forecasts. When the NHC makes a forecast for a 20-foot storm surge, it will mean that it will be twenty (20) feet above the ground.[72]

During hurricane María, winds raised sea level and pushed the water inland, causing a severe storm surge. In southeastern Puerto Rico, maximum flood levels occurred, six (6) to nine (9) feet above ground level. The highest levels were recorded on the coasts of Humacao, Naguabo, and Ceiba. The southern region of the Island had levels in the three (3) to five (5) feet range. The lowest levels were identified on the north and west sides of the Island, in the range of one (1) to four (4) feet.[73]

Although most power stations are not located in census tracts with high social vulnerability, nearly half are located in an LMI block group and the majority of them are located in current (and future) flood hazard areas. This finding is of great concern and may require additional resilience measures be taken to safeguard these critical facilities from future flooding impacts.

Power Sub-Stations

Power substations are integral parts of an electrical grid and form essential links between power plants, transmission systems, distribution systems, and charging points. The power substations should also be located in low-risk areas and provide an equal service to all segments of society. The physical location of each power substation can be considered in its relation to socially vulnerable areas, flood zones, and LMI areas. Figure 19 provides a spatial view of these assets throughout Puerto Rico and vulnerable, low-income, or at-risk areas. Table 4 summarizes these at the municipal level on risks and vulnerabilities.

[72] U.S. National Oceanic and Atmospheric Administration. (n.d.). *Sea, Lake, and Overland Surges from Hurricanes (SLOSH)* https://www.nhc.noaa.gov/surge/slosh.php#INUNDATION.
[73] Monroe, M. (2019, September 21). Looking Back at Historic Hurricane María. *Weather Nation*. https://www.weathernationtv.com/news/looking-back-at-historic-hurricane-maria.

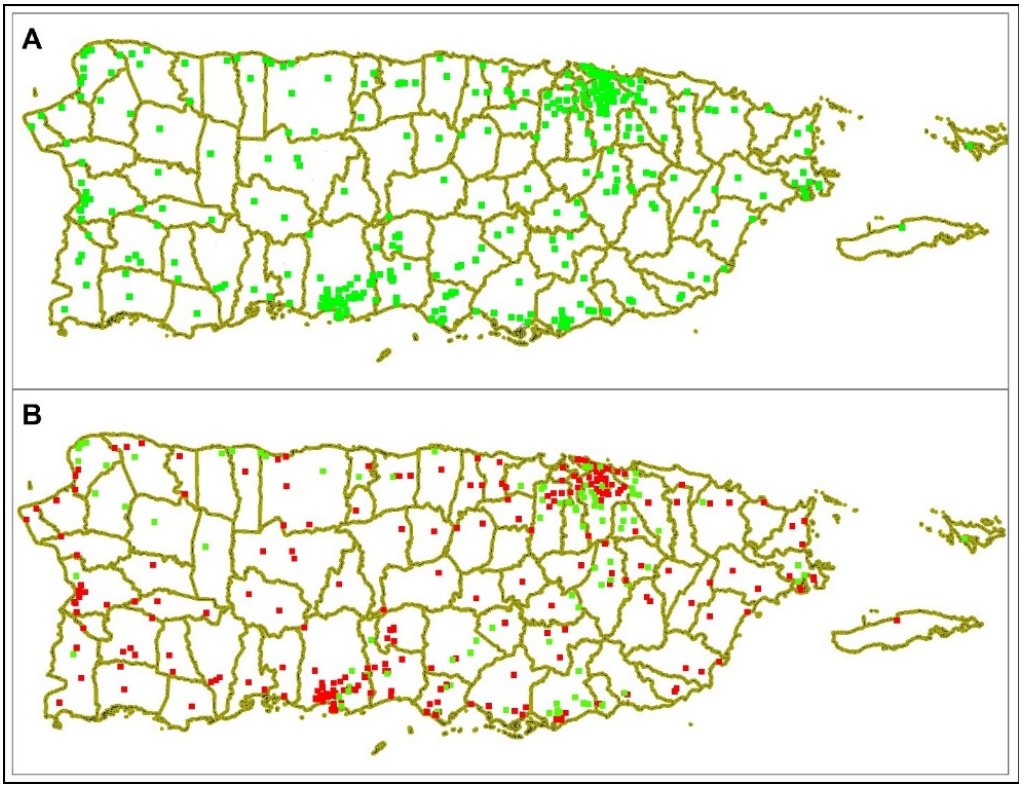


Figure 19 - A. Power Sub-Stations across Puerto Rico and B. Red squares indicate stations located in at risk, low-income, or vulnerable areas

Municipalities	Total Transmission Centers or Portions of Transmission Centers (Those Crossing municipalities)	High Social Vulnerability Census Tract	LMI Block Groups	Current 100-Year Flood Zone	Advisory 100-Year Flood Zone	Advisory 500-Year Flood Zone (includes 100 Year Flood Zone)
Adjuntas	2	2				
Aguada	1	1				
Aguadilla	9	3		1	1	1
Aguas Buenas	1				1	1
Aibonito	2			1	1	1
Añasco	1			1	1	1
Arecibo	7	3		1	2	2
Arroyo	5	1				
Barceloneta	2			1	1	1
Barranquitas	1					
Bayamón	11			2	5	5
Cabo Rojo	5			1	2	2
Caguas	8	2		1	1	1
Camuy	1					
Canóvanas	1			1	1	1
Carolina	10	1			2	2
Cataño	2			1	2	2
Cayey	4			2	2	2
Ceiba	8	1		1	4	4
Ciales	1	1				
Cidra	3					
Coamo	6			1	1	1
Comerío	1	1			1	1

Municipalities	Total Transmission Centers or Portions of Transmission Centers (Those Crossing municipalities)	High Social Vulnerability Census Tract	LMI Block Groups	Current 100-Year Flood Zone	Advisory 100-Year Flood Zone	Advisory 500-Year Flood Zone (includes 100 Year Flood Zone)
Corozal	2	1				
Culebra	1					
Dorado	3			2	3	3
Fajardo	3			1	1	1
Florida	1					
Guánica	1	1		1	1	1
Guayama	17			3	3	3
Guayanilla	2	1		1	2	2
Guaynabo	7	2		1	1	1
Gurabo	3	1		1	2	2
Hatillo	3					
Humacao	2	1		1	1	1
Isabela	4					
Jayuya	3	3			3	3
Juana Díaz	11	2		4	6	6
Juncos	1			1	1	1
Lajas	2					
Lares	1					
Las Marías	1					
Las Piedras	2					
Loíza	1			1	1	1
Luquillo	1	1			1	1
Manatí	4					
Maricao	3	2			1	1
Maunabo	2			1	1	1
Mayagüez	11	7		2	4	4
Moca	2					
Morovis	1					
Naguabo	2			1	2	2
Orocovis	2	2				
Patillas	3			1	1	1
Peñuelas	2	2		1	2	2
Ponce	70	21		31	44	44
Quebradillas	1					
Rincón	3	2		1	1	1
Río Grande	3					
Sabana Grande	2	1		1	1	1
Salinas	7	3		2	3	3
San Germán	4	2		1	1	1
San Juan	52	12		14	21	21
San Lorenzo	2	1		2	2	2
San Sebastián	1	1				
Santa Isabel	17			2	3	3
Toa Alta	3	2				
Toa Baja	2			1	1	1
Trujillo Alto	5					
Utuado	3	1		1	1	1
Vega Alta	3	1				
Vega Baja	2	1		1	1	1
Vieques	1					
Villalba	6				1	1
Yabucoa	3	1			1	1
Yauco	3	3			1	1
Grand Total	389	94		95	147	147

Table 4 - Number of Power Sub-stations by Risk/Vulnerability

The substations and the power plants located around the Puerto Rico coastline are vulnerable to sea-level rise triggered by climate change. The sea-level rise scenarios for one (1), two (2), and three (3) meters by the year 2100 performed by the Department of Marine Sciences, University of Puerto Rico (**UPR**), Mayagüez Campus gave a clear look at the devastating consequences of climate change. Those scenarios used the USACE calculator[74]. The following Figure presents the three (3)-meter sea-level rise scenario and the potential effects on electric power system installations near Arecibo's coastline, such as PREPA's "Charco Hondo" substation and Cambalache Turbines Generating Station.

Figure 20- Sea Level Rise Scenario - Three Meters Flood – Arecibo's Coastline

Power Transmission Centers

The power transmission center is a key component of every utility's power system operation. The power transmission center also should be located in low-risk areas and provide an equal service to all segments of society. The physical location of each power transmission center should consider the socially vulnerable areas, flood zones, and LMI areas. Figure 21 provides a spatial view of these assets throughout Puerto Rico and vulnerable, low-income, or at-risk areas. Table 5 summarizes these at the municipal level on risks and vulnerabilities.

[74] Mercado-Irizarry, A. (2017). *Sea Level Rise Around Puerto Rico: A Projection*. University of Puerto Rico, Mayagüez Campus. http://coastalhazards.uprm.edu/downloads/Other_reports/SEA%20LEVEL%20RISE%20AROUND%20PUERTO%20RICO-A%20PROJECTION_v9.pdf.

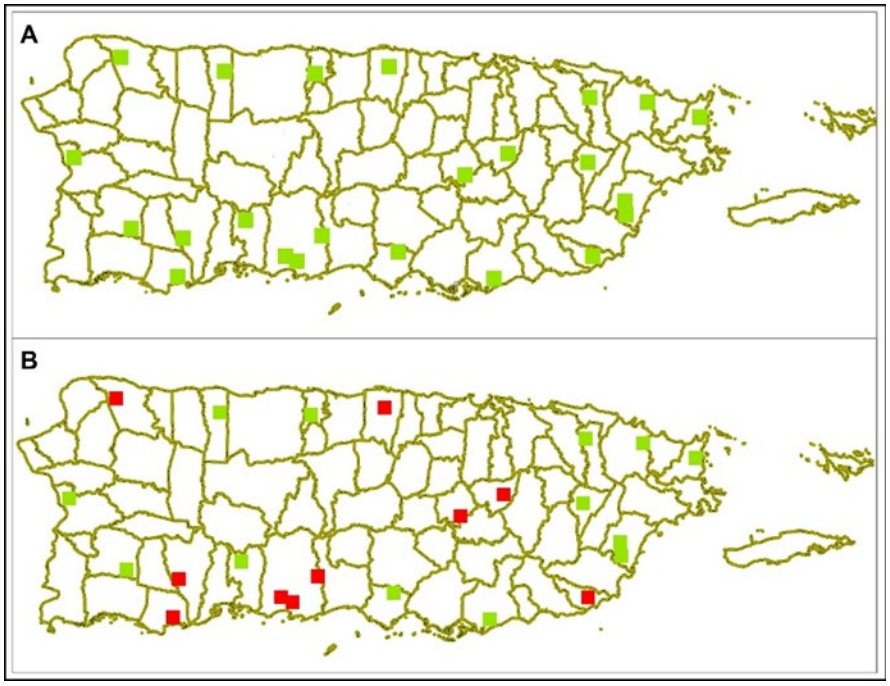


Figure 21 - A. Power Transmission Centers across Puerto Rico and B. Red squares indicate stations located in at risk or vulnerable areas.

Four (4) power transmission centers are located on the Puerto Rico southern coast. The power transmission centers facilities are also vulnerable to the sea-level rise caused by climate change. The sea-level rise scenarios for three (3) meters by 2100 performed by the Department of Marine Sciences, UPR, Mayagüez Campus predicted devastating consequences for these transmission centers' locations.[75] The following Figure presents the three (3)-meter sea-level rise scenario and the potential effects of power transmission centers near Ponce's coastline.

Figure 22- Sea Level Rise Scenario - Three Meters Flood – Ponce's Coastline

[75] Id.

Municipality	Total Transmission Centers or Portions of Transmission Centers (Those Crossing municipalities boundaries)	High Social Vulnerability Census Tract	LMI Block Groups	Current 100-Year Flood Zone	Advisory 100-Year Flood Zone	Advisory 500-Year Flood Zone (includes 100 Year Flood Zone)
Aguas Buenas	1					
Barceloneta	1					
Canóvanas	1					
Comerío	1					
Fajardo	1					
Guánica	1	1				
Guayama	1			1	1	1
Hatillo	1					
Humacao	2					
Isabela	1					
Juncos	1					
Maunabo	1					
Mayagüez	1					
Peñuelas	1					
Ponce	3	1		2	3	3
Río Grande	1					
San Germán	1				1	1
Santa Isabel	1					
Vega Baja	1	1		1	1	1
Yauco	1	1		1	1	1
Grand Total	**23**	**4**		**5**	**7**	**7**

Table 5 - Number of Power Transmission Centers by Risk/Vulnerability

Hurricane Impact

Damage to the Electrical System

Many assessments were conducted after the hurricanes in order to understand the immediate and long-term effects of the storms. According to one of these reports, "Hurricane María Effects on Puerto Rico Electric Power Infrastructure,"[76] one of Hurricane María's most significant impacts on Puerto Rico was the electric power outage that initially affected the entire Island and lasted more than ten (10) months before regaining service for all customers. The grid's electrical transmission and distribution components suffered worse damage than that observed during other hurricane events that affected the U.S. in the last ten (10) years.[77] Extensive damage and the Island's mountainous

[76] Kwasinski, A., Andrade, F., Castro-Sitiriche, M. J., and O'Neill-Carrillo, E. (2019). *Hurricane María Effects on Puerto Rico Electric Power Infrastructure*. IEE. https://resourcecenter.ieee-pes.org/publications/pets-j-open-access-papers/PES_TP_PETSJ-00101-2018_3-19.html.
[77] Id., p. 85.

topography were significant factors that contributed to a prolonged restoration process.[78] Figures 19 and 20 are examples of those damages.

Due to the high-intensity winds, the renewable energy generation infrastructure assets that suffered the worst damage were the Punta Lima wind farm and the Humacao photovoltaic (**PV**) plant. Another non-renewable power generation infrastructure, the Cambalache Gas Turbines, was damaged due to flooding. Almost all power transmission lines in the eastern half of the island had severe damage, and the electric distribution lines experienced unprecedented devastation.[79]

Figure 23 - Fallen wooden and concrete electric distribution pole at Puerto Rico Highway 65

[78] Id.
[79] Id., p. 87.

Figure 24 - Guaynabo, Puerto Rico – Power lines remain broken and down along roads and residential areas nearly three months after Hurricane María

Power Generation Infrastructure

Damage to the power generation facilities from Hurricanes Irma and María was minor compared to other assets; however, it was still significant.[80] Several power plants experienced flooding, such as the Cambalache Power Plant located in Arecibo. Also, various portions of the AES Power Plant coal conveyor belt showed moderate damage.

Of the two (2) wind farms in Puerto Rico, the Punta Lima wind farm had its thirteen (13) wind turbines damaged. See Figure 25. Two (2) types of damage were observed in these wind turbines, where some blades experienced delamination and others broke at their neck.[81] Punta Lima's 1.8 MW wind turbines, located in the northeastern quadrant of the hurricane path, experienced the storm's strongest winds "with maximum sustained winds of no less than 125 mph".[82] The largest of the two (2) wind farms, located in Santa Isabel and with an installed capacity of 95 MW, experienced more moderate winds than Punta Lima and was not damaged by the hurricane.[83]

[80] Kwasinski, A., Andrade, F., Castro-Sitiriche, M. J., and O'Neill-Carrillo, E., p. 90.
[81] Id., p. 87.
[82] Id.
[83] Id.

Figure 25 - Inoperable and damaged wind turbines at Punta Lima wind farm after Hurricane María in Naguabo, Puerto Rico

The five (5) utility-scale photovoltaic (PV) plants on the Island experienced different degrees of damage during the hurricane. The PV plant in Humacao suffered some of the most significant damage since it is located near the point where Hurricane María made landfall. "At that time, about a third of this PV system had been expanded to make the total plant capacity reach almost 100 MW, which would have [made] it the largest PV power generation facility in the island. However, the expanded area was almost complete[ly] destroyed by the storm. Although the other two areas (operating before María) had much less damage, about 50% of such area still suffered considerable damage. […] The failure mode in all of these PV plants was PV modules blown away by the wind."[84] The PV plants in Isabela, Salinas, and Guayama experienced light to moderate damage, while the PV plant in Loíza was practically undamaged.[85]

Electrical Transmission Infrastructure

The damage caused to transmission lines was one of the hurricane's most significant impacts on Puerto Rico's power infrastructure.[86] Many of the affected transmission lines had been installed in difficult-to-access mountainous locations with heavy vegetation, making it more challenging for repair crews to reach them.[87] "Reports indicated that

[84] A. Kwasinski, F. Andrade, M. J. Castro-Sitiriche and E. O'Neill-Carrillo, supra, p. 87.
[85] Id.
[86] See Figure 26.
[87] A. Kwasinski, F. Andrade, M. J. Castro-Sitiriche and E. O'Neill-Carrillo, supra, p. 88.

only 15% of the lines could withstand wind forces caused by a Category 4 hurricane. As a result, almost all transmission lines in the eastern half of the island experienced severe damage."[88] Many monopole structures broke due to high winds and flying debris or fallen vegetation, including wooden and concrete poles.[89] Possibly the most severe faults were those observed in 230 kV structures.[90] One of the most critical transmission areas in Puerto Rico is located in the north of the Coquí community, in the Municipality of Salinas, where the transmission lines from the Aguirre and AES power plants meet. It is in this crucial area where lines carrying the power capacity from all the main generation plants converge.[91]

Other reports stated that 74% of the nearly 350 substations incurred moderate to severe flooding and varying levels of wind damage. Damaged substation components included "capacitor banks, disconnect switches, switchgear support structures[,] and perimeter fences."[92]

Electrical Distribution Infrastructure

A damage assessment showed that at least 10% of the distribution poles in the Island were damaged. Although PREPA provides no exact figures, "this percentage is consistent with reports indicating that more than 50,000 poles needed to be replaced. This percentage is considerably higher than a typical 1 to 3 percent observed in areas affected by hurricanes in the past."[93] The same damage assessment also noted more broken poles (wooden and concrete) than fallen poles. This result may be due to Puerto Rico's dense vegetation, mountainous geography that tends to increase wind speeds by channeling wind through valleys, and the natural increase in wind speed at higher elevations.[94] "Additional contributing factors for pole failures included overloaded poles and poles installed at a time with less demanding wind speed withstanding requirements."[95]

[88] Id.
[89] Id.
[90] Id.
[91] Id., p. 88-89.
[92] Id., p. 89
[93] Id.
[94] Id., p. 89-90.
[95] Id., p. 90.

Figure 26 - Wooden electrical distribution pole damaged by Hurricane María at Trujillo Alto, Puerto Rico

Electrical System Impact on the Healthcare System

The intersection between health and energy is deep and intertwined. In Puerto Rico, this was evidenced after the passage of María. The hurricane-related failure of the entire electrical system led to a wave of adverse effects on the public health of all Island residents. Some of the most obvious effects were reflected in the absence of electrical power in hospitals and water processing plants. They were also reflected in the amount of pollutant particle emissions to the environment from the burning of fuels in communities by using emergency generators, in many cases non-stop for days at a time. Figure 27 shows the importance of the electric grid in relation to healthcare, showing where health providers are located across the Island and overlaying the transmission and distribution infrastructure. The 38 kV electric grid lines can be essential to supply power to health services providers. Even in the center of the Island, the electric system supports hospitals and centers of diagnosis and treatment that use electric power to serve the communities.

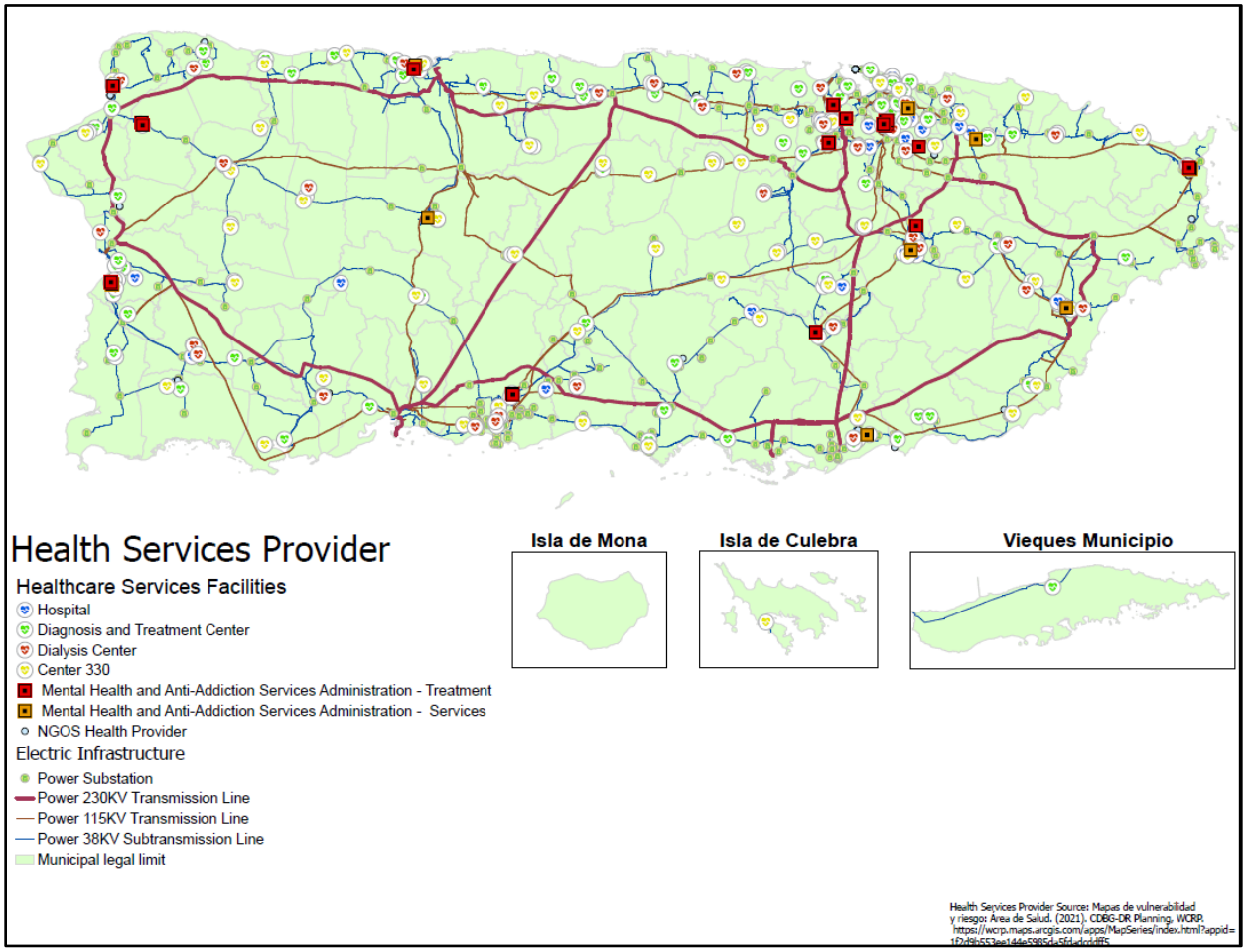


Figure 27 - Electric Infrastructure Power Distribution Lines & Health Services Providers

The lack of energy directly impacted the health of the Puerto Rican population. Beyond the impact on physical health conditions, both the passage of the hurricane and the long-term absence of energy had a profound impact on the mental health of the population.

Before the passage of Hurricanes Irma and María, Puerto Rico faced one of the worst social, economic, and fiscal crises that the Island has experienced in its history. Puerto Rico was classified as one of the poorest jurisdictions in the United States, with 43.5% of the population living under federal poverty rates. Puerto Ricans had already been faced with cuts to the working hours of public employees, increases in taxes, reduction in salaries received by young adults, a decrease in allocations for non-profit organizations, and increases in the costs of water and electricity. In fiscal terms, the Island had approximately $74 billion in public debt, which led to a cycle of underemployment, unemployment and migration, among others. This scenario complicated matters more for the population and meant that the starting point for recovery after the hurricanes was already at a disadvantage. Because of the preexisting stressors, the passage of

hurricanes Irma and María became a compounding factor faced by the population and in turn triggered the development and or deterioration of mental health concerns.[96]

Post-traumatic stress is known to be related to the intensity of exposure to the event. This applies to people's experiences during the disaster event, as well as the aftermath that follows. For example, factors such as disaster displacement, relocation, loss of property and finances have been found to represent risk factors for the development of post-traumatic stress disorder or depression. In the case of Puerto Rico, the population dealt with the effects of post-traumatic stress disorders and other factors because of the hurricanes. This has only been exacerbated in recent months due to continuous power outages and blackouts caused by an already debilitated power system.

The healthcare system is comprised of institutions that include governmental, private non-profit, and private for-profit entities.[97] After the catastrophic events of the hurricanes, every hospital and medical clinic in Puerto Rico were left without power. Several of the backup generator systems failed due to hurricane-related damage or lack of sufficient fuel to keep buildings operating and able to run life-saving equipment such as nebulizers and dialysis machines, or to keep critical medicines refrigerated.[98]

The Island-wide blackout caused a series of healthcare risks that cost the lives of many Puerto Ricans. Crucial appointments such as surgical procedures, medical evaluations, and other essential medical assessments were canceled and postponed due to the lack of working equipment and proper conditions to care for patients. Some hospitals had to close, leading to patients being relocated to other healthcare institutions or sent home without proper medical care.

During stakeholder engagement activities conducted by PRDOH for the development of the CDBG-Mitigation Action Plan (CDBG-MIT), the US Department of Health and Human Services (DHHS) confirmed that sixty-eight (68) hospitals and more than 100 health clinics experienced structural damage from the hurricanes, and many backup generators were damaged or destroyed, presenting operational challenges during the prolonged power outage.[99] **Because of the power failure and the dependence on fuel, health and medical services were placed at risk, and as a cause of this thousands of lives were lost over the course of the prolonged disaster.**

While many of Puerto Rico's hospital buildings endured Hurricane María, not all of them did. An example of this is the hospital in the municipality of Vieques which was destroyed. Additionally, Centro Médico, which is a full-service scattered campus hospital system that serves the entire Caribbean region, had to close down operating rooms and other parts of the facility due to lack of power. Other hospitals lost power, communications, water,

---

[96] Instituto Nacional de Energía y Sostenibilidad Isleña. (2018). *Estado de Situación Energética de Puerto Rico, Informe Anual 2017.* https://static1.squarespace.com/static/5b6c67d071069910870c6820/t/5cbd046be5e5f0648a778456/1555891502310/%282018%29+Oeppe%2C+Estado+de+situacio%CC%81n+energe%CC%81tica+de+Puerto+Rico+%282017%29.pdf)

[97] PRDOH CDBG-MIT Action Plan, p. 184.

[98] Id., p. 186.

[99] Id., p. 187. ("Information obtained from US Department of Health and Human Services, Health and Social Services Recovery during stakeholder meeting held June 22, 2020.")

and while the buildings stood, they were unable to function. Equipment was unusable, condensation from lack of air conditioning damaged electrical equipment, and hospital staff could not be reached and could not travel to the hospital because of infrastructure damage.

Electrical System Impact on the Educational System

The impact of hurricanes Irma and María on the electrical system also affected the educational system of Puerto Rico in many aspects. This includes social, economic, demographic, and health impacts, among others. Before the hurricanes, the educational system consisted of approximately 1,113 public elementary and secondary school campuses with 5,000 buildings and 400,000 students; 750 private elementary and secondary school campuses with 2,000 buildings and 150,000 students; community colleges and technical schools with approximately 65,000 students; and 24 universities with more than 250,000 students.[100] The system had several significant challenges: enrollment had been declining for many years, there were low rates of high school graduation, financial problems due to various factors, and a high concentration of economically disadvantaged students and students with needs for specialized services.[101]

After the hurricanes, thousands of educational facilities were severely damaged and some seventy (70) schools were permanently closed due to structural damage.[102] Consequently, thousands of students and teachers left the island looking for other options to continue their studies and employment opportunities, significantly impacting the educational system. The passage of Hurricane María aggravated existing problems and caused significant damage to the educational infrastructure. The decline in school enrollment also accelerated. Schools had extensive closings and, after reopening, had limited functionality and faced significant transportation problems.[103] In some schools, teaching was interrupted by the need to use buildings as shelters, which caused a delay in reopening, resulting in a loss of teaching time, which had a negative impact on student performance.

It was estimated that $8,413,208,822 was needed to restore the island's educational system while at the same time taking advantage of the opportunity to improve and rebuild it. For the optimization and reinvestment in the school system's infrastructure, $300,000,000 was estimated.[104] These amounts do not cover the impact on the electrical grid damages.

---

[100] Puerto Rico Energy Resiliency Working Group. (2017). *Build Back Better: Reimagining and Strengthening the Power Grid of Puerto Rico*. https://www.governor.ny.gov/sites/default/files/atoms/files/PRERWG_Report_PR_Grid_Resiliency_Report.pdf.

[101] Chistopher, N, Prado Tuma, A, Marsh, T. et al. (2020). *The Education Sector in Puerto Rico After Hurricane María: Predisaster Conditions, Hurricane Damage, and Themes for Recovery*. Homeland Security Operational Analysis Center. https://www.rand.org/pubs/research_reports/RR2858.html.

[102] Id, p. 12.

[103] Id.

[104] Puerto Rico Energy Resiliency Working Group. (2017). *Build Back Better: Reimagining and Strengthening the Power Grid of Puerto Rico*. https://www.governor.ny.gov/sites/default/files/atoms/files/PRERWG_Report_PR_Grid_Resiliency_Report.pdf.

Electrical power instability has a direct relationship to societal stress and lost school hours. In recent outages related to the rolling blackouts, parents were called to pick up their children from school because these unplanned outages left entire schools without electricity and administrators had no way of knowing when or if power would come back on during the school-day. Without the ability to plan, schools had no choice but to ask parents or the person in charge of picking up the children, to leave work and come back to an unexpected early dismissal. To pick up the children emergency evacuations had to take place, in which long lines of cars were navigating without traffic signals; parents trying to find their children; teachers trying to provide a sense of calmness and order, as kids crowded darkened hallways. Children were overheated and sweaty from being crowded indoors without air conditioning; conditions were exacerbated by the COVID-19 pandemic because children needed to maintain their masks on, in the heat and humidity. Many community members sought refuge at large commercial centers with power, because the outages were widespread.[105]

As part of strengthening the electricity system in the education sector, educational facilities are key candidates for the possible installation of distributed energy generation with the necessary electrical infrastructure, incorporating renewable resources to the extent feasible.

Demographic Profile

Demographic Profile of Impacted Area

According to the U.S. Census Bureau, in 2010, the total population of Puerto Rico was approximately 3,725,789 with a median age of 36.9 years. After the hurricanes in the year 2017, the Government estimated that Puerto Rico had a population of 3,193,694 residents with a median age of 39.4; a median age that is nearly two (2) years older than the median age in the U.S. which is 37.9. The 2019 population reduction of approximately 14.3% and the 2.5% increase in the median average age illustrate a migration trend of the Island's youngest population, mainly to the U.S., which was accelerated by the Hurricane disasters in 2017.

Puerto Rico has an average of 43.5% of people living in poverty according to the U.S. Census estimates for 2019, which is significantly higher than the U.S. average at 10.5%. Figure 28 demonstrated the population density in Puerto Rico per hex grid, based on HUD's LMI tract-level data. The population per hex grid is a method to quantify the people in a hexagonal grid. In the map in Figure 28, each hexagon represents 0.5 square miles of area and the tonality of the blue color represents the estimated population with higher concentrations being in dark blue.

About 40% of the island's population lives in the larger metropolitan area of San Juan. The rural population is located mostly in the difficult to access mountainous areas at the center of the island. Puerto Rico's population has been declining for the last ten years

[105] Coto, D. (2021, October 3). Puerto Ricans fume as outages threaten health, work, school. *ABC News*, https://abcnews.go.com/International/wireStory/puerto-ricans-fume-outages-threaten-health-work-school-80378832.

and the rate of outmigration increased after hurricane María in no small part due to the lack of electricity for months after the storm. The largest demand for electricity occurs in the metropolitan areas of the north, making the transmission lines that cross from south to north to be particularly critical.

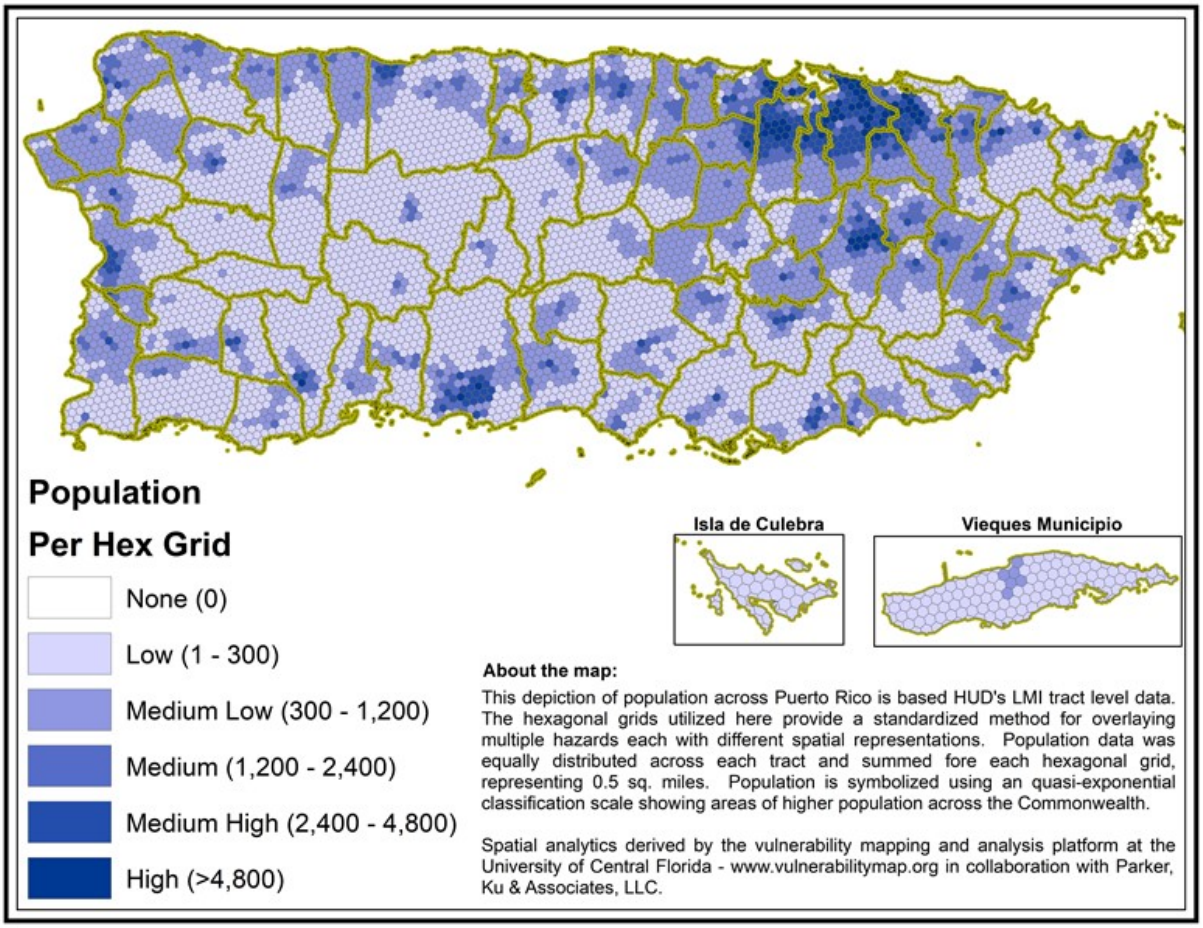


Figure 28 - Population per Hex Grid[106]

Some populations may be more vulnerable than others, due to their need for special care, susceptibility to harm, potential mobility constraints, and limited access to resources, all of which influence the ability to get out of harm's way in the event of an emergency. Puerto Rico has a 21.3% population over the age of 65, which is higher than the U.S. average of 16.5%. Puerto Rico is considered an island whose population is aging. Additionally, the total female population of Puerto Rico in the year 2010, was estimated at 1,940,618, representing 52.1% of the population of the Island. These are important indicators to determine the social vulnerability of an area. This trend in the demographics of the Island represents significant challenges to planning efforts and disaster mitigation approaches.

[106] CDBG-MIT Action Plan, p. 84.

HUD uses the "best available" data for all eligible affected areas. For Puerto Rico, all components are considered most impacted and distressed for purposes of the allocation for electrical power system enhancements and improvements under Public Law 115-123. Based on this assessment, HUD notified Puerto Rico via 86 FR 32681 that for this allocation, all areas of the Island are considered most impacted and distressed.

Figure 29 illustrates that most of the Island has more than 80% of their population classified as Low to Moderate Income (LMI). A household is considered LMI if the persons make less than 80% of the area median income as defined by HUD.[107]

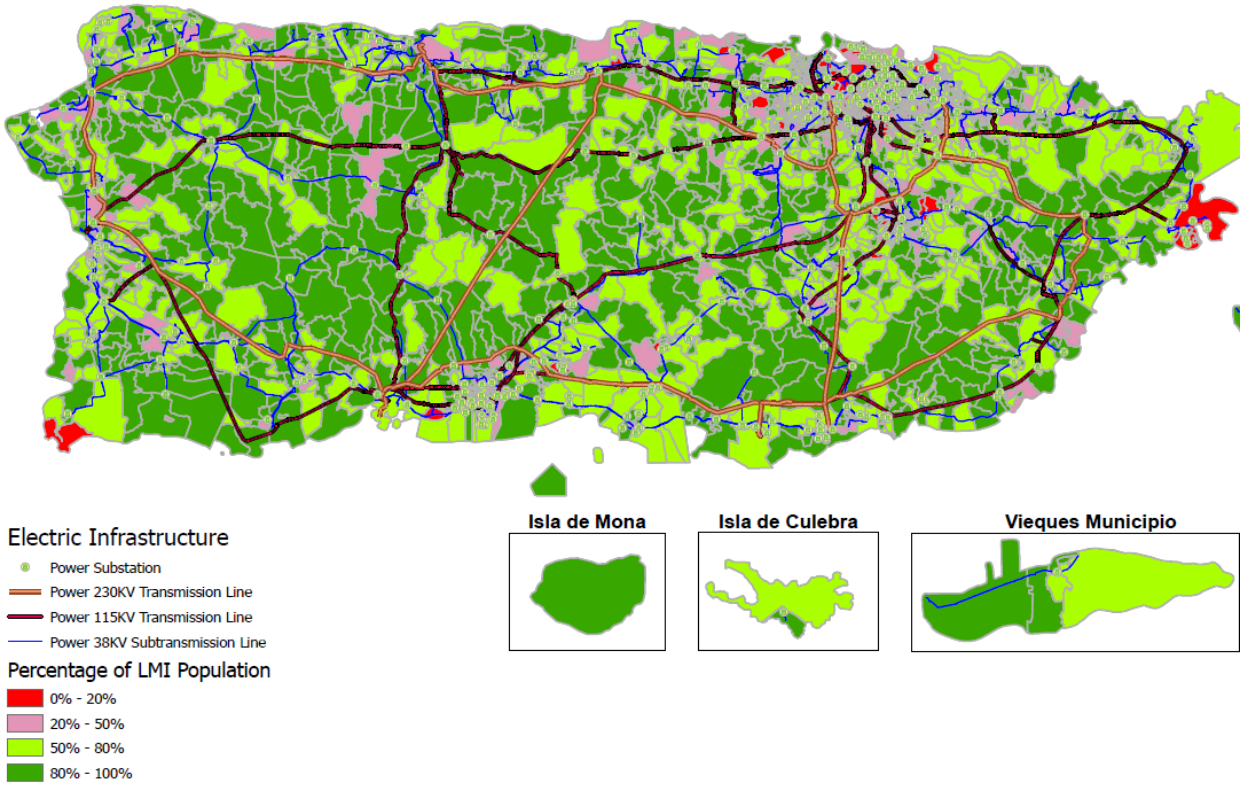


Figure 29 - Electric Infrastructure Power Distribution Lines and LMI Population

Vulnerable Populations and Protected Classes

Assessing Puerto Rico's Vulnerable Populations and Protected Classes

The Fair Housing Act (42 U.S.C. § 3601 *et seq.*) protects people from discrimination when renting or buying a home, getting a mortgage, seeking housing assistance, or engaging in other housing-related activities. Specifically, the Fair Housing Act prohibits housing discrimination based on race, color, national origin, religion, sex, familial status, or disability. Additional protections apply to federally assisted energy projects for housing, including certain CDBG-DR funded activities, including consideration of racially and ethnically concentrated areas and concentrated areas of poverty. Understanding where different racial and ethnic populations and others with pre-existing social

[107] CDBG-MIT Action Plan, p. 264

vulnerabilities reside across disaster impacted areas can be useful for emergency response, recovery, and mitigation planning and program development.

Vulnerable Populations, Underserved Communities, and Low and Moderate-Income *Persons*

Puerto Rico's socio-economic make-up, summarized in Table 6, highlights certain population differences between Puerto Rico and the U.S. as a whole. Several socio-economic characteristics are markedly different across Puerto Rico when compared to the U.S., putting residents at an immediate disadvantage in terms of their capacity to prepare for, respond to, or recover from emergency situations, such as natural disasters. This "social vulnerability" is a well-known and thoroughly documented phenomena that is explained by a specific set of socio-demographic indicators culled from disaster case study literature and combined using statistical analysis to highlight pockets of vulnerability at various geographic scales.

Fact	Puerto Rico	United States
Population estimates, July 1, 2019	3,193,694	328,239,523
Population estimates base, April 1, 2010	3,726,157	308,758,105
Population, percent change - April 1, 2010 (estimates base) to July 1, 2019	-14.30%	6.30%
Population, Census, April 1, 2010	3,725,789	308,745,538
Persons under 5 years, percent	3.70%	6.00%
Persons under 18 years, percent	17.90%	22.30%
Persons 65 years and over, percent	21.30%	16.50%
Female persons, percent	52.50%	50.80%
White alone, percent	65.90%	76.30%
Black or African American alone, percent	11.70%	13.40%
American Indian and Alaska Native alone, percent	0.20%	1.30%
Asian alone, percent	0.20%	5.90%
Native Hawaiian and Other Pacific Islander alone, percent	0.00%	0.20%
Two or More Races, percent	5.30%	2.80%
Hispanic or Latino, percent	98.70%	18.50%
White alone, not Hispanic or Latino, percent	1.00%	60.10%
Foreign born persons, percent, 2015-2019	2.70%	13.60%
Owner-occupied housing unit rate, 2015-2019	68.10%	64.00%
Median value of owner-occupied housing units, 2015-2019	$111,500	$217,500
Median selected monthly owner costs -with a mortgage, 2015-2019	$880	$1,595
Median selected monthly owner costs -without a mortgage, 2015-2019	$149	$500

Fact	Puerto Rico	United States
Median gross rent, 2015-2019	$478	$1,062
Persons per household, 2015-2019	2.75	2.62
Language other than English spoken at home, percent of persons age 5 years+, 2015-2019	94.50%	21.60%
Households with a computer, percent, 2015-2019	68.60%	90.30%
Households with a broadband Internet subscription, percent, 2015-2019	60.40%	82.70%
High school graduate or higher, percent of persons age 25 years+, 2015-2019	76.50%	88.00%
Bachelor's degree or higher, percent of persons age 25 years+, 2015-2019	25.90%	32.10%
With a disability, under age 65 years, percent, 2015-2019	14.90%	8.60%
Persons without health insurance, under age 65 years, percent	9.60%	9.50%
In civilian labor force, total, percent of population age 16 years+, 2015-2019	44.40%	63.00%
In civilian labor force, female, percent of population age 16 years+, 2015-2019	39.70%	58.30%
Mean travel time to work (minutes), workers age 16 years+, 2015-2019	29.3	26.9
Median household income (in 2019 dollars), 2015-2019	$20,539	$62,843
Per capita income in past 12 months (in 2019 dollars), 2015-2019	$12,914	$34,103
Persons in poverty, percent	43.50%	10.50%
Total employment, percent change, 2017-2018	-2.20%	1.80%
Population per square mile, 2010	1,088.20	87.4

Table 6 - Demographic Profile for Puerto Rico

Social vulnerability describes an area's capacity to prepare for, respond to, and rebound from disaster events, and has a long conceptual and theoretical history in social and disaster science fields. Socially vulnerable populations historically have had fewer resources to aid in preparation for disasters, while often bearing the brunt of disaster impacts, thus taking longer to recover from disaster events. Empirical measures of social vulnerability enable decision makers and emergency managers to understand where vulnerable populations reside and how that vulnerability manifests across a landscape. Figure 30 shows the SoVI (Social Vulnerability Index) and the Adaption and Center for Disease Control and Prevention (**CDC**) Vulnerability indices across regions of Puerto Rico. These indices categorize the northeast of Puerto Rico as a Low Vulnerability area (San

Juan regions and La Ruta Panorámica Region), while most of the eastern regions are categorized as medium and high vulnerability areas.[108]

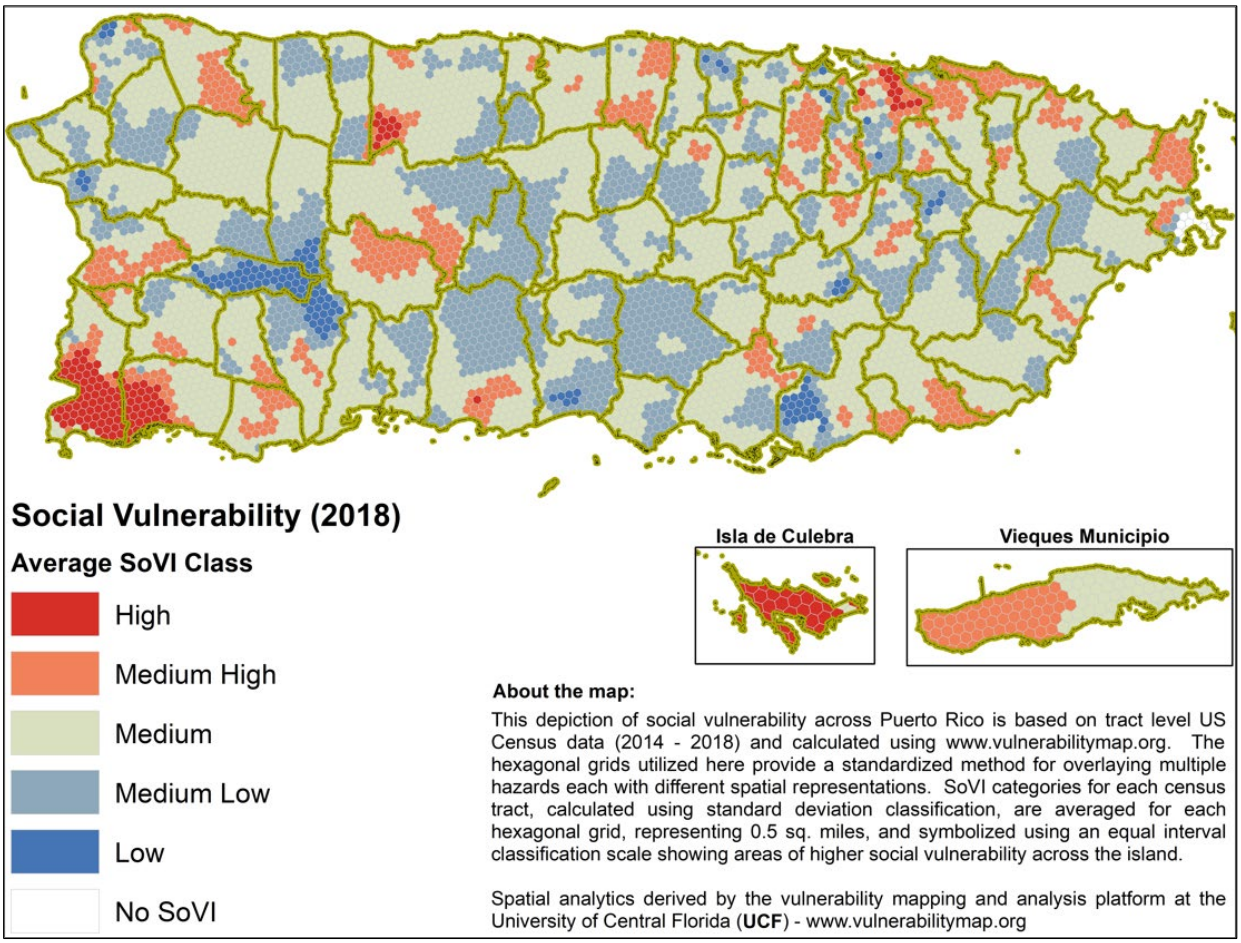


Figure 30 - Social Vulnerability (2018)

The social vulnerability index implemented in Puerto Rico's CDBG-DR risk assessment includes at least ten (10) indicators of protected classes, including: race, sex, familial status, and certain measure of disability. Indeed, each of the seven (7) "components" of Puerto Rico's 2018 social vulnerability index (Table 7) includes protected class categories, including: Component 1: Poverty and Class, which includes educational attainment and limited English Proficiency (LEP) – each of which contribute to a lack of ability to deal with the consequences of a disaster; Component 2: Renters and Access, which includes Female Headed Households; Component 3: Age (Old), which includes both children (under 18) and elderly (over 65) populations as well as social security beneficiaries who often have disabilities; Component 4: Gender and Employment, which includes the percentage of females participating in the labor force; Component 5: Lack of Insurance, Race (Black), and Service Sector Employment, which includes the percentage of Black

[108] Ipek, Pamukcu, Szczyrba and Zhang. (2020). *Analyzing and Contextualizing Social Vulnerability to Natural Disasters in Puerto Rico*. http://idl.iscram.org/files/deryaipekeroglu/2020/2238_DeryalpekEroglu_etal2020.pdf.

populations; Component 6: Ethnicity (Hispanic) and Special Needs, which includes Asian and Hispanic populations; and Component 7: Substandard Housing and Race (Native American), which includes Native American populations. **It is important to note the Social Vulnerability concentrations identified in Figure 30 measure criteria that offer a baseline view of vulnerability. Energy-related vulnerability, including the locations of communities that did not have power the longest after Hurricane María, is a separate metric that must be evaluated using additional data sets.**

Component No.	1	2	3	4	5	6	7
Description	Poverty and Class	Renters and Access	Age (Old)	Gender (Female) and Employment	Lack of Insurance, Race (Black), and Service Sector Employment	Ethnicity (Hispanic) and Special Needs	Substandard Housing and Race (Native American)
MEDAGE *(Median Age)*	-0.151	-0.261	0.852	-0.125	0.105	-0.042	0.013
QASIAN *(Percent Asian)*	-0.128	-0.020	0.041	0.022	-0.007	-0.817	-0.017
BLACK *(Percent Black)*	-0.053	0.054	-0.035	-0.042	0.561	-0.103	-0.011
QHISP *(Percent Hispanic)*	0.233	-0.064	-0.068	0.068	-0.195	0.748	-0.156
QNATAM *(Percent Native American)*	0.006	-0.018	-0.048	-0.002	-0.019	-0.046	0.412
QAGEDEP *(Percentage of Age Dependent Population under 5 and over 65 years of age)*	-0.059	0.131	0.868	0.141	-0.074	-0.027	0.023
QFAM *(Percent of Children Living in 2 parent families)*	-0.337	-0.557	0.076	-0.389	-0.033	0.112	0.040
QPUNIT *(People per Unit)*	0.326	-0.465	-0.514	-0.134	-0.317	0.132	0.087
QRENTER *(Percent Renters)*	0.093	0.843	-0.157	0.186	0.083	0.024	-0.145
QNRRES *(Nursing Home Residents per Capita)*	-0.221	0.227	0.242	-0.039	0.104	0.246	0.130
QFEMALE *(Percent Female)*	-0.071	0.177	0.019	0.727	-0.156	0.037	-0.054
QFHH *(Percent Female Headed Households)*	0.290	0.444	-0.391	0.490	-0.064	0.153	-0.137
QUNOCCHU *(Percent Unoccupied Housing Units)*	0.049	0.092	0.282	-0.181	0.156	-0.231	0.593
QCVLUN *(Percent Civilian Unemployment)*	0.612	0.382	-0.063	-0.260	-0.413	-0.004	0.106
QPOVTY *(Percent Poverty)*	0.651	0.626	-0.122	-0.156	-0.139	-0.002	0.124
QMOHO *(Percent Mobile Homes)*	0.060	-0.103	0.010	0.093	-0.050	0.135	0.780
QFEMLBR *(Percent Female Participation in Labor Force)*	-0.022	0.048	-0.032	0.737	-0.060	0.007	0.079
QSSBEN	0.393	-0.338	0.643	-0.171	-0.268	0.005	0.034

Component No.	1	2	3	4	5	6	7
Description	Poverty and Class	Renters and Access	Age (Old)	Gender (Female) and Employment	Lack of Insurance, Race (Black), and Service Sector Employment	Ethnicity (Hispanic) and Special Needs	Substandard Housing and Race (Native American)
(Percent Households Receiving Social Security Benefits)							
QRICH200K ***(Percent Households Earning over $200,000 annually)***	-0.824	0.048	0.018	-0.126	-0.117	-0.011	0.047
PERCAP ***(Per Capita Income)***	-0.925	-0.111	0.161	0.035	0.069	-0.131	-0.035
QESL ***(Percent Speaking English as a Second Language with Limited English Proficiency)***	0.816	0.111	-0.110	-0.139	-0.095	0.201	0.031
QED12LES ***(Percent with less than 12th Grade Education)***	0.663	0.298	0.122	-0.425	0.002	0.055	0.175
QEXTRCT ***(Percent Employment in Extractive Industries)***	0.150	0.027	-0.033	-0.523	-0.241	-0.015	-0.010
QSERV ***(Percent Employment in Service Industry)***	0.517	0.320	-0.042	0.024	0.404	0.046	0.000
QNOAUTO ***(Percent of Housing Units with No Car)***	0.248	0.840	0.076	0.054	0.194	-0.016	0.029
MDGRENT ***(Median Gross Rent)***	-0.617	-0.466	-0.023	0.060	0.157	-0.091	0.000
MHSEVAL ***(Median Housing Value)***	-0.877	-0.040	-0.007	0.065	0.074	-0.061	-0.005
HOUSEBURDEN ***(Percentage of population spending more than 30% of their income on housing related expenses)***	-0.264	0.101	0.019	0.380	0.331	-0.118	-0.098
UNINSURED ***(Percent of population without insurance)***	0.000	0.053	0.045	0.014	0.839	0.022	0.051

Table 7 - Rotated Component Matrix for SoVI (All Puerto Rico Census Tracts).

The highlighted cells in Table 7 indicate characteristics driving social vulnerability for Puerto Rico where red shading shows variables heavily increasing social vulnerability, green shows variable heavily increasing social vulnerability, green shows variables attenuating social vulnerability and yellow shading show variables with lower overall influence that might have more localized impact on social vulnerability.

This assessment of socially vulnerable and protected class populations aims to identify areas where these groups reside and understand where concentrations of the most marginalized populations occur across Puerto Rico. Included here are assessments of disability, sex, familial status, race, ethnicity, and national origin, with a specific focus on racially and ethnically concentrated areas of poverty.

Disabilities and Difficulties

Identifying and accounting for persons of functional diversity is an important facet of vulnerability assessment, including disaster mitigation activities. To this end, data on disability and "difficulty" from the U.S. Census was assessed for Puerto Rico in order to identify the locations in which functional diversity populations are residing. The Census has evolved its understanding (and measurement) of disabilities. Beginning in the American Community Survey (ACS) 2008, the census moved from the strict use of the term disability to a more broadly inclusive term of "difficulty". The Census defines several difficulties in the following ways.

Hearing Difficulty	"deaf or … [had] serious difficulty hearing."
Vision Difficulty	"blind or … [had] serious difficulty seeing even when wearing glasses."
Cognitive Difficulty	"serious difficulty concentrating, remembering, or making decisions."
Ambulatory Difficulty	"serious difficulty walking or climbing stairs."
Self-care Difficulty	"difficulty dressing or bathing."
Independent Living Difficulty	"doing errands alone such as visiting a doctor's office or shopping."

Figure 31 - Functional Diversity Descriptions

While persons with functional diversity reside all throughout Puerto Rico, certain municipalities have larger larger concentration of people disabilities and difficulties. In fact, nine (9) municipalities have greater than 20% of their respective populations categorized as disabled or having difficulty in at least one (1) of the six (6) categories accounted for by the U.S. Census. Those municipalities are: Bayamón, Cataño, Culebra, Guánica, Loíza, Mayagüez, Orocovis, Sabana Grande, and Yauco. The full data set may be found in the Appendix.

Low-to Moderate -Income Individuals

For purposes of the CDBG-DR program, low- to moderate-income is defined as total household income at or below 80% of Area Median Income (**AMI**) as defined by HUD. AMI is calculated yearly at the state level with each municipality and for certain metropolitan areas having defined income limits. HUD has established specialized income limits adjusted by 4-person federal poverty guidelines for Puerto Rico and applied these limits to its CDBG-DR programs at a uniform level across the Island, as adjusted by family size. For reference purposes, in 2021, the LMI threshold for a single-person household in Puerto Rico (at or below 80% AMI) is $29,700. The complete income limit

tables may be found on HUD Exchange at: https://www.hudexchange.info/resource/5334/cdbg-income-limits/.

Remote Communities

The UPR, Mayagüez Campus, conducted a study in 2018 to analyze data related to the blackout experienced after hurricane María and the implications on remote rural communities across Puerto Rico. The study is based on the total customer hours of lost electricity service (**CHoLES**), which highlights the need to provide a viable alternative for remote rural communities that usually are the last to recover access to electric power services.[109] The study showed that almost a third of the total CHoLES (900 million) was due to the last 200,000 customers that were reconnected to the grid from day 156 to day 329 after the Hurricane.[110]

Five (5) months after hurricane María, 80% or more of Puerto Rico had recovered electrical power services, except for the Caguas Region, which includes remote municipalities from the central mountain range such as Orocovis, and from the southwest coast such as Yabucoa, Humacao, and Naguabo.[111] The Caguas and Arecibo regions took more time than others to recover electrical power services. This was mostly due to the fact that these municipalities contain most of the towns in the Central Mountain Range.[112]

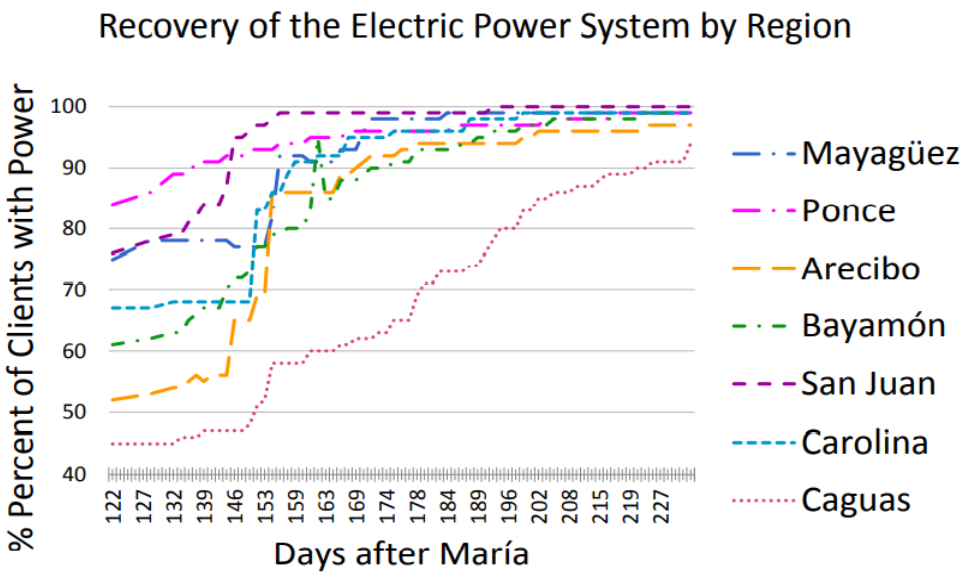


Figure 32 - Regional Power Recovery in Puerto Rico after Hurricane María (Source: Castro-Sitiriche, M., Cintrón-Sotomayor, Y., and Gómez-Torres, J. (2018). The Longest Power Blackout in History and Energy)

[109] Castro-Sitiriche, M., Cintrón-Sotomayor, Y., and Gómez-Torres, J. (2018). "The Longest Power Blackout in History and Energy Poverty", *Proc. 8th Int. Conf. Appropriate Technol.*
[110] Id., p. 4.
[111] Id., p. 5.
[112] Id., p. 6-7.

Ten months after Hurricane María, 500 households did not have power, accounting for 3.6 million CHoLES, which is the equivalent of a more than two (2) hours long blackout in Puerto Rico. Six (6) out of the nine (9) municipalities that were not 100% energized (Utuado, Jayuya, Morovis, Adjuntas, Orocovis, and Cayey) are located in the central mountain region while the other three (Naguabo, Guayama, and Guayanilla) are coastal municipalities that also have a large mountain rural area. Two municipalities were less than 99% energized (Utuado and Jayuya), both located in the most remote central mountain region of the Island.[113]

The study suggests that the status of the power recovery ten (10) months after hurricane María showed that the remote rural areas needed to be prioritized. "Considering the transition phase the electric power industry in Puerto Rico is going through, it is crucial that the interests of those last customers in remote communities are put first when considering resilient distributed power systems."[114] Additionally, it proposes that "[t]he remote context calls for decentralized power solutions, which are mainly driven by solar PV plus battery systems (PV+B) at the household level. Other technologies will also play an important role to add levels of resiliency at community level and even at municipality and regional level."[115]

Figure 33 - Municipalities in Grey had 0% Electric Power on November 20, 2017 (Source: M. Castro-Sitiriche, Y. Cintrón-Sotomayor and J. Gómez-Torres, "The Longest Blackout in History and Energy Poverty")

Regarding these remote communities and those that went the longest without power, the U.S DOE has developed a social burden metric as a manner of quantifying "how hard people have to work to get critical infrastructure needs satisfied."[116] This metric is particularly relevant for rural communities that had longer outages after hurricane María, and may continue to suffer from underreported or unreported outages due to additional complications with telecommunications services, which hinders community members' ability to report service needs.

Initial Recovery of the Puerto Rico Electric Power System

[113] Id., p. 5.
[114] Id., p. 4.
[115] Id., p. 8.
[116] DOE comment to PRDOH provided as technical feedback via email on October 4, 2021.

Based on the effects caused by hurricanes Irma and María, a damage assessment of the Puerto Rico electric power system was performed by the Puerto Rico Energy Resiliency Working Group (**Working Group**) established under the New York State's Governor's office to aid Puerto Rico in planning for the reconstruction of the electric power system.[117] The Working Group was formed by the following members: New York Power Authority (**NYPA**), PREPA, Puerto Rico Energy Commission, Consolidated Edison Company of New York, Inc. (**Con Edison**), Edison International, Electric Power Research Institute (**EPRI**), Long Island Power Authority (**LIPA**), Smart Electric Power Alliance (**SEPA**), U.S. Department of Energy (**DOE**), Brookhaven National Laboratory (**BNL**), National Renewable Energy Laboratory (**NREL**), Pacific Northwest National Laboratory (**PNNL**), Grid Modernization Lab Consortium (**GMLC**), and PSEG Long Island, an agent for and on behalf of the Long Island Lighting Company d/b/a LIPA (PSEG Long Island).[118]

The working group provided recommendations based on their "collective experience with power system recovery, rebuilding, and hardening" from hurricanes encountered on the U.S. mainland.[119] Their recommendations to rebuild summed up an estimated cost of $17.6 billion, accounting for modern technology as a resilience measure.

COR3 commissioned a report to assess the status of the overall energy grid, plan for its modernization, and estimate the costs to achieve the modernization goal. From this initiative resulted The Grid Modernization Plan, which estimates that an investment of approximately $21 billion dollars is needed to rebuild the electrical power system at least up to industry standards.[120]

Electrical System Current Situation

The electricity in Puerto Rico is supplied by the PREPA power generation plants and independent power producers that are comprised primarily of two private plants, a Natural gas Combined Cycle owned by EcoEléctrica in Peñuelas and a coal power plant belonging to AES in Guayama, and private renewable energy power producers, under power purchase and operation agreements. PREPA currently has an installed generation of 4,908 MW in conventional plants fueled by natural gas and petroleum oil distillate, located in the north, west and south of Puerto Rico.

Besides the electric power produced by PREPA, independent power producers can supply 961 MW from two conventional coal and natural gas plants also located in the south of Puerto Rico, and 254 MW supplied by different renewable energy independent power producers. When one of the PREPA power plants experiences an outage or is taken offline for maintenance, the system offsets that power shortage using units with a higher fuel cost. As explained in the 2021 Fiscal Plan for PREPA as approved by the Financial Oversight and Management Board (**FOMB**), "earthquake-related losses in

---

[117] Puerto Rico Energy Resiliency Working Group. (2017). *Build Back Better: Reimagining and Strengthening the Power Grid of Puerto Rico*. https://www.governor.ny.gov/sites/default/files/atoms/files/PRERWG_Report_PR_Grid_Resiliency_Report.pdf.
[118] Id.
[119] Id.
[120] Government of Puerto Rico. (2019). *The Grid Modernization Plan for Puerto Rico: Transforming and Upgrading the Energy Sector*. https://recovery.pr/documents/Grid%20Modernization%20for%20Puerto%20Rico-English1.pdf.

Costa Sur's natural gas generation (average fuel cost of $ 82 / MWh) were offset by increasing generation in diesel units (average fuel cost of $ 112 / MWh)."[121]

To reduce the excessive dependence on conventional petroleum-derived fuels with fluctuating prices, PREPA has made efforts by converting certain principal units to natural gas, but even so, most of the customers depend on the electric power produced by outdated oil units and an electric rate structure that depends on the unsteady oil costs. This results in historically volatile electric rates which continue to negatively affect the customers and the economy of the Island.

PREPA adjusts the electric rates according with the purchase of energy and the variations of the cost of fuel on a monthly and quarterly basis to reconcile and update costs, without changing the base rate to cover management, operation, and maintenance. As a result, those type of changes have subjected PREPA electric rates to wild fluctuation depending on the price of fuel.

According to the FOMB, PREPA's revenue collection rate has been decreasing in an inverse way as the customer rates increase due to the volatility of the global fuel market. As the 2021 Fiscal Plan explains, "[b]etween 2009 and 2014, PREPA's fuel adjustment rider increased by about 45% as the price of oil doubled from $60 to $120 per barrel."[122]

As the Fiscal Plan further explains, "the combined impact of lower sales and higher fuel prices contributed to high and volatile average customer rates, ranging from 20-30 c / kWh."[123] In fiscal year 2020, 30% from the total power supplied to the customers was produced by natural gas, 50% was produced by oil fuel, 17% by coal, and only 3% was produced from renewable energy technologies. This means that the citizens and the total economy of Puerto Rico are vulnerable and highly dependent on fluctuating fuel prices.[124]

Unmet Needs Assessment

The geographical location and topography of Puerto Rico, its islanded nature, pre-existing weaknesses, and ongoing economic challenges expose the electric grid to sustained pressures and system vulnerabilities. These continued natural and man-made threats are important elements that needs to be considered in the planning, design, and reconstruction of the electrical power system of Puerto Rico. There are so many needs, that it is challenging to quantify them all and align them with finite resources in recovery funding and human capital.

The DOE puts order to these priorities by consolidating them into four main areas:

- System reliability and resiliency

[121] PREPA. *2021 Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on May 27, 2021.* https://drive.google.com/file/d/1dXFJldZpOIsAObMZDBd7T2P3j2xMPaal/view.
[122] Id.
[123] Id.
[124] Id.

- System security and grid stability
- Energy efficiency and sustainability
- System mitigation of disaster risks[125]

The Government of Puerto Rico has made aggressive goals for renewable energy adoption, and as an island located in the warm waters of the Caribbean, is well aware of its vulnerability to the impacts of climate change. This includes heat, storms, drought, and sea-level rise. The forward-thinking legislative agenda on energy was enacted before the impact of Hurricane María, but it has established a guiding framework against which to organize the path to recovery.

PRDOH will prioritize projects to reduce the impact of climate change, such as those using renewable sources of energy. In addition, projects that improve the efficiency of electric power generation, electricity transmission, and distribution infrastructure can substantially reduce impacts to climate change. By decreasing transmission and distribution losses, these projects minimize the consumption of fossil fuels in power generation.

The listing of the resilience projects proposed by PREPA, LUMA and PRASA in this section does not guaranty them for funding at this time. Projects must first be evaluated for FEMA 406[126] Hazard Mitigation Grant Program (HMGP) and other sources and evaluated in order of priority for remaining available energy funds.

PREPA and LUMA Unmet Needs

Coordination of Electrical Power System Improvements and Planned Leverage

PREPA partnered with LUMA to issue a report that outlines a long-term plan to improve the electrical system infrastructure. The PREPA 10-Year Infrastructure Plan was issued in June 2021 and includes a funding estimate of $10.5 billion to repair and/or replace electrical systems with FEMA's Public Assistance 428 Program.[127] PREPA's vast infrastructure contains thousands of miles of transmission and distribution lines, along with electrical substations and power generation systems.

As stated in the 10-Year Plan:

> "This Plan provides an overview of PREPA's infrastructure investment strategy; the context for the selection of projects included in the plan; a prioritized list of these proposed infrastructure projects; the expected benefits, projected costs, key project milestones, and the estimated time horizon for each project; and a brief overview of PREPA's approach to manage execution of this program and the portfolio of projects described herein."
>
> "Although this plan is only required by COR3 and FEMA to address PREPA's plans for the 428 obligated funds, PREPA has taken the approach of developing a plan that includes all planned infrastructure investments regardless of funding source.

[125] U.S. Department of Energy. (2018). *Smart Grid System Report: 2018 Report to Congress*. https://www.energy.gov/sites/prod/files/2019/02/f59/Smart%20Grid%20System%20Report%20November%202018_1.pdf.
[126] Section 406 of the Stafford Act, 42 U.S.C. § 5172. 126
[127] Public Assistance Program Alternative Procedures, Section 428 of the Stafford Act 42 U.S.C. § 5189f.

> This is being done to provide a holistic view of the work to be performed on PREPA's system and a view for how the 428 funds will support PREPA's overall infrastructure investment strategy and approach."

Projects under the PREPA's 10-Year Plan included funding from FEMA 428 and 404 mitigation programs, CDBG-DR, and PREPA's Necessary Maintenance Expense (**NME**) program. PREPA and LUMA indicated that they would seek CDBG-DR for the 10% cost share allocation.

The Plan further states:

> "These foundational elements include the development of PREPA's Governing Board Vision Statement, FEMA's Damage Assessment Reports, Puerto Rico's IRP, PREPA Certified Fiscal Plan(s), Puerto Rico Energy Public Policy Act 17, Sargent & Lundy's (**S&L**) Engineering Reports including a T&D Roadmap and various Independent Engineer's Reports, as well as components of the COR3's Energy System Modernization Plan".

Asset Category	FEMA 428 ($M)	FEMA 404 ($M)	NME Funds ($M)	Estimated Total (M$)
Generation	$84	$878	$294	$1,256
Dams, Hydro and Irrigation	$862	$658	$0	$1,520
Transmission	$3,842	$0	$0	$3,842
Distribution	$4,191	$0	$0	$4,191
Substations	$774	$4	$340	$1,118
IT/Telecom	$686	$0	$92	$778
Buildings	$63	$0	$0	$63
Environmental	$15	$0	$0	$15
Total	**$10,517**	**$1,540**	**$726**	**$12,783**

Table 8 - Total Estimated Cost by Asset Category and Funding Source from PREPA 10-Year Plan

It is important to note that PREPA did not include estimates for infrastructure hardening work eligible for funding through FEMA's 406 Public Assistance Mitigation Program in its figures. FEMA's 406 Program is designed to provide funding to rebuild infrastructure above industry standards to prevent damage from future disaster events. FEMA evaluates proposed public assistance mitigation measures based on four main criteria: risk reduction, cost-effectiveness, technical feasibility, and compliance with applicable laws and regulations.[128] Because the costs of hardening the repaired assets against future risk

[128] FEMA. (2019). *Mitigate Disaster Damage with FEMA Publica Assistance*. https://www.fema.gov/sites/default/files/2020-06/fema-pa406-mitigation-brochure.pdf.

are not known, this remains an unfunded need at a potentially significant scale. Puerto Rico has learned since María, and the multiple disasters that have occurred since, including ongoing sea-level rise and coastal erosion, that repairing to existing code is not sufficient to protect communities and to protect the federal investment. If FEMA approves a significant amount in 406 projects, that will generate additional cost-share obligations for Puerto Rico that are not currently accounted for.

PREPA organized its energy system power projects as near-term (2021-2023), mid-term (2024-2027) and long-term (2028 and beyond). PRDOH will coordinate with PREPA, LUMA and the COR3 on aligning CDBG-DR cost-share based on eligibility criteria and timelines for funds expenditure.

There are PREPA resiliency needs that are not fully funded in the PREPA Island Wide FEMA Accelerated Awards Strategy (**FAASt**) project and that may be potential candidates for CDBG-DR Electrical Power System Improvements Programs. These projects include PREPA's hydroelectric power generation fleet ($303,000,000). PREPA is currently seeking approval for FEMA 404 funding but may request assistance to cover costs through CDBG-DR if such application is denied. This proposed project will retrofit the hydro turbines including controls, auxiliaries, penstocks, etc. The project will improve the efficiency and reliability of the units, also increasing the capacity factor of the units. Perform bathymetry on all generation capable reservoirs. This project will bring the necessary information to develop a project for reservoirs dredging.

The Emergency Generation - Remaining Peaking Capacity (Generation - $235,322,500) envisioned for FEMA 404[129] was denied by the Puerto Rico Energy Bureau (**PREB**) in Resolution and Order March 26, 2021. As submitted by PREPA to PRDOH, "[t]he project includes the procurement of nine (9) mobile emergency generation units – each with an output of approximately 30 MW for a total of 270 MW – to replace the existing gas turbines and potentially be deployed as necessary around the island to strategic locations where power may be needed following an emergency, such as hurricanes and earthquakes. After Hurricane María, the USACE installed mobile generation units on the island to support emergency power generation to critical facilities until repairs could be made to damaged infrastructure. These mobile generating units were critical to restoring power but cost approximately $2M per unit per month to lease and operate. As FEMA has provided funding through its 404 Hazard Mitigation program for PREPA to secure emergency generation assets, they may not cover costs to lease emergency units should they be required in the future. PREPA proposed to work with the PREB to determine the optimal locations for these mobile generating units as part of the Optimization Process. These mobile generating units will also support distributed generation alternatives, allowing them to be integrated in the new T&D grid as the system is transformed to make it more robust and resilient. This project will also include demolition of any existing gas turbine infrastructure approved for replacement with new mobile emergency generation units. In alignment with the March 26th PREB Order, PREPA will explore fulfilling this need with renewable energy resources and battery energy storage. This project is contingent

[129] Section 404 of the Stafford Act, 42 U.S.C. § 5170c

upon systems needs and PREB's review and approval. Provides hazard mitigation against natural disasters ensuring reliability and resiliency to the grid limiting load shedding. Furthermore, implementation provides support to Minigrids across the Island."[130]

LUMA

As an operator of PREPA assets, significant portions of the hurricane damage are documented in the PREPA Island Wide FAASt project award, subaward number 6099 for approximately $10.5 billion, or otherwise identified in the 10-year plan. Those projects will be considered for cost-share under the CDBG-DR Energy allocation.

Remaining unmet need associated with electrical system resilience proposed by LUMA to PRDOH include:

I. Advanced Metering Infrastructure - $569,400,000

   a. Install Advanced Metering Infrastructure (AMI) throughout Puerto Rico, with the purpose of improving reliability and resilience, as well as customer experience. LUMA recognizes that customers of low and medium income (LI and MI) levels need to have a "no surprise" electric bill. An AMI system will provide the information needed for customers to control their usage and consequently their electric bill. It will also provide flexible bill due dates to accommodate LI and MI pay days. Another important benefit from an AMI system is the detailed energy usage that can be used to apply for energy efficiency programs.

II. Vieques and Culebra Microgrid - $48,000,000

   a. This project proposes to develop microgrids on Vieques and Culebra in a phased approach, focused initially on developing robust diesel-based microgrids to deliver quick resilience gains. Years 2 and 3 will involve integration of renewables and energy storage to reduce the diesel footprint and enhance resilience through a layered microgrid concept that enables islanding of multiple electrical islands according to the state of the system following a major event. The two islands represent excellent candidates for developing practical, sustainable microgrids, due to their potential to serve as a non-wires alternative (NWA) to reduce historic diesel consumption. This is especially important in the face of climate change, as a microgrid powered by renewable resources addresses both climate change mitigation through decarbonization, and adaptation through providing sustained power during emergencies.

III. Vieques and Culebra Submarine Cable - $208,870,000

   a. Reliable and resilient connection to the main island's grid is crucial to achieve resilience in Vieques and Culebra. This project proposes to replace

[130] PREPA. (2021). *PREPA 10-Year Infrastructure Plan*. https://aeepr.com/es-pr/Documents/20201207_PREPA%2010-Year%20Infrastructure%20Plan_vF.pdf

and reroute existing submarine cables that connect Vieques and Culebra to the main island, as well as new transition stations. PREPA has proposed Playa Los Machos to replace the Punta Lima Station. The new infrastructure will enhance reliability and resilience of power delivered to Vieques and Culebra through the submarine cables. New infrastructure and rerouting will address the issues previously listed with the current location of the transition station in Punta Lima. As such, the new station structures will be located outside the Special Flood Hazard Area, reducing the risk of damages from future hurricanes and severe storms.

IV. Energy Control Center Replacement - $84,000,000

a. Project proposes to operate the grid through the updated Energy Management System (EMS) from one Primary Control Center and one Secondary Control Center with the goal of improved management, oversight, and functionality of the electric power grid. The new centers will be built to Mission Critical industry standards and codes, hence allowing to operate the grid in a safe, reliable, resilient, and economic manner. Consolidating hence centralizing six (6) centers into two (2) will bring benefits of economies of scale, elimination of duplication service such as staffing and maintenance.

As discussed previously, consideration of these projects will require close coordination between PRDOH, COR3, FEMA, PREPA and LUMA to ensure projects are directed to the funding stream that best suits its purpose and that funds are not duplicative in nature. **FEMA 406 HMGP and other funds remain potential funding sources for preliminary consideration of the LUMA unmet need projects.**

Puerto Rico Aqueduct and Sewer Authority (PRASA) Unmet Needs

PRASA energy needs projects can be categorized in two (2) main areas:

- Raw Water Filtration Plants and Pumping Stations.
- Wastewater Treatment Plants and discharge outfalls.

PRASA presented unmet energy needs related to fourteen (14) projects for Waste-Water Treatment Plants (**WWTP**), one Raw Water Pumping Station (**RWPS**), and one chemical laboratory operation, totalizing 25,600 kW of energy demand. These projects will operate with solar photovoltaic (**PV**) energy, as the primary source. Table 9 shows the energy consumption, the solar photovoltaic estimated size, and the probable cost estimate for each project.

Facility	Energy consumption (kWh/year)	kVA Max	Solar PV - Estimated Size (kW AC)	Probable Cost Estimate ($)
Barceloneta WWTP	8,000,000	1,500	1,000	$2,352,000.00
Bayamon WWTP	5,000,000	1,900	3,000	$7,344,000.00
Mayaguez WWTP	6,500,000	1,200	3,000	$7,344,000.00
Super Aqueduct RWPS	55,000,000	9,000	5,000	$12,240,000.00
Guayama WWTP	2,000,000	600	1,500	$3,672,000.00
Fajardo WWTP	3,500,000	800	2,500	$6,120,000.00
Fajardo WTP & RWPS	3,000,000	650	2,000	$4,896,000.00
Ponce WWTP	3,000,000	1,100	700	$1,646,400.00
Utuado WWTP	900,000	450	700	$1,646,400.00
Hatillo Camuy WWTP	800,000	325	600	$1,411,200.00
Arecibo Islote WWTP	1,100,000	350	700	$1,646,400.00
Caguas WWTP	6,500,000	1,500	700	$1,646,400.00
Carolina WWTP & Torrecillas WWPS	3,500,000	1,800	2,000	$6,051,000.00
Santa Isabel WWTP	2,600,000	700	700	$1,646,400.00
Caguas Laboratory	3,800,000	820	1,500	$3,672,000.00
Total	**105,200,000**	**22,695**	**25,600**	**$63,334,200.00**

Table 9 - Photovoltaic projects proposed by PRASA

Another important component of PRASA infrastructure are the pump stations of the potable water storage tanks for the water treatment plants and the booster pump stations for the wastewater treatment plants. These lift stations make possible that every citizen can obtain the potable water at their houses and the sewer system can operate in normal conditions avoiding environmental harm resulting from an overflow of wastewater.

The use of solar energy reduces the carbon footprint considerably in comparison to the use of fossil fuel usage, as well as providing a significant reduction in the operation and maintenance cost to PRASA. Notwithstanding these advantages, these projects need redundancy to provide an alternative source of energy for catastrophic events. For these PV projects an alternative source of energy consists of coupling solar installations with backup generators to ensure provision of water in emergency situations. Loss of power

means that pumping stations are unable to function, leaving entire neighborhoods and communities without clean water. Each power interruption causes increased workload and takes time to bring the system back online, further stressing the system. PRASA, as a resiliency measure, seeks to acquire generators for raw pump stations, potable water storage tanks pumps stations and wastewater treatment plant booster pumps stations to operate during outages.

To be more resilient and prepared for any power outage, PRASA has identified key and critical facilities that need a secondary source of power. These needs include:

(1) Purchase and installation of 539 standby generators for critical facilities that either do not have a generator or the generator is not in operation.

(2) Purchase 50 trailer mounted generators (10 per region) of 500 kW or less to use them when and where the need arises especially in small pump stations.

PRASA estimates the cost of providing backup generation to key water facilities across the island at **$93,222,778**. A hybrid alternative that includes renewable energy source integration with generators provides both a carbon footprint reduction and resiliency.

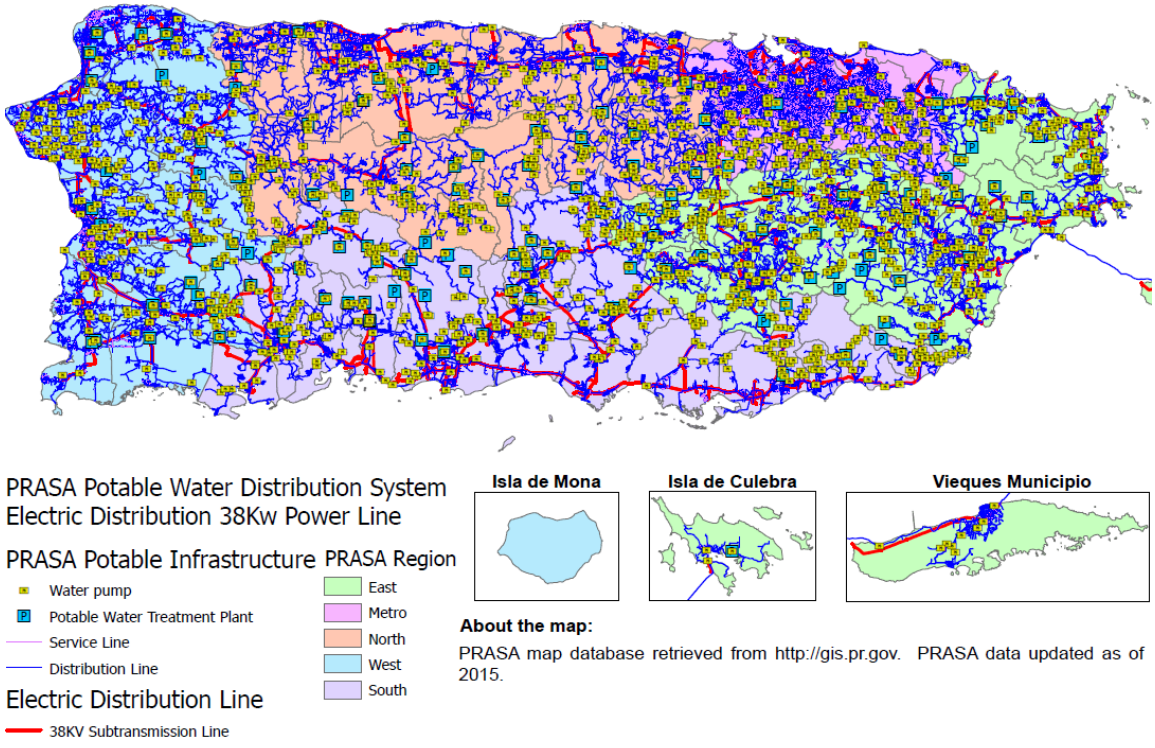


Figure 34 - PRASA Potable Water Distribution System & Electric Distribution 38KV Power Line

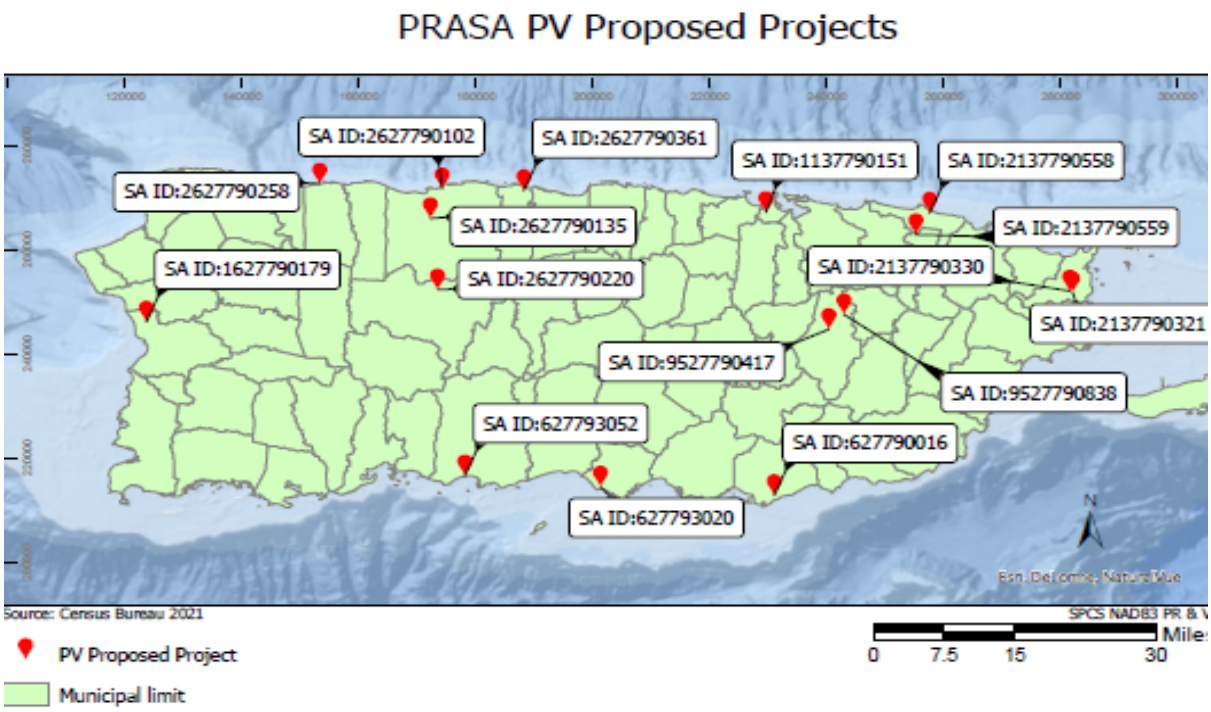
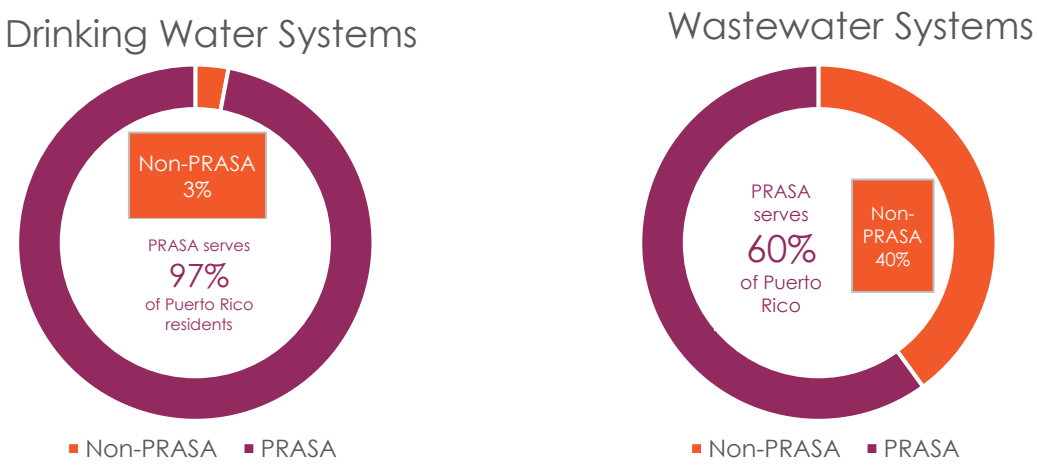


Figure 35 - PRASA PV Proposed Projects Locations

Non-PRASA Unmet Needs

Non–PRASA unmet energy needs covers potable water systems administrated by communities, where PRASA did not provide the potable water service. These Non-PRASA systems needs a Puerto Rico Department of Heath permit according with the Safe Drinking Water Act (**SDWA**) provisions.



Source: OIG analysis based on a 2018 EPA Caribbean Environmental Protection Division presentation. (EPA OIG image)

Figure 36 - Drinking Water and Wastewater systems serviced by PRASA.[38]

Non-PRASA potable water systems are required to comply with water monitoring and analyses to demonstrate compliance with all primary and secondary maximum contaminant level thresholds, stipulated in the SDWA. The potabilization process and the water monitoring and analyses are the responsibility of the permit holder. The Non-PRASA drinking water systems energy needs can be address by renewable sources, such as the renewable energy projects financed by non-governmental organizations in partnership with EPA. More than 20 of the 240 non-PRASA systems in Puerto Rico have achieved energy independence over the past year, according with the EPA. [131]

Currently 206 from 240 of Non-PRASA systems still needs alternative energy systems of an inventory provided and dated January 20, 2021. These unmet energy needs could be satisfied with renewable energy projects to reduce the carbon footprint and serve low to moderate income communities.

A cost estimate for the 240 Non-PRASA projects is included in the following table:

Municipality	Population to be served	Total of PWSID Systems	PV Panels Capacity (kw)	Probable Cost PV (A)	Probable Cost Storage (B)	Probable Total Cost (A+B)
Adjuntas	3,629	13	287.16	$574,320	$488,172	$1,062,492
Aguada	3,880	7	319	$638,000	$542,300	$1,180,300
Aguadilla	1,285	2	128	$256,000	$217,600	$473,600
Aguas Buenas	5,430	9	649	$1,298,000	$1,103,300	$2,401,300

[131] U.S. Environmental Protection Agency. (2018). *EPA Announces Agreement with Community and Non-Profit Organizations Will Help Transform Communities in Puerto Rico*. https://archive.epa.gov/epa/newsreleases/epa-announces-agreement-community-and-non-profit-organizations-will-help-transform-0.html.

Municipality	Population to be served	Total of PWSID Systems	PV Panels Capacity (kw)	Probable Cost PV (A)	Probable Cost Storage (B)	Probable Total Cost (A+B)
Aibonito	920	2	87	$174,000	$147,900	$321,900
Añasco	1,480	4	145	$290,000	$246,500	$536,500
Arecibo	1,140	2	77	$154,000	$130,900	$284,900
Barranquitas	5,679	10	418.92	$837,840	$712,164	$1,550,004
Caguas	10,754	19	270.92	$541,840	$460,564	$1,002,404
Ciales	540	2	55	$110,000	$93,500	$203,500
Canóvanas	380	2	38	$76,000	$64,600	$140,600
Cayey	761	4	77	$154,000	$130,900	$284,900
Cidra	1,700	3	163	$326,000	$277,100	$603,100
Coamo	1,070	5	113	$226,000	$192,100	$418,100
Comerío	1,883	5	173	$346,000	$294,100	$640,100
Corozal	4,039	10	402	$804,000	$683,400	$1,487,400
Fajardo	80	1	8	$16,000	$13,600	$29,600
Guayama	200	1	22	$44,000	$37,400	$81,400
Guayanilla	360	2	35	$70,000	$59,500	$129,500
Gurabo	80	1	8	$16,000	$13,600	$29,600
Jayuya	3,380	7	340	$680,000	$578,000	$1,258,000
Juana Díaz	1,420	3	159	$318,000	$270,300	$588,300
Lares	628	5	77	$154,000	$130,900	$284,900
Las Piedras	2,710	4	185	$370,000	$314,500	$684,500
Manatí	32	1	8	$16,000	$13,600	$29,600
Maricao	400	1	38	$76,000	$64,600	$140,600
Las Marías	80	1	10	$20,000	$17,000	$37,000
Maunabo	480	3	48	$96,000	$81,600	$177,600
Naguabo	680	3	41	$82,000	$69,700	$151,700
Naranjito	5,760	6	560	$1,120,000	$952,000	$2,072,000
Orocovis	6,012	14	282	$564,000	$479,400	$1,043,400
Patillas	3,401	11	315	$630,000	$535,500	$1,165,500
Yabucoa	2,400	1	275	$550,000	$467,500	$1,017,500
Peñuelas	2,368	7	374	$748,000	$635,800	$1,383,800
Ponce	3,707	12	326	$652,000	$554,200	$1,206,200
Río Grande	260	1	24	$48,000	$40,800	$88,800
San Germán	1,150	3	110	$220,000	$187,000	$407,000
San Lorenzo	3,131	14	236	$472,000	$401,200	$873,200
San Sebastián	1,141	3	86	$172,000	$146,200	$318,200
Utuado	2,796	12	295	$590,000	$501,500	$1,091,500
Villalba	4,304	10	433	$866,000	$736,100	$1,602,100
Yabucoa	7,712	8	555	$1,110,000	$943,500	$2,053,500
Yauco	1,416	6	117	$234,000	$198,900	$432,900
Total	**100,658**	**240**	**8,370**	**$16,740,000**	**$14,229,000**	**$30,969,000**

Table 10 - Non-PRASA Photovoltaic Projects

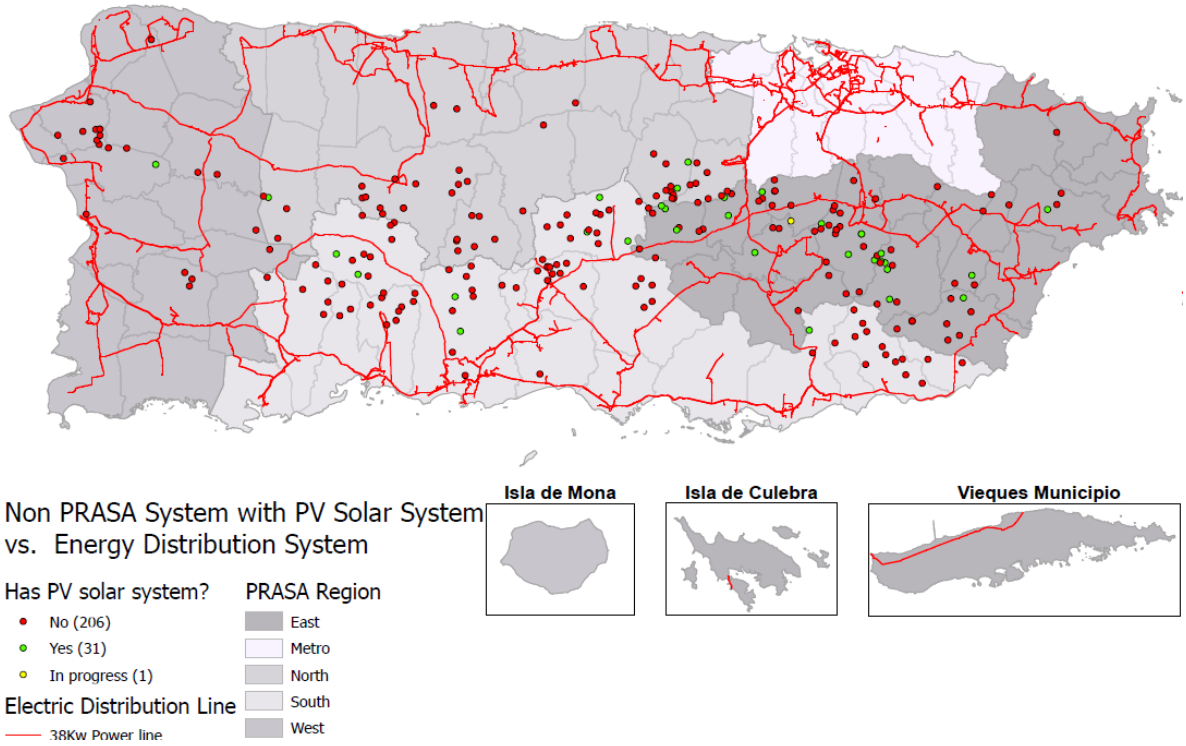


Figure 37 - Non-PRASA System with PV Solar System

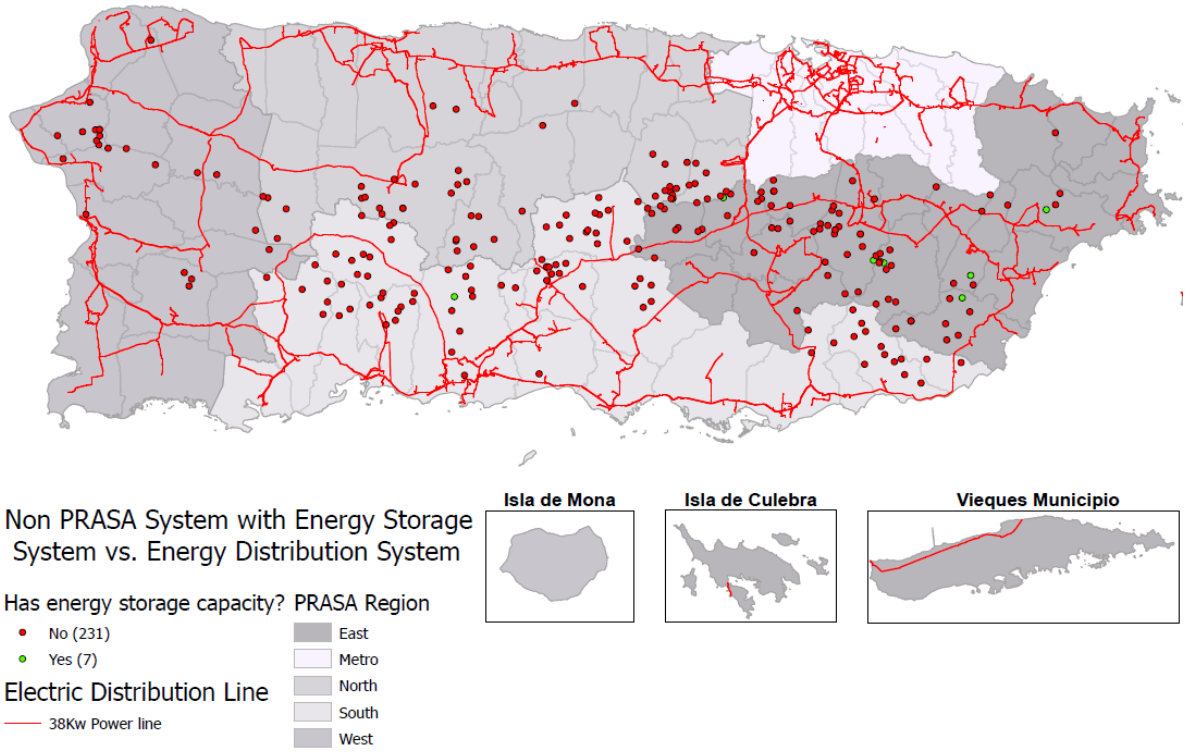


Figure 38 – Non-PRASA System with Energy Storage

Focus on Renewable Energy

Sandia National Laboratories conducted a comprehensive "Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico."[132] The report identified clusters of critical infrastructures to inform 159 microgrid options across the Island, and how those microgrids could impact critical service provision during a power outage, therefore providing much-needed resilience for targeted communities. The report outlines the Lab's use of a social burden metric to "gain quantitative insight into how grid improvements impact the community, especially those in the population that have fewer means to acquire services even on a blue-sky day."[133] The report looks at the percent of families below poverty line, burden to acquire infrastructure services, critical infrastructure overlaid to FEMA flood plains, and several other factors.

According to the analysis, "[a] microgrid essentially works as an integrated energy system consisting of loads and distributed energy resources (DERs) operating as a coherent unit, either in parallel with or islanded from the power grid, and either utilizing elements from the existing grid (power lines, transformers, switches, etc.,) or operating as a separate unit which can tie to or be isolated from the power grid. A microgrid should have capabilities designed to make the microgrid operate with flexibility and efficiency…Microgrids are designed to distribute existing and new generation resources among critical buildings to meet critical energy needs."

While PREPA begins to integrate renewable energy at scale as part of the Integrated Resource Plan (**IRP**), the analysis points out that, "[m]icrogrids are recommended as one of the suites of grid modernization solutions of interest for PREPA and the Commonwealth of Puerto Rico. Over small areas, for example 50 square miles, microgrids are highly effective at providing resilient infrastructure services to a population."[134]

The defined boundaries of a microgrid, their scalability, and their potential alignment and prioritization to critical facilities and the most vulnerable communities make them excellent candidates for electrical system improvements under the CDBG-DR approach.

Opportunities also exist to place solar installations on land that would otherwise have limited use, therefore fulfilling dual purposes. According to the National Renewable Energy Laboratory (NREL), "Puerto Rico is particularly well suited for solar PV installation because of the solar resource availability. Due to suspected or known contaminants, landfills have limited redevelopment potential, and solar PV installations are viable for reuse."[135] Approximately 140 underused sites consist of landfills, Superfund, Corrective Action, and Brownfield project sites with high potential for possible solar PV installation that are technically and economically viable.

---

[132] Jeffers, R.F. *et al.* (2018). *Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico*. United States. https://doi.org/10.2172/1481633.
[133] Id., p 15.
[134] Id., p. 52.
[135] National Renewable Energy Laboratory. (2011). *Feasibility Study of Solar Photovoltaics on Landfills in Puerto Rico*. https://www.nrel.gov/docs/fy11osti/52181.pdf).

As per the NREL, "[u]sing available and accessible land unavailable for other purposes allows for the reuse of land that would not otherwise contribute to productivity for Puerto Rico. Installing a solar generation plant and the associated facilities on landfills and abandoned or underused sites relieves "greenfield" of land-use impacts. Developing solar facilities in landfills and abandoned or underused areas can provide an economically viable reuse option for these sites in Puerto Rico." [136]

Also, in terms of job creation, "[t]he implementation of this [kind of] project could represent a large amount of money entering the clean energy industry of Puerto Rico."[137] In 2011, "[t]he Council of Economic Advisors (CEA) calculated the number of jobs (direct, indirect, and induced) created due to federal spending using economic models developed with real-world data. CEA found that $92,000 in federal spending is equivalent to one job-year. This means that for every $92,000 of federal money that is spent, there is one job created that can be sustained for one year. This project represents a large amount of money that would create a significant number of jobs."[138] The projects could generate installation and maintenance jobs within every community where the systems are located.

The island of Puerto Rico has an electric grid that covers almost the whole Island. All the towns and neighborhoods have distribution infrastructure to supply the electric power for households and other facilities. The hard-to-reach communities of Puerto Rico that are distributed along rural communities and clusters that belong to the towns in the center of the island are served by distribution feeders of different voltages. This infrastructure was designed to serve as many homes, commerce, and industry as possible from across the Island with electric service to carry out their operations.

According to the 2020 Fiscal Plan for the Puerto Rico Electric Power Authority, "PREPA faces notable geographic challenges given that its primary load center is located in the north (San Juan Metro Area and Humacao Industrial District, approximately 70% of total load) while the majority of the most economic and efficient generation resources are in the south (approximately 70% of online generation capacity)."[139]

The electric distribution infrastructure dispersed throughout the island supports the medical centers, schools, and other private and nonprivate facilities spread in the rural zones of Puerto Rico. Figure 39 shows the distribution of those feeders on the Island, at the same time demonstrating that the Island is entirely populated even in the more remote areas. The electric feeders support a whole network of interdependencies that are the driving force for socio-economic activities and opportunities for economic development in all corners of Puerto Rico. It ensures the employment of the LMI population to maintain the economic activities in the difficult-to-reach and remote communities.

---

[136] Id., p. 62.
[137] Id., p. 55.
[138] Id.
[139] PREPA. *2020 Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on June 29, 2020.* https://drive.google.com/file/d/1a-AZ_JhQ5e6eQQlxy1Uwl4eovaQ4QoRR/view.

Most LMI people who live in the remote rural areas of Puerto Rico do not have the financial resources to buy a reliable electrical backup system for their homes. They depend on the electric grid to have electricity in their houses and have an average quality of life. During the aftermath of the hurricane, those who were able to purchase an electric generator spent considerable resources trying to find fuel to run them for at least a few hours a day.

Vieques and Culebra are no exception. Transportation difficulties, among other factors, greatly affected system repairs and the efforts to develop logistics to maintain reliable service. The local electricity production systems are not resilient, so these populations are maintained with an unstable electrical service that is susceptible to natural events. Both municipalities contain distressed communities that have suffered greatly due to natural emergencies that have occurred.

As distributed generation is proposed, including residential and community-based solar solutions, it will be critical to consider the hosting capacity of the current transmission and distribution system and to make the upgrades necessary to support additional power integration. An online hosting capacity portal has been published by LUMA Energy and is available for public use. According to the portal user guide, "[t]he interconnection capacity map provides guidance to developers and customers to understand the impacts of connecting distributed generation to the system." Interested individuals are encouraged to explore the mapping tool at: https://experience.arcgis.com/experience/99811dd66276465bb687a7fc8cc8cbe0/.

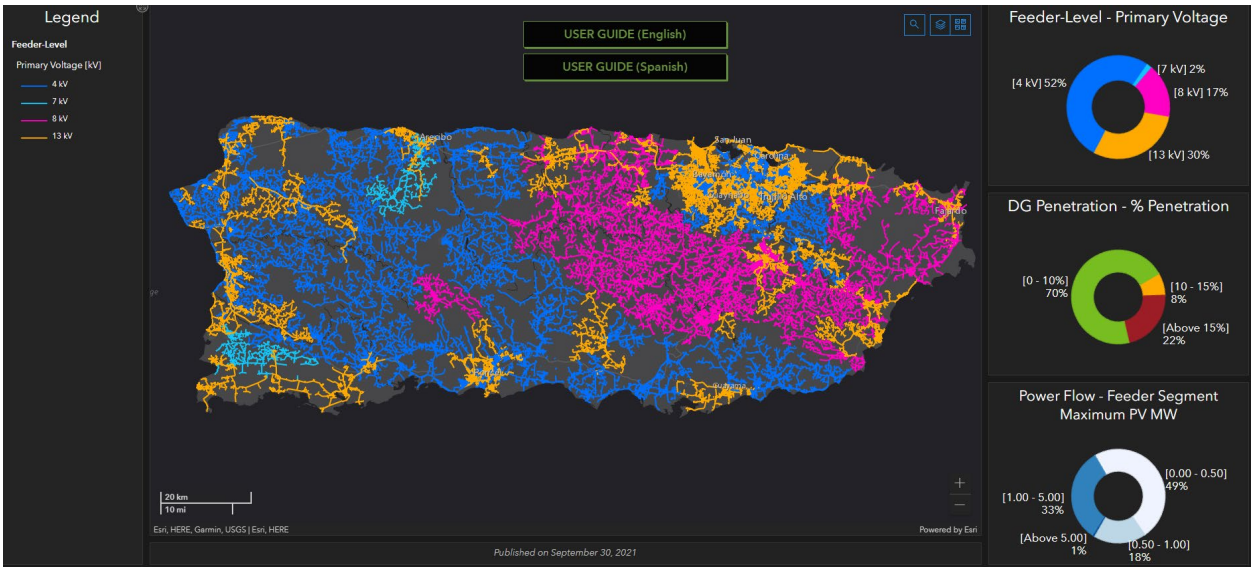


Figure 39 - LUMA Hosting Capacity Dashboard

According to EPA, "there has been an increase in communities organizing around energy especially following Hurricane María in 2017. Several community solar-based energy projects have come to fruition, all offering slightly different approaches and models for community solar in Puerto Rico."[140] Community solar systems offer key benefits such as resiliency, community empowerment and equitable access.

Electric Vehicle Provision

The Public Energy Policy Program of the Department of Economic Development and Commerce (DEDC) is in charge of developing and promulgating the public energy policy of the Government of Puerto Rico, by virtue of Act No. 141 of July 11, 2018. The Public Energy Policy Program Is in charge of administering and operating different federal programs, among them, the Home Weatherization Program (WAP), the State Energy Program (SEP) and the State Program of the Green Energy Fund.[141] With their role in promoting energy efficiency and introducing renewable energy to the Puerto Rico electricity grid, DEDC would lead the necessary studies to integrate electric vehicle provisions through research and strategic planning, infrastructure deployment, and program education and community engagement.

The integration of the Electric Vehicles (**EVs**) in the Puerto Rican society is a near-term reality and is one of the biggest steps to reduce the carbon footprint. The National Renewable Energy Laboratory (**NREL**) is conducting an evaluation of the improvements necessary for the integration of the EVs to the different electric grids of the nation.[142]

Currently Puerto Rico lacks the required infrastructure for the integration of the EVs. Most car manufacturers already announced specific goals to stop the production of fuel powered vehicles and shifting to electric vehicles between 2030 and 2035. Puerto Rico Act No. 33 of May 22, 2019 mandates the replacement of government vehicles to electric or hybrid vehicles by 2028. With the integration of electric vehicles Puerto Rico will decrease the import of fuel, which currently exceeds $1.5B annually. In combination with the electric system transformation, the integration of EVs will improve Puerto Rico's self-sufficiency.

Puerto Rico has initiated efforts to reduce the carbon footprint produced by vehicles. As a recipient of funds from the Diesel Emission Reduction Act (**DERA**) of 2010 (P.L. 111-364), the Puerto Rico Department of Natural and Environmental Resources has implemented activities to install "diesel emissions reduction retrofit devices and low rolling resistance tires for selected private and public entities to reduce diesel emissions in the metropolitan area."[143] PRDOH will monitor the availability of these and other funds to incorporate them into the portfolio.

---

[140] EPA comment to PRDOH provided as technical feedback via email on September 24, 2021.
[141] Department of Economic Development and Commerce. (n.d.). *Public Energy Policy Program*. https://www.ddec.pr.gov/en/public-energy-policy-program/.
[142] National Renewable Energy Laboratory. (n.d.). *Transportation & Mobiility Research* https://www.nrel.gov/transportation/project-ev-grid-integration.html.
[143] Environmental Quality Board. (2018). *Application And Workplan Amendment To Fiscal Year 2017 Fiscal Year 2018 State Clean Diesel Grant Program*. https://www.drna.pr.gov/wp-content/uploads/2019/07/DERA-FY17-18-Work-Plan.pdf

The improvements to the Puerto Rico electric power system should take into consideration the guidelines developed by the DOE and NREL. This will provide the appropriate standard for the design and construction of the transmission and distribution power lines ensuring the proper integration and allowing the LMI communities to benefit from the electric vehicle technology.

Summary of Unmet Need

As per HUD requirements detailed in the Federal Register, 86 FR 32681, PRDOH has assessed the unmet needs for the enhancement of the Puerto Rico Electrical Power Systems. This analysis of unmet needs is based on the best available data from FEMA, the Build Back Better report, PREPA 10-Year Infrastructure Plan, among other sources. The analysis outlined here relies on the assessed damage from these reports, the available insurance funding as per FEMA estimates, and the Federal disaster recovery funds available for the improvement of the Electrical Power Systems.

As described in this Action Plan, the Puerto Rico electric grid interweaves with PRASA potable water systems. The high dependency the water systems have on the main electric grid makes it imperative to seek resilient energy sources that will continue providing electric power during outage events. PRASA is a primary user of PREPA-generated electricity and therefore a critical stakeholder. In consideration of the importance of potable water system for the public health, estimates for Non-PRASA projects have also been included as a resiliency measure for these potable water systems that mainly serve vulnerable communities.

PRDOH calculated known impact and applied resiliency estimates (for hardening). Then, PRDOH compiled energy resilience projects submitted by key stakeholders and/or identified in existing reports to calculate need. After this, available funds were accounted for and were subtracted from the need to determine the estimated Unmet Need. The CDBG-DR Electrical Grid funds ($1.9 billion) were not listed as available funds as they are not yet available, and their use has not yet been determined. However, the $1.9 billion will be used to address Unmet Need assessed in this Action Plan. It is important to note that Unmet Needs are based on best available data and the assessment is expected to change as new information becomes available over time.

Impact Estimates

The PREPA/LUMA costs used for the calculation are based on FEMA Accelerated Award Strategy (**FAASt**) Project. The FAASt includes a damage assessment from PREPA's assets that goes from generation and telecommunications to transmission and distribution.

Description	PREPA/LUMA (Rebuild)*	PREPA/LUMA (Resilience Factor = 0.42)**	PRASA***	Total
Island Wide Transmission Line System	$2,642,131,654	$1,109,695,295		$3,751,826,949
Island Wide Substations	$781,890,094	$328,393,839		$1,110,283,933
Island Wide Telecommunication System	$685,928,721	$288,090,063		$974,018,784
Island Wide Generation Plants	$108,927,715	$45,749,640		$154,677,355
Island Wide Buildings	$125,088,363	$52,537,112		$177,625,475
Island Wide Distribution Lines System	$5,499,837,405	$2,309,931,710		$7,809,769,115
Island Wide Dams and Hydroelectric Power Plants	$860,926,276	$361,589,036		$1,222,515,312
Total Impact Estimate	$10,704,730,227.54	$4,495,986,696	$0	$15,200,716,923

Rebuild cost based on Puerto Rico Electrical Power Authority Island Wide FAASt Project as of 8/11/20.
****Since the resilience cost to existing assets is unknown, a resilience factor was applied, based on the Rebuild and Hardening Cost Consideration from "Build Back Better - November 2017"***
*****PRASA impact not accounted for here because the damages are covered by a separate FEMA FAASt project.***

Table 11 - Impact Estimates

The generation cost estimate for PREPA/LUMA is based on a list of generation projects provided by PREPA for the purpose of this action plan.

PRDOH learned through the Action Plan development that the damage assessment of the PREPA/ LUMA assets was performed in part using a sampling method, due to the scale of the damage and the enormity of the electrical power system. It is also presumed that there were many rural communities in hard-to-reach mountainous areas that were difficult or impossible to access after the hurricane. Because of this, and since the resilience cost to existing assets is unknown, a resilience factor was applied to the damage estimate using a calculation employed in the Rebuild and Hardening Cost Consideration from "Build Back Better - November 2017."

Resilience Projects

Energy resilience projects are designed to enhance an entity's ability to make available a reliable, regular supply of energy and to support contingency measures in the event of a power failure, or to mitigate against continued power insecurity. Causes of energy insecurity include unstable power supply (power surges or loss of generation), natural

disasters, accidents, equipment failure, operational and administrative challenges and affordability issues. Some of the projects outlined below may be potential candidates for FEMA 404 or FEMA 428 funding.

Project	PREPA	LUMA*	Non-PRASA	PRASA**	OTHER***	TOTAL
Solar for Key Pumps			$30,969,000	$63,334,200		$94,303,200
Generators				$93,222,779		$93,222,779
Metering Project		$569,400,000				$569,400,000
Vieques and Culebra Submarine Cable		$208,870,000				$208,870,000
Vieques and Culebra Microgrids		$48,000,000				$48,000,000
Minigrids to serve specific areas in PR					$1,933,000,000	$1,933,000,000
Generation (Hydro electric)	$303,000,000					$303,000,000
Energy Control Centers Buildings w/ new Energy Management System		$84,000,000				$84,000,000
Sandia Labs Microgrids Estimate					$1,165,000,000	$1,165,000,000
Resiliency Cost	$303,000,000	$910,270,000	$30,969,000	$156,556,979	$3,098,000,000	**$4,498,795,979**

Estimates provided by LUMA to PRDOH on 9/21/21.

****These photovoltaic projects would operate interconnected with the PREPA grid, producing clean energy and generating savings in energy expenditure for the AAA, using the net metering mechanism (without batteries). To size these projects, it was considered that the CDBG-DR funds will be a 100% grant, which allows maximizing the amount of renewable energy produced and makes it feasible to generate an excess of renewable kWh. The probable cost estimates DO NOT contemplate eventual improvements to the substations or AAA electrical infrastructure that the PV projects may require (only the Loíza project includes an estimate for a 4.16 kV feeder from the PRASA). Information provided by PRASA to PRDOH on 9/10/21.***

*****These amounts include: To be built in two critical zones of Puerto Rico. The cost is approximately $966 million per minigrid. Calculated of ($7,735,000,000)/8=$966 million (IRP Approved by PREB Resolution; 159 microgrids, from the Report Analysis of Microgrids Location Benefitting Community Resilience for Puerto Rico (Sandia Report SAND 2018-11145)***

Table 12 - Resilience Projects

PREPA's list of projects for generation includes resiliency measures, and costs for generation, dams, irrigation, hydro repairs, and dredging. Of these projects, the proposed hydroelectric power generation fleet improvements were related to power system improvements and therefore listed as a resiliency project. For its part, LUMA provided for this Action Plan a report titled *LUMA Energy's Unfunded Needs* which includes estimated costs for a metering project, Vieques and Culebra submarine cable, Vieques and Culebra microgrids, and Energy Control Centers Buildings with new Emergency Management System. These projects have been included in this assessment as resiliency projects.

Non-PRASA solar for key pumps stations projects costs were based on the information provided by EPA for 240 Department of Health licensed systems across the island that are administered by communities.[144] The PRASA solar projects needs costs were based on fourteen (14) projects presented by PRASA.[145]

Available Funds

Available funds for energy system improvements are accounted for to be able to subtract them from the identified need and determine the estimated Unmet Need. Also, available funds must be accounted for to properly sequence funding streams and avoid duplication of benefit. The CDBG-DR Electrical Grid funds ($1.9 billion) were not listed as available funds as they are not yet available, and their use has not yet been determined. However, the $1.9 billion will be used to address Unmet Need assessed in this Plan. The U.S. Department of Agriculture (**USDA**) and the U.S. Economic Development Agency (**EDA**) available funds were based on EDA grants tables supporting opportunity zones as of February 22, 2021; and USDA Rural Development Grants Awards tables for FY 2019, 2020 and 2021. For the USDA granted amounts the total amount granted for FY19, FY20 and FY21 were divided by three (3) to obtain an average amount.

Program	PREPA/LUMA	PRASA	OTHER	Total Available
FEMA 428 Federal Share	$9,459,885,412			$9,459,885,412
Insurance	$193,746,436			$193,746,436
FEMA 404 HMGP	$1,540,000,000			$1,540,000,000
USDA*	$543,830	$863,934		$1,407,764
EDA	$5,160,000	$9,717,697		$14,877,697
FEMA 406 -Unknown				$0
	$11,199,335,678	$10,581,631	$0	**$11,209,917,309**

Renewable Energy System Grants: $2,500 minimum and $500,000 maximum; Energy Efficiency Grants: $1,500 minimum and $250,000 maximum.

Table 13 - Available Funds

Unmet Needs Conclusion

After accounting for hurricane impact, resilience needs, and available funds, not including the $1.9 billion in CDBG-DR for this allocation, PRDOH estimates a remaining unmet need of over $8.4 billion, not including potential costs for new generation. This assessment also does not include resilience needs at the household level, which would be in the billions of dollars if they were to be quantified. Unmet Needs are based on best available data and the assessment is expected to change as new information becomes available over time.

[144] Fericelli, Paul; U.S. Environmental Protection Agency. On the Road to Recovery Puerto Rico Community Water Systems Lessons Learned and Success Stories.
[145] Information provided by PRASA to PRDOH via email on September 10, 2021.

Unmet Needs Assessment						
Estimate $ / Funds	**LUMA***	**PREPA**	**Non-PRASA**	**PRASA**	**OTHER**	**Total**
Impact Estimate		$10,704,730,228				$10,704,730,228
Hardening		$4,495,986,696				$4,495,986,696
Resilience Projects Estimate	$910,270,000	$303,000,000	$30,969,000	$156,556,979	$3,098,000,000	$4,498,795,979
Available Funds		$11,199,335,678		$10,581,631		$11,209,917,309
Unmet Need Estimate	$910,270,000	$4,304,381,245	$30,969,000	$145,975,348	$3,098,000,000	**$8,489,595,592**

For purposes of the Impact Estimate, damages for transmission and distribution (LUMA) are accounted for under PREPA.

Table 14 - Unmet Needs Assessment

Program Requirements

REGULATORY FRAMEWORK

Applicable Puerto Rico Law

The Puerto Rico Legislature has developed laws and mechanisms to improve the Puerto Rico energy system. Through various bills, the Legislature has dictated a clear message to reduce energy costs and diversify the energy portfolio through greater reliance on renewable energy and decentralized energy options, such as microgrids. The Puerto Rico Energy Bureau (**PREB**) is aware of the legislative mandate to carry out these policies as it reviews PREPA's proposed plans and budget expenditures. The following acts address issues relevant to Puerto Rico energy policy:

LAW	NAME
Act 416-2004	Environmental Public Policy Act
Act 82-2010	Public Policy on Energy Diversification by Means of Sustainable and Alternative Renewable Energy in Puerto Rico Act
Act 83-2010	Green Energy Incentives Act of Puerto Rico
Act 57-2014	Puerto Rico Energy Transformation and RELIEF Act
Act 120-2018	Puerto Rico Electric Power System Transformation Act
Act 17-2019	Puerto Rico Energy Public Policy Act
Act 33-2019	Climate Change Mitigation, Adaptation, and Resilience Act

Table 15 - Summary of Applicable Puerto Rico Legislation

Act 416-2004, known as the Environmental Public Policy Act, 12 L.P.R.A. § 8001 et seq.

Article 4 B (3) of Act 416-2004, as amended, known as the *Environmental Public Policy Act* (**Act 416**), states that any private or public action needs to comply with all recommendations or reports related to the potential environmental impacts of a proposed action. Additionally, before taking any government action or promulgating any government decision which significantly affects environmental quality, the entity must issue a written and detailed statement on:

- The environmental impact of the proposed legislation, the action to be taken, or the decision to be promulgated;
- Any adverse effects on the environment that cannot be prevented if such proposed action is approved and applied,
- Alternatives for such proposed legislation, government action or government decision;
- The relation between the short-term local uses of the environment and the long-term conservation and improvement of productivity; and
- Any irrevocable or irreparable compromise of the natural resources that would be involved in the legislation proposed.

Act 82-2010, known as the Public Policy on Energy Diversification by Means of Sustainable and Alternative Renewable Energy in Puerto Rico Act, 12 L.P.R.A. §§ 8121-8136

Act 82-2010, as amended, known as the *Public Policy on Energy Diversification by Means of Sustainable and Alternative Renewable Energy in Puerto Rico Act* (**Act 82**), established the first Renewable Portfolio Standard in Puerto Rico and required that any retail energy provider procure 12% of its power needs through renewable energy by 2015, 15% by 2020, and 20% by 2035.[146] Act 82 was amended by Act 17-2019, known as the *Puerto Rico Energy Public Policy Act* (**Act 17**), to establish new milestones for renewable energy goals: 20% by 2022, 40% by 2025, 60% by 2040, and 100% by 2050.[147] It also created Renewable Energy Certificates (**RECs**)[148], which encompassed all the environmental and social attributes of one megawatt-hour (**MWh**) of electricity and could be traded beyond the borders of Puerto.[149]

Act 83-2010, known as the Green Energy Incentives Act of Puerto Rico, 13 L.P.R.A. § 10421 et seq.

Act 83-2010, as amended, known as the *Puerto Rico Green Energy Incentives Act* (**Act 83**), was established to, among other things: achieve the diversification of energy sources, reduce the dependency on energy sources derived from fossil fuels, reduce and stabilize energy costs, reduce the exportation of capital caused by the import of fossil fuels, and preserve and improve the environment.[150] Act 83 also created a special fund known as the "Green Energy Fund of Puerto Rico" to finance the development of sustainable renewable energy systems that further energy use savings and efficiency.[151] The legislation also incorporated Green Energy Initiatives and tax benefits to encourage consumers and businesses to use renewable energy.[152]

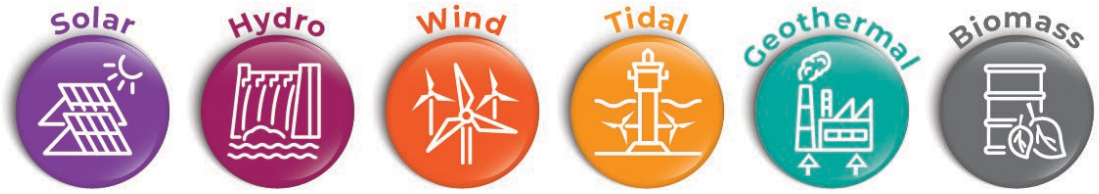


Figure 40 – Types of Renewable Energy Sources

[146] See Act 82, Statement of Motives.
[147] See Act 17, Statement of Motives.
[148] "Renewable Energy Certificate or REC means a personal property that constitutes a tradeable and negotiable asset or commodity that may be purchased, sold, assigned, and transferred between persons for any lawful purpose, which is integrally and inseparably equal to one (1) megawatt-hour (mwh) of electricity generated from a sustainable renewable energy source or alternative renewable energy source in Puerto Rico (issued and registered pursuant to Act No. 17-2019) and, in turn, represents all environmental and social attributes." Act 17-2019, Chapter IV. Amendments to Act No. 82-2010 and Act No. 83-2010.
[149] See Act 82, Statement of Motives.
[150] See Act 83, Section 1.2, Statement of Public Policy.
[151] See Act 83, Section 1.2, Statement of Public Policy.
[152] Id.

Act 57-2014, known as the Puerto Rico Energy Transformation and RELIEF Act, 22 L.P.R.A § 1051 et seq.

Act 57-2014, as amended, known as the *Puerto Rico Energy Transformation and RELIEF Act* (**Act 57**), was enacted to provide oversight of PREPA through the creation of an independent regulatory body and establish strategic planning and information requirements to promote transparency and active citizen participation. In Act 57's Statement of Motives, the Legislature stated the following:

> "There is a broad consensus on the need to evolve from our dependence on fossil fuels and use to the maximum extent possible the Island's energy resources such as the sun and the wind, conservation, and efficiency.
>
> The high cost of energy limits our ability to stimulate the economy, strengthen small- and medium-sized businesses; attract private investors from abroad, develop commercial, industrial, and manufacturing activities, and improve the quality of life of all Puerto Ricans. This prevents our Island from becoming a competitive and attractive place in all aspects. We have been held hostages by a poorly efficient energy system that excessively depends on oil as fuel and does not provide the tools to promote our Island as a place of opportunities in the global market. The current cost per kilowatt-hour (**kW**) of approximately twenty-seven cents ($0.27) is extremely high when compared to other jurisdictions that compete with Puerto Rico to attract investors and severely affects the pockets of local consumers".[153]

Act 120-2018, known as the Puerto Rico Electric Power System Transformation Act, 22 L.P.R.A. §1111 et seq.

Act 120-2018, as amended, known as the Puerto Rico Electric Power System Transformation Act (**Act 120**), created the legal framework required for the sale, disposition, and/or transfer of PREPA's assets, operations, functions, and services.[154] The Legislature approved Act 120 in response to the many deficits in the PREPA-operated energy system, including, among other things, "[…] the high cost of fuel in a very volatile and speculative market; an old and deteriorated electric power infrastructure dependent on the costliest, less efficient, and most polluting fuels […]."[155] In doing so, it delineated the issues with the power system that require correction by noting:

> "Although the Electric Power Authority operates as a Government monopoly, it lacks the conditions to offer an efficient service at a reasonable cost for residential, commercial, and industrial customers. Given the budgetary and financial uncertainties that have accumulated over the last decade, neither PREPA nor the Government have the necessary financial resources to carry out its operational restructuring,

[153] Not an official translation. See Act 57, Statement of Motives.
[154] See Act 120, Statement of Motives.
[155] Id.

achieve financial recovery, and make the substantial infrastructure changes it requires".

Act 17-2019, known as the Puerto Rico Energy Public Policy Act, 22 L.P.R.A. § 1141a et seq.

Act 17-2019, known as the *Puerto Rico Energy Public Policy Act* (**Act 17**), was enacted for integrated resource planning in Act 57 and the focus on accelerated renewable energy provision, energy conservation and efficiency, demand response (**DR**), and distributed generation (**DG**).[156]

Act 17 increased the renewable portfolio to a minimum of 20% by 2022, 40% by 2025, 60% by 2040, and 100% by 2050.[157] It also created an energy efficiency target of 30% by 2040.[158] Act 17 emphasizes the role of "prosumer"[159] generation and envisions an enhanced role for microgrids.[160] Additionally, Act 17 reinforces PREB's authority to conduct Integrated Resource Plan (**IRP**) proceedings and states that the IRP will be prepared by the electric power company responsible for the operations of the electrical system and shall be approved by PREB prior to its implementation.[161]. A key point in the legislation is that actions taken regarding generation and related matters must conform to the approved IRP, thereby highlighting the importance of the IRP as a central planning tool. PREB shall approve any changes or amendments to the IRP.[162]

Act 33-2019, known as the Puerto Rico Climate Change Mitigation, Adaptation, and Resilience Act, 12 L.P.R.A. § 8012 et seq.

Act 33-2019, known as the *Puerto Rico Climate Change Mitigation, Adaptation, and Resilience Act* (**Act 33**), details the roadmap to eliminate fossil fuels dependency, achieve 100% clean energy by 2050 (in accordance to Act 17), improve energy efficiency, reduce greenhouse gas emissions, promote electric car use, and conduct reforestation and ecosystem service restoration. It also establishes an advisory committee, responsible for the development of a Mitigation, Adaptation, and Resilience Plan.

Act 33 set forth the public policy of the Government of Puerto Rico on climate change and on the mitigation, adaptation, and resilience processes per sector; established a greenhouse gas emission inventory; directed the approval of a Climate Change Mitigation, Adaptation, and Resilience Plan per sector; set specific initial reduction targets; and created the Expert Advisory Committee on Climate Change and the Joint

[156] "Distributed Generation" means the electric power delivered to the distribution grid that is generated from an energy source in a facility near where it will be used. Act 17, Section 1.2 (g).
[157] Act 17, Section 1.6 (7).
[158] Id., Section 1.6 (11).
[159] "Prosumer" means any users or customers of the Electrical System who have the capacity to generate electric power for self-consumption that, in turn, have the capacity to supply any energy surplus through the electric power grid. Act No. 17-2019, Section 1.2 (r).
[160] "Microgrid" means a group of interconnected loads and distributed energy resources within electrical boundaries clearly defined by the Bureau that acts as a single controllable entity with respect to the transmission and distribution system of the electric power grid. Act No. 82-2010, Section 1.4 (21).
[161] Act 17, Section 1.9 (1).
[162] Id., Section 1.9 (2).

Committee on Climate Change Mitigation, Adaptation, and Resilience of the Legislative Assembly.

Among other things, Act 33 established the functions and duties of the Expert Advisory Committee aimed at instituting and promoting the development of a public policy, with quantifiable metrics, and establishing the coordination and integration of different sectors in the development of a strategy against the effects of climate change. Additionally, Act 33 amended Section 1-A of Act 30-1997 to provide that, starting on Fiscal Year 2018-2019, governmental entities that need to acquire or replace vehicles shall comply with the established public policy that said vehicles be hybrid in nature or whose operation is with alternative methods to fossil fuels. By FY2027-2028, all vehicles purchased must comply with those conditions. As seen in Figure 41, from the total of U.S. Greenhouse emissions, the transportation sector contribution is 29%.

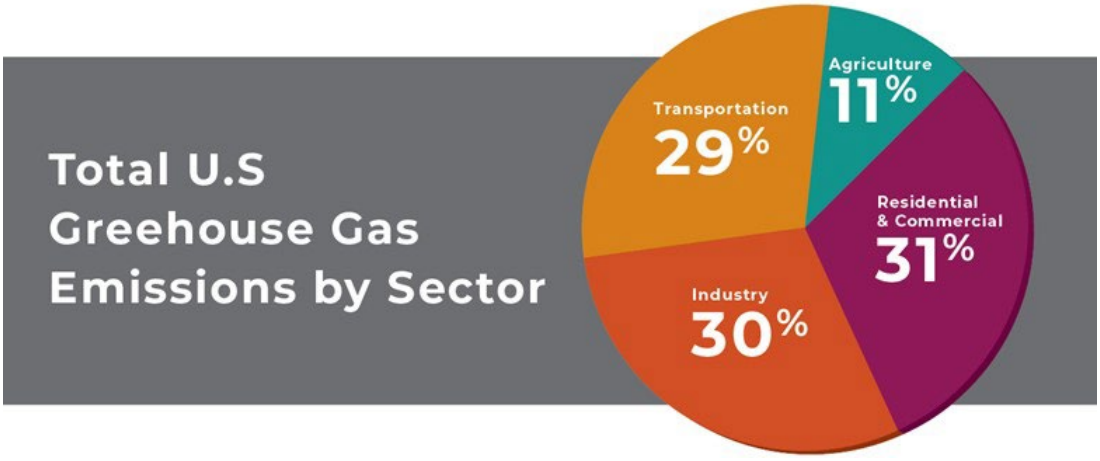


Figure 41 - Total U.S. Greenhouse Emissions by Sector. Percentages may not add up to 100% due to independent rounding. [163]

Applicable Federal Law

The United States enacted laws to improve the Puerto Rico energy system. Through two (2) main acts Pub. L. 115-123 (Bipartisan Budget Act of 2018) and Pub. L. 115-254 (Disaster Recovery Act of 2018 (**DRRA**)), Congress has provided economic assistance to restore and mitigate the electric power system. These laws emphasize the resilience aspect of the electric power system enhancements. Table 16 below summarizes the federal legislation that applies to Puerto Rico's electric power system enhancements and improvements.

At the beginning of 2021, President Joe Biden signed Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad", which takes a comprehensive government

[163] U.S. Environmental Protection Agency. (2021). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019*. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2019 and https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

approach to the climate crisis.[164] This Executive Order integrates a plan to achieve or facilitate a carbon pollution-free electricity sector no later than 2035 and clean and zero-emission vehicles for all the federal fleet. Also, the Executive Order establishes procurements standards for the renewable energy industry and the increment of renewable energy on public lands and in offshore waters. The Executive Order is a guiding principle to be followed in energy transformation across the nation.

LAW	NAME
Pub. L. 115-123	Bipartisan Budget Act of 2018
Pub. L. 115-254	Disaster Recovery Reform Act of 2018 (**DRRA**)
Pub. L. 91-190	National Environmental Policy Act of 1969 (**NEPA**)
Pub. L. 71-798	Davis Bacon Act of 1931

Table 16 - Applicable Federal Legislation

Pub. L. 115-123, Bipartisan Budget Act of 2018

The Bipartisan Budget Act of 2018 provides, under the Department of Energy Programs, for an additional amount of $13,000,000 for ''Electricity Delivery and Energy Reliability'' to remain available until expended. This is for the necessary expenses related to the consequences of Hurricanes Harvey, Irma, and María, including technical assistance related to electric grids. The provision of such amount was designated by the Congress as being for an emergency requirement pursuant to Section 251(b)(2)(A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985.

Disaster Recovery Reform Act of 2018 (DRRA)

The Disaster Recovery Reform Act of 2018 (DRRA), Division D of Pub. L. 115-254, was enacted on October 5, 2018 and, among other things, amended various sections of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, 42 U.S.C. § 5121 et seq.).

A few of the key provisions of the DRRA, as identified by the Congressional Research Service include:

- Increasing support for mitigation efforts;
- "Amending FEMA's Public Assistance (PA) program, including with regard to the PA Alternative Procedures program and by allowing FEMA to provide PA to repair, reconstruct, or replace eligible facilities in accordance with 'the latest published editions of relevant consensus-based codes, specifications, and standards that incorporate the latest hazard-resistant designs'"; and
- "Requiring FEMA to issue rules, including to define the term 'resilience'".[165]

[164] Executive Order 14008. (2021). "Tackling the Climate Crisis at Home and Abroad". https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.
[165] Congressional Research Service. (2021). *The Disaster Recovery Reform Act of 2018 (DRRA): Implementation Updates for Select Provisions*. https://crsreports.congress.gov/product/pdf/R/R46776/3.

These revisions were of major significance to Puerto Rico because they allowed for a more streamlined approach to incorporating resilience measures into the project process and by encouraging a forward-thinking approach to recovery. The application of these provisions will have a positive impact on the recovery of the electrical grid.

National Environmental Policy Act of 1969 (NEPA)

The U.S. Congress promulgated the National Environmental Policy Act (NEPA) in 1969. Its purpose was to address the public concern regarding the environmental impacts of major projects, and to ensure safe, healthy, productive, and environmentally pleasing surroundings.

The Puerto Rico environmental review process mirrors the NEPA process in terms of identifying the proposed action and the identification of environmental impacts of major projects. However, the NEPA environmental review process requires written consultation with other federal agencies regarding potential effects on the Clean Water Act, 33 U.S.C. §1251 *et seq.*, Endangered Species Act Section 7, 16 U.S.C.A. § 1536, and National Historic Preservation Act, 54 U.S.C.A. § 300101 et seq., among others.

As the Congressional Research Service stated, "[b]efore the Department of Housing and Urban Development (HUD) can grant an applicant request for Community Development Block Grant (CDBG) funds, that applicant must complete an environmental review of the proposed project. A required element of that review is the applicant's certification that compliance with any applicable requirements related to historic preservation, floodplain management, endangered species, air quality, and farmland protection have been considered. This review is required to meet NEPA obligations and ensure that the project being funded does not violate other applicable laws."[166]

Davis Bacon Act of 1931

The Davis-Bacon Act provides for the determination of prevailing wage rates and fringe benefits to corresponding PRDOH CDBG-DR programs, projects, and activities. The Act requires the payment of prevailing wage rates to all laborers and mechanics on Federal government construction contracts in excess of $2,000. Section 110 of the Housing and Community Development Act of 1974 (HCDA), 42 U.S.C. § 5301 *et seq*., determines the applicability of the Davis Bacon Act to CDBG-DR.

PRDOH will apply Occupational Safety and Health Administration (OSHA) regulations during the construction and operation activities of the electrical power system improvements projects. Federal Energy Regulatory Commission (FERC) regulations may be applicable if a fuel supply line construction is included in an electrical power system improvements project.

[166] Congressional Research Service. (2017). *Implementing the National Environmental Policy Act (NEPA) for Disaster Response, Recovery, and Mitigation Projects*. https://crsreports.congress.gov/product/pdf/RL/RL34650.

Electrical Power System Industry Standards

The CDBG-DR Program established specific requirements for the construction of electric power system enhancements and improvements. The construction and subsequent operation activities must comply with resiliency, quality, durability, efficiency, and sustainability standards. The relevant electric power system industry standards to be applied are the ones adopted and established by federal agencies and include, among others, the following:

- The **USDA Utilities Services** is the engineering standards branch for USDA electric programs and maintains a list of accepted materials for electric construction projects. Also, this USDA branch developed engineering practices, policies, standards, and guidelines related to electric power systems construction, in addition to criteria, procedures, and analyses for improvement of the operating performance for the forecasting of potential subrecipients' power requirements.
- The **National Institute of Standards and Technology (NIST)** is a nonregulatory federal agency under the Department of Commerce. One of their main objectives is to promote industry standards to enhance productivity through the NIST laboratories, which perform research to advance the U.S. technological infrastructure. The CDBG-DR requirement for efficiency, resiliency, and sustainability of electric power system improvements must meet the NIST standards application for all their components.
- The **North America Electrical Reliability Corporation (NERC)** defines the reliability requirements for planning and operating the North American power system using a results-based approach that emphasizes performance, risk management, and entity capabilities. The NERC reliability standards are developed using an industry-driven, American National Standards Institute (**ANSI**) accredited process that ensures the process is open to all persons who are directly affected by the reliability of the North American power system. The CDBG-DR requirement for the reliability of electric power system improvements will adopt the NERC standard.
- The **American Society for Testing and Materials (ASTM)** is an international standards organization that develops technical standards for materials, products, systems, and services. The CDBG-DR requirement for the quality of electric power system improvements will adopt the ASTM standard to ensure that only quality raw materials are used to produce the components.
- The **National Association of Regulatory Utility Commissioners (NARUC)** represents the state public service commissioners that regulate essential utility services like energy. In general, PREPA adopted the NARUC standards to design and regulate its tariffs. Now PREB regulates the LUMA tariffs. The CDBG-DR requirement for the reasonable cost of electric power system improvements uses the PREB's regulation to assure reliable utility service at fair, just, and affordable rates. PREB adopted

NARUC guidelines for the evaluation of the electricity rates. At the present, PREB is an active member of NARUC.[167]

Oversight Structure

PRDOH is one party in a complex funding and oversight system. In Figure 42 below, PRDOH adapted a chart concept from the Government Accountability Office (**GAO**) included in a 2019 report, and modified it to add PRDOH, the Department of Economic Development and Commerce's (**DDEC,** for its Spanish acronym) Public Energy Policy Program (**PEPP**), Puerto Rico Public Partnership Authority (**P3A**), and LUMA, and to put order to the different agency roles, visions, and funding streams. PRDOH is the administrative entity responsible for administering CDBG-DR, CDBG-MIT and CDBG-DR Energy funds as allocated by HUD.

Among its many tasks, COR3 works with FEMA "to fund repair and reconstruction activities in the energy sector and to initiate FEMA program funding support activities."[168]

[167] Walton, R. (2020, February 27). NARUC Offers Puerto Rico guidance on FEMA funding use, public-private approach to grid operations. *Utility Dive*. https://www.utilitydive.com/news/naruc-offers-puerto-rico-guidance-on-fema-funding-use-public-private-appro/573060/.
[168] Government of Puerto Rico. (2019). *The Grid Modernization Plan for Puerto Rico: Transforming and Upgrading the Energy Sector*. https://recovery.pr/documents/Grid%20Modernization%20for%20Puerto%20Rico-English1.pdf.

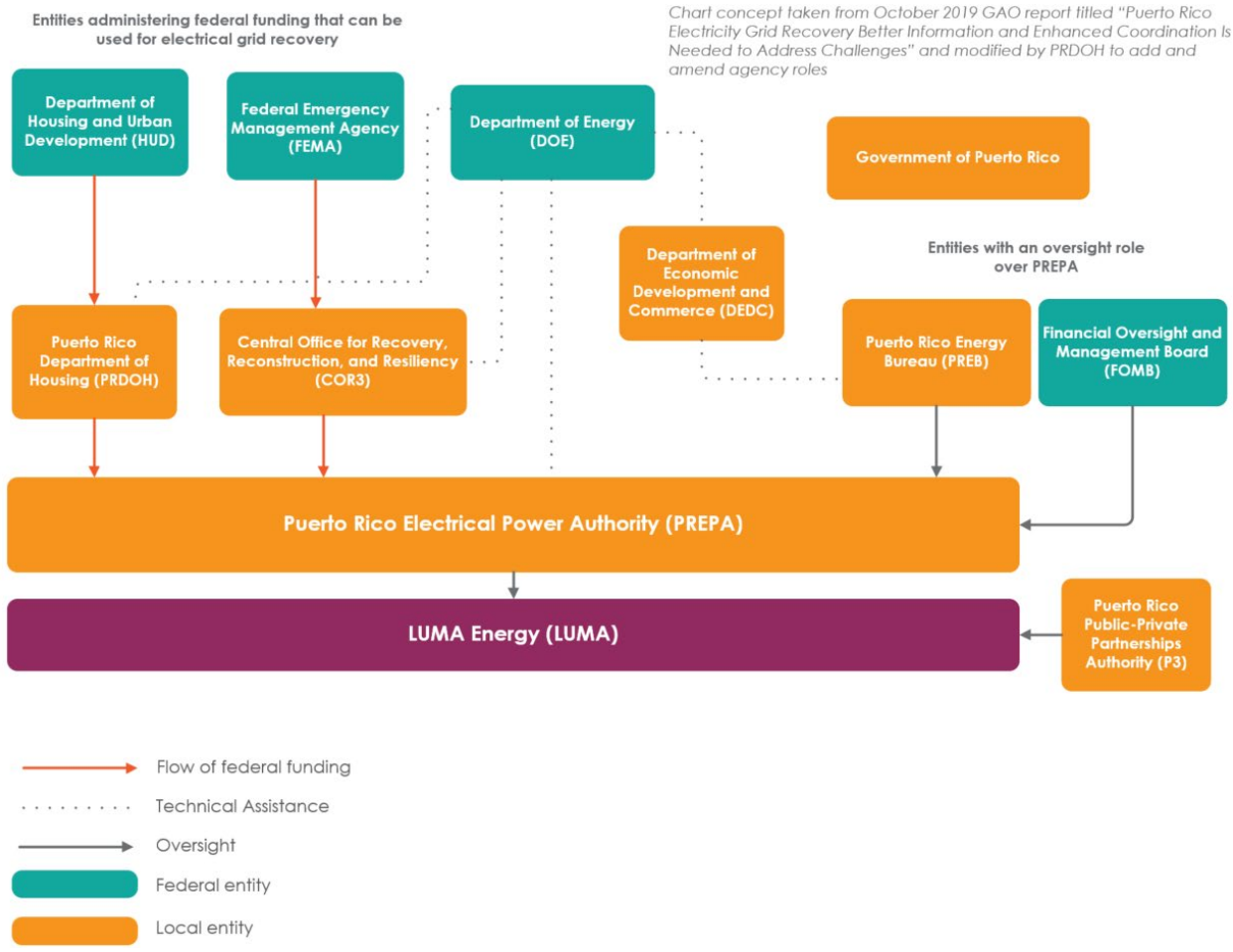


Figure 42 - Oversight Structure

DDEC's PEPP is the entity responsible for developing and promulgating the public energy policy of the Government of Puerto Rico, by virtue of Act No. 141 of July 11, 2018, known as the *Reorganization Plan Execution Act of the 2018 Department of Economic Development and Commerce*. DDEC also serves as the State Energy Office for Puerto Rico and has a formal relationship with DOE in that function.

Act 120 and Act No. 211 of August 12, 2018, as amended, known as the Act for the Implementation of the Puerto Rico Public Service Regulatory Board Reorganization Plan, established the legal framework for PREPA's transformation, granting the PREB the authority to approve any transformation-related agreements. Under Act 57, PREPA, or any successor entity, is required to comply with the IRP, subject to the supervision of the PREB.

PREB is the independent and specialized body created by Act 57, as amended, responsible for regulating, monitoring, and enforcing the public energy policy of the

Government of Puerto Rico as established by DDEC's PEPP. According to the 2021 Fiscal Plan for PREPA as approved by the FOMB, PREB's "statutory mandate as an independent regulator is to promote an efficient, reliable, resilient, and customer-responsive energy system. As such, PREB's primary responsibilities include (1) rate setting, (2) IRP approval and compliance, (3) protecting the interests of customers and consumers, and (4) ensuring workforce safety." PREB has an annual budget of $20 million which is not subject to executive or legislative approval.[169]

Performance Metric Benchmarks

Act 17, known as the Puerto Rico Energy Public Policy Act, provided for PREB to establish incentive mechanisms to enforce the energy public policy. According to PREB's Resolution and Order dated May 21, 2021,[170] performance metric benchmarks may be used to provide a utility with a financial incentive to achieve desired outcomes or as a tool to help guide a utility's performance. These benchmarks define "the precise level of service or output that a utility is expected to achieve during a particular time period for a particular metric."[171]

To set performance metric benchmarks, PREB considers the following design principles and methods:[172]

- Tie benchmarks to policy goals.
- Balance costs and benefits.
- Set realistic benchmarks.
- Historical performance.
- Peer utility performance.
- Frontier methods.
- Incorporate stakeholder input.
- Use deadbands to mitigate uncertainty and variability.
- Use time intervals that allow for long-term, sustainable solutions.
- Allow benchmarks to evolve.

As per its legal power and authority, on May 21, 2021, PREB established PREPA's initial benchmark values for selected reported metrics. Additionally, PREB identified the following categories for the applicable benchmarks:[173]

- Overall Metrics
- Generation Metrics
- Customer Service Metrics
- Human Resources Metrics

[169] PREPA. *2021 Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on May 27, 2021*. https://drive.google.com/file/d/1dXFJldZpOIsAObMZDBd7T2P3j2xMPaal/view.
[170] *In Re: The Performance of The Puerto Rico Energy Public Authority*. (2021). Resolution and Order. NEPR-MI-2019-0007 (P.R.). https://energia.pr.gov/wp-content/uploads/sites/7/2021/05/Resolution-and-Order-NEPR-MI-2019-0007.pdf.
[171] Id., p. 3.
[172] Id.
[173] Id., pp. 10-14

- Transmission and Distribution Metrics
- Renewable Energy and Demand Side Management Metrics

Although PREPA is a unique utility based on Puerto Rico's climate and geography, PREB established its benchmarks after evaluating a combination of island utilities with similar challenges as PREPA, investor-owned utility benchmarks for similarly sized utilities, and public power authorities for similarly sized utilities. However, PREB stated that it would continue to evaluate historic performance and utility and industry performance standards for consideration in adopting future benchmarks.

There is currently an open docket before PREB regarding LUMA's performance targets.[174] This docket will establish the performance targets and performance-based incentives and penalties (PIMs) to be applicable to LUMA. Once these benchmarks are established and metrics reported, the data will be useful to determine the impact of the proposed projects, once implemented, and their alignment with HUD's goals for the improvement and enhancement of Puerto Rico's electrical power system with CDBG-DR funds.

[174] *In Re: Performance Targets for LUMA Energy Servco, LLC*, NEPR-AP-2020-0025. https://energia.pr.gov/expedientes/?docket=nepr-ap-2020-0025

PROGRAM REQUIREMENTS

Technical Coordination Team (TCT) Consultation

During the development of the Electrical Power System Enhancement and Improvements Action Plan, PRDOH consulted with stakeholders of the energy sector, including affected local governments, public utilities (PREPA and LUMA as operator), rural electrical cooperatives, regulators (PREB), commercial and industrial users of the system through the different associations and representatives, and residential customers and public interest groups representing residential customers of the system.

These engagement efforts also included the required consultation with the Federal members of the TCT on the Action Plan development, which was executed through regular meetings held during the months of August and September 2021. [Appendix to be provided at Action Plan submittal] contains a list and summary of these meetings. It was through continued collaboration with the TCT that PRDOH was able to gather the information and documents needed to prepare the Electrical Power System Enhancement and Improvements Action Plan.

These are the federal members of the Energy TCT that participated in the consultation meetings for the development and implementation of the Electrical Power System Enhancement and Improvements Action Plan:

- DOE
- EDA
- EPA
- FCC
- FEMA Interagency Recovery Coordination (IRC)
- FEMA PA
- FEMA Community Planning and Capacity Building (CPCB)
- FEMA Unified Federal Review (UFR)
- FEMA HMGP
- GAO
- HUD
- USACE
- USDA-RUS
- Treasury

Prior to the publication of the Action Plan, PRDOH consulted with the TCT on the following areas:

- The development of the Action Plan and unmet needs assessment;
- PRDOH's proposed budget for electrical power system improvements to be funded with CDBG-DR funds;
- The technical evaluation of proposed electrical power system improvements using models and other sources of expert assistance available through TCT Federal members; and

- The implementation of applicable electrical power system industry standards and the commercial availability of system components that PRDOH proposes to fund.

Upon HUD's approval of the Action Plan, PRDOH shall consult with the TCT in the following areas:

- The evaluation of the financial and operational capacity of any public utility that will receive a subaward or otherwise carry out a portion of the grant and the mitigation of risk associated with the public utility's use of CDBG–DR funds; and
- To request recommendations for appropriate controls to mitigate the financial management, program, and other risks of noncompliance related to the public utility's use of Federal funding for electrical power system improvements.

National Objectives

The primary objective of the HCDA is the "development of viable urban communities, by providing decent housing and a suitable living environment and expanding economic opportunities, principally for persons of low and moderate income." (42 U.S.C. § 5301(c)). Consistent with the HCDA, PRDOH shall comply with the overall benefit requirements established in the HCDA and 24 C.F.R. § 570.484(a) which require that 70% of CDBG funds be used for activities that benefit low- and moderate-income persons.

Figure 43 - CDBG-DR Eligibility Criteria

For purposes of this grant, HUD is establishing an alternative requirement that the overall benefit test shall apply only to the use of CDBG–DR funds provided under Pub. L. 115–123 (**Appropriations Act**), for electrical power system improvements and related program income, and not to all CDBG funds received by PRDOH during another period selected. CDBG–DR electrical power system improvements will be considered to meet the criteria

for activities benefitting low- and moderate-income persons—area benefit activities at 24 C.F.R. § 570.483(b)(1) q--+5at grant closeout. PRDOH shall appropriately ensure that activities that meet these criteria do not benefit moderate income persons to the exclusion of low-income persons. The criteria are that at least 70% of the grant funds allocated by the Federal Register notice, not including planning and administrative costs, have been used to:

> *Provide at least **51% of the grantee's low- and moderate-income (LMI) residents** with either a subsidized rate for electricity below that charged to other residential ratepayers or a lower rate for electricity than was charged prior to complete implementation of the CDBG–DR funding electrical power system improvements; or measurably improve the reliability of the electrical power system in low- and moderate-income areas that are primarily residential. For purposes of this paragraph, measurably improved reliability shall mean a documented decrease in power supply interruptions, excluding planned interruptions and interruptions caused by major events. To document compliance with this national objective criterion, a grantee's policies and procedures shall provide for the measurement of improved reliability in low- and moderate income areas that are primarily residential, using relevant legal and regulatory standards, as amended from time to time, including those identified by Puerto Rico Act 17, FEMA Section 1235(b) of DRRA "Consensus-Based Codes and Standards", RUS Bulletins for Electric Power, Institute of Electrical and Electronics Engineers (IEEE) standards and guidance, EPA environmental protections, and, as appropriate, NERC standards and guidance.*[175]

PRDOH may also use CDBG–DR funds allocated to meet the **urgent need** national objective, pursuant to the waiver and alternative requirement provided by HUD in 86 FR 32681. Unless PRDOH has received prior approval from HUD, CDBG–DR funds for electrical power system improvements cannot meet the CDBG national objective for the elimination of slum and blight as provided at 24 C.F.R. § 570.208(b) and 24 C.F.R. § 570.483(c). However, even though projects may qualify under the Urgent Need National Objective, the 70% LMI target for the allocation must still be met.

Considerations on the LMI National Objective for Electrical Systems

As outlined above, 86 FR 32681 stipulates at least 70% of the grant funds allocated for the electrical system, not including planning and administrative costs, must be used to either:

- Provide at least 51% of the grantee's LMI residents with either a subsidized rate for electricity below that charged to other residential ratepayers or a lower rate for electricity than was charged prior to complete implementation of the CDBG–DR funding electrical power system improvements; or

[175] 86 FR 32681, 32693.

- Measurably improve (a documented decrease in power supply interruptions) the reliability of the electrical power system in LMI areas that are primarily residential.

Implementing either of these scenarios has certain considerations that must be evaluated. The 2021 Fiscal Plan for PREPA noted that several of the key historical challenges leading to PREPA's current problematic financial position have been lack of rate adjustments to cover costs, macro-economic challenges that led to fewer customers and a lower revenue base where "existing customers have had to pay higher rates to cover fixed system costs," and an "overreliance on fossil fuels with fluctuating prices for power generation."[176] Therefore, the rate-subsidy scenario for a subset of ratepayers may be problematic in terms of FOMB approval as it runs contrary to efforts to move away from contributors to PREPA's negative financial status. The option to document a lower rate for electricity post-implementation of the CDBG-DR improvements is subject to many variables, coupled with the difference in timing between funding streams and a long road to grid transformation. The long-term improvements necessary to transform the grid may not be complete before the six (6) year deadline for the CDBG-DR Electrical funds, complicating the ability to reduce rates mid-recovery.

Regarding the measurable improvement in reliability, there has been much deliberation regarding the key performance indicators and baseline data against which to evaluate LUMA performance. Additionally, LUMA, as operator, has indicated that data for residential-level outages and service area impact by feeder improvement are not readily available due to limitations on available data, included GIS capabilities, as well as the difficulty of segmenting or partitioning the impact of improvements from one area to the next.

As stated in the *Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico Report* prepared by Sandia National Laboratories,

> "There are a number of methods to assess the vulnerabilities of the power system infrastructure in a given region, and they all depend on the availability of high-quality data sources. Metrics such as the system average interruption duration index (SAIDI), the system average interruption frequency index (SAIFI), and the customer average interruption duration index (CAIDI) are all useful measures of the overall reliability of a power system. However, these metrics are calculated as an average over a period of time, often a year, and they typically leave out large-scale outage events caused by extreme events, such as a named tropical cyclone. Thus, their utility in assessing vulnerability to adverse weather is limited."[177]

---

[176] PREPA. *2021 Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on May 27, 2021*. https://drive.google.com/file/d/1dXFJldZpOIsAObMZDBd7T2P3j2xMPaal/view.

[177] Jeffers, R.F., *et al*. (2018). *Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico*. United States. https://doi.org/10.2172/1481633.

However, the report also indicates that "there were parts of the island that were performing significantly worse than average… To improve overall system performance, it might make sense to further investigate the feeder locations that have exceptionally high CAIDI, SAIDI, or SAIFI values."[178]

PRDOH will need access to additional levels of data from awarded entities and will need close consultation with HUD on sufficient documentation for meeting the LMI National Objective specific to LMI residential areas, especially when CDBG-DR funded improvements are designed to improve the performance of the grid as a whole. PRDOH has initiated consultation with HUD regarding the applicability of island-wide benefit standards, however those consultations may continue as specific project scenarios are developed.

Eligible Activities

PRDOH's Action Plan describe electrical power systems and activities that qualify for electrical power system(s) improvements and meet the criteria for a national objective.

PRDOH will use CDBG–DR funds for electrical power system improvements in a manner that leverages other sources of federal and public utility funds, to the extent feasible, to increase the long-term impact of Federal investments on the electrical power system. For this Action Plan, an **electrical power system** is defined as:

> "An interconnected or autonomous set of transmission lines, distribution lines, substations, central power generation stations, other sources of power, distributed energy resources, or enabling technologies and services, such as industry standard billing, accounting information technology, cybersecurity enhancements, microgrids and fuel transfer delivery systems, that are necessary for the provision of reliable, resilient, stable, and cost-effective electrical service."[179]

To achieve the purpose of the Appropriations Act and due to the unprecedented complexity of these recovery efforts, HUD has granted a waiver to establish a **new eligible activity**, the *Electrical Power Systems Improvements Activity*. **Electrical power system improvements** are defined as:

> "The acquisition, construction, reconstruction, rehabilitation or installation of facilities, improvements, or other components (including interim assistance, and financing public or private acquisition for reconstruction or rehabilitation, and reconstruction or rehabilitation, of privately owned property) that are undertaken to extend, upgrade, and otherwise enhance and improve the cost-effectiveness, reliability, efficiency, sustainability, or long-term financial viability of the grantee's electrical power system

[178] Id.
[179] 86 FR 32681, 32692.

> including activities to increase the resilience of the electrical power system to future disasters and to address the impacts of climate change."[180]

The non-Federal share required in connection with a Federal grant-in-aid program can be undertaken with this grant, as long as the activity is an eligible activity pursuant to the Allocation Notice, 86 FR 32681.

As a restricted **eligible activity**, the refinancing or paying down of debt of an electrical power system improvement can "be eligible only for the purpose of acquiring a facility and only upon HUD's consultation with the federal agencies that comprise the TCT, and a demonstration by the grantee that such acquisition is critical to the improvement of the grantee's electrical power system and to long term financial stability of the grantee's public utility and will allow the grantee to meet a low- and moderate-income national objective as established by this notice."[181]

Regarding the eligibility of generation assets, 86 FR 32681 states that,

> "To align with long term decarbonization goals, the term electrical power system improvements, as applied to central power generating stations, shall only include an improvement or replacement of a central power generating station operating on the applicability date of this notice if HUD, in consultation with DOE and EPA, determines that such improvement or replacement will result in a net decrease in carbon emissions from that generating power station at comparable levels of operation."[182]

PRDOH will conduct feasibility consultations with the TCT regarding proposed Energy Action Plan projects, as required. The areas to be consulted include the following:

- Technical evaluations of proposed electrical power system improvements using models and other sources of expert assistance available through the TCT members.
- The proper application of electrical power system industry standards in the construction and operation of the projects.
- Ensuring the commercial availability of system components that PRDOH proposes to fund.

Duplication of Benefits

One measure that PRDOH implements to prevent the duplication of benefits is the reconciliation of budgets, obligations, funding draws, and expenditures. Another measure is the calculations of expenditures to determine compliance with administrative and public service caps and the overall percentage of funds that benefit low- and moderate-income persons. The 70% minimum threshold expenditure of the funds for LMI persons will be monitored to demonstrate compliance with the CDBG-DR Program.

[180] Id.
[181] 86 FR 32681, 32698.
[182] 86 FR 32681.

PRDOH has established procedures to prevent duplication of benefits as defined by Section 312 of the Stafford Act, 42 U.S.C. § 5155. However, PRDOH will submit updates to reflect any material changes in its certification submissions, as necessary.

Section 312 of the Stafford Act, as amended, generally prohibits any person, business concern, or other entity from receiving financial assistance with respect to any part of a loss resulting from a major disaster for which such person, business concern, or other entity has received financial assistance under any other program or from insurance or any other source. To comply with Section 312 and the requirement that all costs are necessary and reasonable, PRDOH will ensure that each activity provides assistance to a person or entity only to the extent that the person or entity has an electrical power system improvement need that has not been fully met. Accordingly, PRDOH will comply with the requirements of the Federal Register Vol. 84, No. 119 (June 20, 2019), 84 FR 28836 (**2019 DOB Notice**). Requirements on CDBG–DR funds and CDBG–DR grants in the 2019 DOB Notice shall apply equally to CDBG–DR funds for electrical power system improvements.

All CDBG–DR grants for electrical power system improvements under the Appropriations Act are subject to the requirement under the tenth provision following the Community Development Fund heading of Pub. L. 115–123 (Declined Loans Provision) and the requirements for its implementation in the 2019 DOB Notice. The Declined Loan Provision states: "Provided further, that with respect to any such duplication of benefits, the Secretary and any grantee under this section shall not take into consideration or reduce the amount provided to any applicant for assistance from the grantee where such applicant applied for and was approved, but declined assistance related to such major disasters that occurred in 2014, 2015, 2016, and 2017 from the Small Business Administration under section 7(b) of the Small Business Act (15 U.S.C. 636(b))." According to Section 312 of the Stafford Act in the Disaster Recovery Reform Act (Pub. L. 115–254, Division D), for disasters occurring between 2016 and 2021, a loan is not a duplication of other forms of financial assistance, provided that all Federal assistance is used toward a loss suffered as a result of a major disaster or emergency.

CDBG–DR funds for electrical power system improvements may be used to meet a matching requirement, share, or contribution for any other Federal program when used to carry out an eligible CDBG–DR activity permitted by 86 FR 32681. This includes PA and other grants administered by FEMA as well as grants provided by the USACE (by law, as codified in the HCDA as a note to 42 U.S.C. § 5305, the maximum amount of CDBG–DR funds that may be contributed to a project funded by the USACE is $250,000).

Grantees may only use CDBG–DR funds allocated pursuant to 86 FR 32681 to meet the match requirement of an activity that meets the definition of an electrical power system improvement and other requirements of the Notice. In considering the use of CDBG–DR funds as match, grantees are further advised that the Appropriations Act prohibits the use of CDBG–DR funds for any activity that is reimbursable by, or for which funds are also made available by FEMA or the USACE. HUD notes the substantial amount of FEMA PA funding that has also been committed to electrical power system improvements. Accordingly, PRDOH is aware that when CDBG–DR funds for electrical power system

improvements are used in combination with FEMA or USACE funds, PRDOH must document that such CDBG–DR funds were not used to pay for costs that could be charged to the FEMA or USACE award (although CDBG–DR funds may be used for CDBG–DR eligible costs of the other Federal agency-funded award up to the amount required for the non-Federal match and for costs that cannot be charged to the FEMA or USACE award).

Statutory order of assistance provisions also prohibits the use of CDBG–DR funds to ''front'' costs that will later be reimbursed with FEMA or USACE funds. CDBG–DR funds may be used for the costs of compliance with CDBG–DR requirements that cannot be charged to the FEMA or USACE grant. PRDOH is required to record in the Disaster Recovery Grant Reporting (**DRGR**) System the expenditure of funds for the activity for which the match is provided and to indicate that the funds were used to meet a non-Federal match share requirement.

Feasibility, Cost-Effectiveness, and Long-Term Financial Viability

One of the purposes of the use of CDBG–DR funds is to improve the cost-effectiveness, reliability, resilience, efficiency, sustainability, and long-term financial viability of its electrical power systems. Puerto Rico is subject to the requirements of the State CDBG program, as modified by applicable waivers and alternative requirements. Section 102(a)(2) of the HCDA defines "state" to include the Commonwealth of Puerto Rico.[183]

This Electrical Power System Enhancement and Improvements Action Plan explains the steps that are undertaken to extend, upgrade, and otherwise enhance and improve the cost-effectiveness, reliability, efficiency, sustainability, or long-term financial viability of the electrical power system, including activities to increase the resilience of the electrical power system to future disasters and to address the impacts of climate change. The Electrical Power System Enhancement and Improvements Action Plan identifies PRDOH as the lead agency responsible for implementation of the CDBG–DR grant.

As part of project evaluation, PRDOH will evaluate budget estimates to perform operation and maintenance activities for the useful life of the project. It is a PRDOH requisite for applicants to document their Operation and Maintenance approach in order to receive funding. The TCT may be consulted for specific technical evaluations on feasibility, as needed.

Pre-Agreement Costs

The provisions of 24 C.F.R. § 570.489(b) and 570.200 (h) permits a grantee to reimburse itself for otherwise allowable costs incurred by itself or its recipients sub grantees or subrecipients on or after the incident of the covered disaster prior to the execution of a grant agreement with HUD. This includes but is not limited to activities supporting program development, action plan development and stakeholder involvement support, and

[183] 42 U.S.C. § 5302(a)(2).

other qualifying eligible costs incurred in response to an eligible disaster covered under Pub. L. 115–123.

PRDOH incurred in pre-agreement costs and may seek reimbursement for these costs that are reasonable and allowable under this regulation. PRDOH may recover the pre-agreement costs consistent with the authority cited in this section. These costs include the cost for salary, employer fringe benefits, and direct operating cost for each employee based on their individual percentage of time spent on the planning of the CDBG-DR program during a pay period. Any cost associated with the disaster recovery efforts will be allocated based on the total time spent on CDBG-DR activities versus other duties for a particular month.

The total cost of PRDOH or its awarded contractors or subrecipients to assist with disaster recovery research and analysis to help PRDOH prepare the unmet needs assessment and action plan and other costs associated with meetings, community outreach, and any other direct costs associated with the Action Plan may be reimbursed by this CDBG-DR grant. Additionally, once contracted, PRDOH may allow the drawdown of pre-agreement costs associated with eligible disaster recovery activities dating back to the date of the disaster(s) for subrecipients and PRDOH with appropriate documentation.

Program Income

Puerto Rico anticipates it may generate program income[184] as part of the activities allowed under this allocation. If any funds are generated, including program income, these will be used before drawing down additional CDBG-DR funds. Said amounts will be recorded and tracked in the accounting systems and the DRGR system. PRDOH will also use the DRGR system to track program income receipts, disbursements, revolving loan funds, and leveraged funds (if applicable).

If PRDOH allows subrecipients to retain program income prior to grant closeout, PRDOH will establish program income accounts in the DRGR system. The DRGR system requires PRDOH to use program income before drawing additional grant funds and ensures that program income retained by one organization will not affect grant draw requests for other organizations.

Minimizing or Addressing Displacement

PRDOH has plans to minimize displacement of persons or entities, and assist any persons or entities displaced as a result of its electrical power system improvement activities. PRDOH will evaluate the proposed activities and descriptions of the energy system improvements that may directly or indirectly result in displacement and will provide the required assistance for those displaced.

PRDOH will take into consideration the functional needs of persons with disabilities in the relocation process following the relocation considerations for persons with disabilities in

[184] "Program income" is defined as gross income generated from the use of CDBG-DR funds, and received by a grantee or subrecipient. 86 FR 32681.

Chapter 3 of HUD's Relocation Handbook 1378.0 available on the HUD Exchange website at:
https://www.hud.gov/program_offices/administration/hudclips/handbooks/cpd/13780.

Construction and Resiliency Standards

PRDOH emphasizes quality, durability, resiliency, energy efficiency and sustainability in all its electrical powersystem improvements taking in consideration the following standards:

- National Electrical Codes (**NEC**) – the most complete set of electrical code requirements that lead electrical installation, in the most safety way for property and individuals.
- Institute of Electrical and Electronics Engineers (**IEEE**) Code – commitments to the highest standards of integrity, responsible behavior and ethical and professional conduct.
- Puerto Rico Building Code 2018 – this code includes hazard resistant provisions that provide for safer construction in Puerto Rico that also follows 2018 International Building Codes, the model codes and standards used to construct safe, sustainable, affordable and resilient structures.

Through the uses of the above-mentioned codes, PRDOH seeks to achieve sound, sustainable long-term recovery.

Elevation Standards

PRDOH will follow construction standards and land-use decisions that consider responsible floodplain and wetland management and the continued sea level rise. This information will be based on the history of FEMA flood mitigation efforts and taking into consideration projected increase in sea level and the frequency and intensity of precipitation events.

PRDOH will adhere to the following elevation requirements:

> "Nonresidential structures must be elevated to the standards described in this paragraph or floodproofed, in accordance with FEMA floodproofing standards at 44 C.F.R. § 60.3(c)(3)(ii) or successor standard, up to at least two feet above the 100-year (or 1 percent annual chance) floodplain. In addition, structural or nonstructural methods may be used to reduce or prevent damage, and the structure may be designed to adapt to, withstand and rapidly recover from a flood event. All Critical Actions, as defined at 24 CFR 55.2(b)(3), within the 500-year (or 0.2 percent annual chance) floodplain must be elevated or floodproofed (in accordance with the FEMA standards) to the higher of the 500-year floodplain elevation or three feet above the 100-year floodplain elevation. If the 500-year floodplain or elevation is unavailable, and the Critical Action is in the 100-

> year floodplain, then the structure must be elevated or floodproofed at least three feet above the 100-year floodplain elevation. Critical Actions are defined as an activity for which even a slight chance of flooding would be too great, because such flooding might result in loss of life, injury to persons or damage to property. For example, Critical Actions include principal utility lines, hospitals, nursing homes, police stations, and fire stations".[185]

PRDOH and its subrecipients addressing flood risks, will describe how they will document their decision to elevate structures associated with the electrical power system improvements. Also, they will document how they evaluated and determined the elevation to be cost reasonable relative to other alternatives or strategies, such as the demolition of substantially damaged structures with reconstruction of an elevated structure on the same site or infrastructure improvements to reduce the risk of loss of life and property, as required in 86 FR 32681.

Operation and Maintenance Plans

Awardees will describe their plan for ensuring the long-term operation and maintenance (**O&M**) of the electrical power system improvements funded with CDBG–DR funds. Awardees selected by PRDOH will specify the non-CDBG sources of funding to be used for the O&M of the electrical power system improvements. **Subrecipients are responsible for the operations and maintenance costs for the electrical power systems improvements funded with CDBG–DR funds**. PRDOH will specify in the subrecipient agreement that non-CDBG-DR sources of funding shall be used for the operation and maintenance of the electrical power improvement. Subrecipients will describe to PRDOH how they will use reserve funds, borrowing authority or retargeting of existing financial resources to support the O&M plan, and how the Subrecipient plans to ensure that public utility resources and other source of funding, as applicable, are committed to the O&M of improvements assisted with CDBG–DR funds over the useful life of the improvements.

Subrecipients must describe any proposed changes to existing taxation policies or collection practices, or changes to public utility revenue billing and collection and other financing policies that are to be used to support the O&M plan. PRDOH will expressly include in the Action Plan whether operations and maintenance plans are reliant on any proposed changes in existing taxation policies, tax collection practices, or changes to utility revenue billing and collection. Additionally, PRDOH will describe any State, local, or other resources (e.g., public utility financing) that have been identified for the operation and maintenance costs of electrical power system improvements assisted with CDBG–DR funds.

[185] 86 FR 32681, 32698.

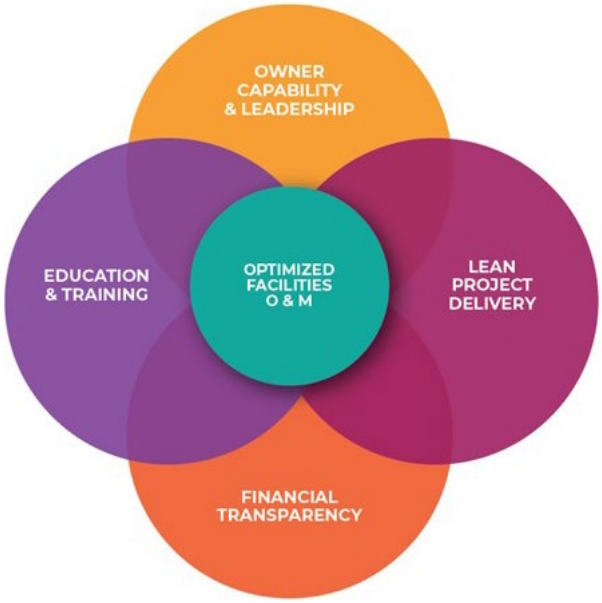


Figure 44 - Optimized O&M Program

With respect to this element of the Action Plan, HUD has advised PRDOH and subrecipients that HUD may impose a grant condition based on risk that requires the grantee to establish or adopt standards for O&M of the functional components of the electrical power system improvements. Proposed plans and subrecipient agreements may be subject to TCT, FOMB, or PREB review and or approval, as applicable.

Application Status Updates

PRDOH and potential subrecipients or partners are required to maintain adequate means of informing applicants on the status of applications for program assistance at all phases of program activities. PRDOH employs multiple methods of communication to ensure applicants receive timely and accurate information regarding their applications. Methods of communications are standardized for each program and include, but are not limited to, the PRDOH CDBG-DR website, email address, telephone number, postal address, and letters. When PRDOH accepts applications from potential subrecipients, the contact with subrecipients is managed at the program-level. Specific methods for application status updates will be clarified in the Program Guidelines.

In such case that PRDOH or a subrecipient manages information from individuals, all communication protects the individual's privacy by strictly adhering to privacy procedures pertaining to personally identifiable information (**PII**). PRDOH has established procedures for the protection of PII and requires adherence to PII Procedures, as well as mandatory training for all relevant staff and assists all subrecipients and partners as necessary in the implementation of equivalent PII protocols. Safeguards to protect PII are overseen by managers and directors on an ongoing basis for their respective program area, and any irregularities are reported to the compliance officer for resolution.

In addition to program-specific protocol for application status updates as published in Program Guidelines, applicants may contact PRDOH at any time to request information at the contact information below:

- Via telephone: 1-833-234-CDBG o 1-833-234-2324 (TTY: 787-522-5950)
  Attention hours: Monday to Friday from 8:00am-5:00pm
- Via email at: infoCDBG@vivienda.pr.gov – for all CDBG-DR inquiries,
- Online at: https://www.cdbg-dr.pr.gov/en/contact/ (English version)
  https://www.cdbg-dr.pr.gov/contact/ (Spanish version)
- In writing at: Puerto Rico CDBG-DR Program
  P.O. Box 21365
  San Juan, PR 00928-1365

Method of Distribution

METHOD OF DISTRIBUTION

Recovery Programs

It is a priority for PRDOH to deliver a people-focused, transparent recovery that ensures that energy needs are addressed with an integrated resilience factor. The effective use of these funds in Puerto Rico's energy system infrastructure will provide a more sustainable society with a unique opportunity to integrate new energy technology capable of resisting future disasters. This Electrical Power System Enhancement and Improvements Action Plan is designed to strengthen low to moderate income communities with resilience energy source strategies designed to protect people and property. Proper investment in the electrical power system enhancement is key to a regenerated Puerto Rico economy.

PRDOH will utilize two distribution models for its recovery programs as follows: (a) A direct distribution model to administer individual energy projects that can be granted directly to an entity for a priority need, and; (b) A subrecipient model in which an administrator (subrecipient) manages community energy projects that satisfy the energy needs of individuals. For example, if PRDOH assigns funds to the PREPA as a subrecipient, PREPA will provide the improved energy service achieved with system improvements to a whole area.

Grantee

The Government of Puerto Rico is formally the Grantee for the CDBG-DR funds. The Governor has designated PRDOH as the grantee for purposes of administering the program and executing grant agreements with HUD. Therefore, PRDOH will be referred to as the grantee in this Action Plan and in administrative agreements with HUD.

Beneficiary

Beneficiaries are the persons to whom assistance, services or benefits are ultimately provided.

Subrecipients

Subrecipients are chosen by the grantee to undertake certain eligible CDBG activities. Subrecipient means a public or private nonprofit agency, authority, or organization, or a for-profit entity authorized under 24 C.F.R. § 570.201(o), receiving CDBG funds from the recipient or another subrecipient to undertake activities eligible for such assistance. Subrecipients may include public and private organizations, agencies, including nonprofit and for-profit subrecipients, as applicable for the programs established in the Action Plan. For-profits may only be included as subrecipients when assisting with economic development and micro-enterprise activities, unless otherwise waived by HUD. Subrecipients will meet the selection criteria outlined in the Action Plan and/or program guidelines and will:

- Meet the grantee's specific selection criteria based on capacity - grant management history, staffing and program activity and experience
- Carry out specified program on behalf of PRDOH.
- Comply with all Federal statutes, regulations, and program requirements.
- Meet all established performance goals.
- Comply with all terms and conditions of the subrecipient agreement.

Applicability of various requirements is dependent upon the type of entity; the selection method and the role being played by the entity.

PRDOH, in consultation with the TCT, is required to conduct an evaluation of the capacity of any public utility that will receive a subaward or otherwise carry out a portion of the grant and the mitigation of risk associated with the public utility's use of CDBG–DR funds. Consultation shall occur before entering a subaward or other agreement with the public utility.

PRDOH is the responsible entity for subrecipient compliance and performance and Environmental Review under 24 C.F.R. Part 58. Agreements with subrecipients will comply with 24 C.F.R. § 570.503. Therefore, Subrecipients who fail to meet any of the criteria outlined above, or as specified in their Subrecipient Agreement (**SRA**), may have their ability to carry out program activities rescinded, in which case, activities would be managed by PRDOH or its designee, or funds redistributed in accordance with the Action Plan.

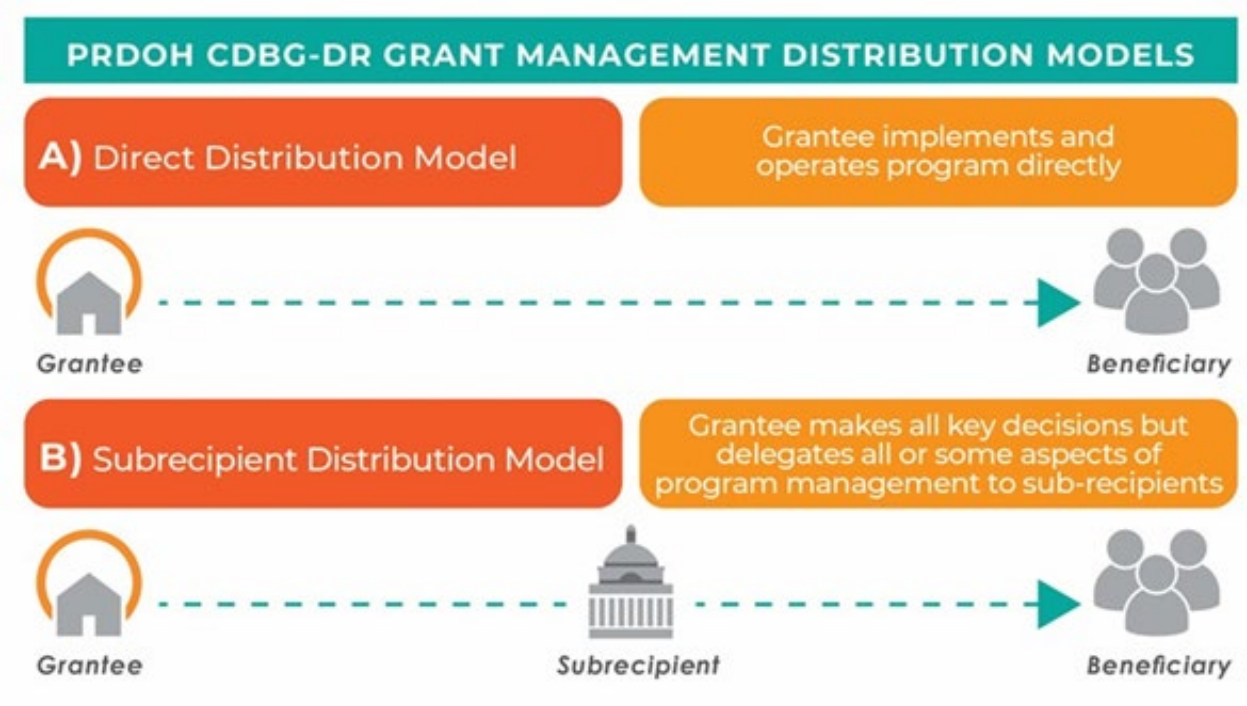
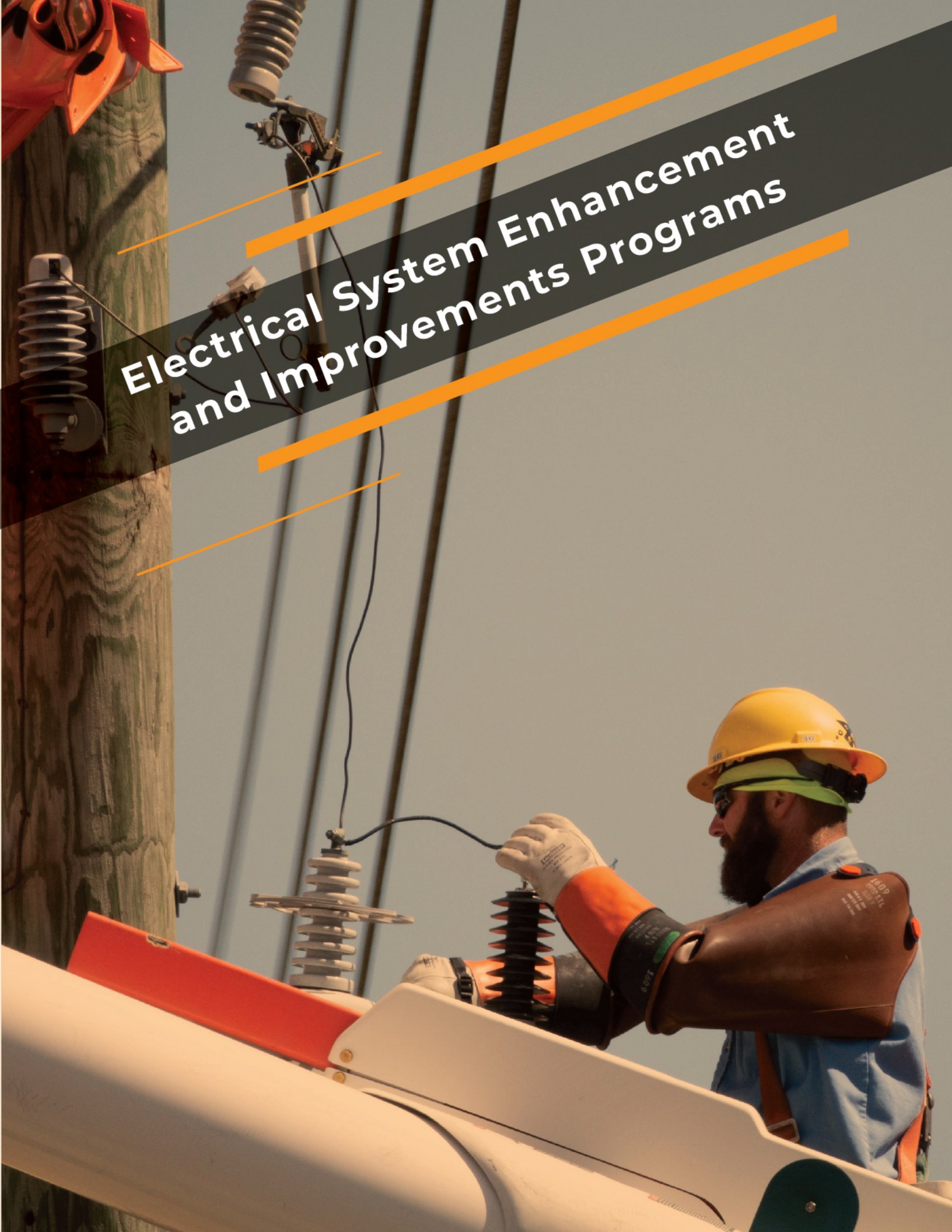


Figure 45 - Management Distribution Models



Electrical System Enhancement and Improvements Programs

ELECTRICAL POWER SYSTEM IMPROVEMENTS PROGRAMS

Best-Fit Approach and Leveraging of Funds

According to 86 FR 32681, the grantee must "increase the long-term impact of Federal investments on the electrical power system." To achieve this, the grantee should foster the use of multiple sources of funding, "such as leveraging other existing capital improvement projects and the potential for private investment." This leverage can also be achieved with sources provided through public-private partnerships, FEMA, EDA, USACE, among others, including State and Community Organizations.[186]

For permanent, long-term recovery projects funded by CDBG-DR, Puerto Rico has little opportunity to leverage local funding due to the widespread economic hardship and the existing bond debt. This economic hardship and the severity of the damage caused by Hurricane María has been recognized by the Federal Government in the approval of a higher federal cost share for FEMA PA funds increasing the standard ceiling of 75% to allow up to 100% federal reimbursement for Category A (debris removal) and B (emergency protective measures) work, and 90% for Categories C through G (permanent work). Significantly, the 100% federal coverage for work performed under Categories A and B expired in phases through September 15, 2018, leaving an increased obligation for non-federal match. 100% cost share is different for each FEMA category.

Puerto Rico's recovery funding strategy primarily aligns federal assistance funding, to the greatest extent possible, through complementary programs to maximize recovery dollars and overcome funding barriers. This includes ensuring programs are funded with the most restrictive eligible funding sources first, in accordance with their proposed eligible activity, and then moving through the funding stream to the least restrictive. For that reason, and to ensure compliance with Stafford Act restrictions against duplication of benefit, this Action Plan will focus on unmet energy power system needs. At the same time, Puerto Rico works with FEMA to implement the program to participate in alternative procedures for all large project funding for PA Categories C-G pursuant to Section 428 of the Stafford Act.

There is a broad range of energy resilience needs and funding mechanisms. Because of the limited funds and the overwhelming need, it is imperative that PRDOH utilize a "Best-Fit" for each potential energy project. PRDOH will need to work with entities and other funding agencies to align projects with the funding stream where they are best-suited. This is applicable even within the different CDBG-DR and CDBG-MIT programs under PRDOH administration. Table 17 below is an example of how we must ensure "best-fit" for each project. On the left are the different funding streams, with timelines and administering entities. Since energy resilience needs may be addressed through a variety of programs, proposed projects may need to be aligned with the appropriate program

[186] 86 FR 32681, 32686.

based on the target area, eligibility criteria, timeline, etc., to maximize the funding available.

Entity	Federal Fund Program	Sub-Program	Time for Completion (Years)	Allocation
COR3	FEMA 428 - Permanent Works Federal Share	FAASt for PREPA	Project must be completed within regulatory deadlines	$9.46B
COR3	FEMA 404-Hazard Mitigation Grant Program (HMGP)		Project must be completed within regulatory deadlines	$853M
COR3	FEMA 406-Public Assistance Program		Project must be completed within regulatory deadlines	TBD
EPA	Drinking Water State Revolving Funds		Subject to project complexity	$11M
EPA	Clean Water State Revolving Funds		7 years	$20.9M
USDA	Rural Energy for America Program (REAP)	-Energy Audit and Renewable Energy Development Assistance (EA/REDA) -Energy Systems and Energy Efficiency Improvements (RES/EEI)	-EA/REDA Programs Applications February 2, 2021 - Jan 31, 2022 -RES/EEI Program Applications Nov. 1, 2021 - March 31, 2022	$538M
EDA	Economic Adjustment Assistant (EAA)		Fiscal year application	$500M
PRDOH	HUD CDBG-DR	CEWRI - Residential	2026	$300M
PRDOH	HUD CDBG-MIT	CEWRI – Residential/ Small Business	2033	$500M
PRDOH	HUD CDBG-MIT	HMGP Match	2033	$1B

Table 17 - Funding Matrix

Table 17 shows information that contains a high-level overview of potential funding sources, not intended to imply that all funds are allocated exclusively for energy. Additionally, some of the potential funding sources refer to revolving funds that are not necessarily set aside for energy.

The cost-share approach will also require ongoing coordination between PRDOH and COR3 to "Best Fit" each energy project, ensuring the projects:

- Are aligned with the correct CDBG-DR/CDBG-MIT/CDBG-DR Energy funding stream; and
- Align with CDBG-DR requirements and LMI National Objective Goals.

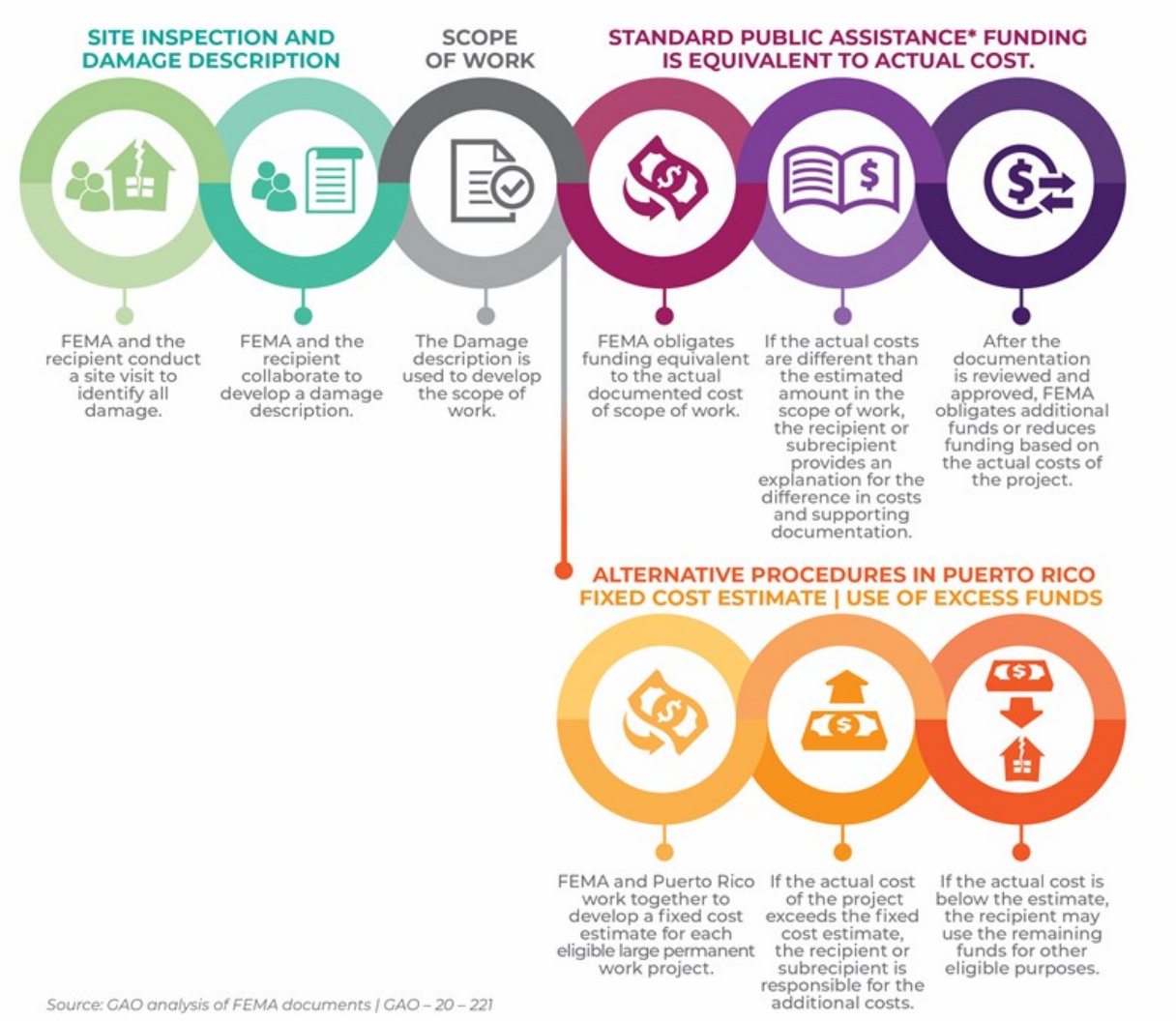


Figure 46 - FEMA's Public Assistance Procedure

Homeowners seeking individual residential-level assistance or communities seeking small-scale microgrid solutions may be referred to CDBG-DR and CDBG-MIT programs designed to address those needs, while large-scale solutions will be evaluated under the Electrical System Enhancements and Improvements Programs in this Action Plan.

PRDOH has a portfolio of programs between its CDBG-DR,[187] CDBG-Mitigation,[188] and CDBG-DR Energy allocations that may serve to provide energy and infrastructure resilience in various ways.

[187] CDBG-DR Community Energy and Water Resilience Installations Program. https://cdbg-dr.pr.gov/en/download/community-energy-and-water-resilience-installations-program/ (English) and https://cdbg-dr.pr.gov/download/instalaciones-comunitarias-para-la-resiliencia-energetica-y-de-abastecimiento-de-agua/ (Spanish).
[188] CDBG-MIT Community Energy and Water Resilience Installations Program. https://cdbg-dr.pr.gov/wp-content/uploads/2021/08/ADM_MIT_Summary-of-CDBG-MIT-Programs_EN.pdf (English) and https://cdbg-dr.pr.gov/wp-content/uploads/2021/08/ADM_MIT_Summary-of-CDBG-MIT-Programs_ES.pdf (Spanish).

These programs address needs at different scales, such as the residential scale for the Community Energy & Water Resilience Program in CDBG-DR, at the municipal or regional level for the Community Energy & Water Resilience Program in CDBG-MIT, and at the energy system level for the Electrical Systems Improvement allocation.

Individual households are eligible to receive photovoltaic systems with battery backup under the Community Energy & Water Resilience Program (**CEWRI**) in CDBG-DR. The program, currently funded at $300,000,000, is anticipated to provide approximately 12,000 households with localized energy resilience.

The Community Energy and Water Resilience Installations (CEWRI) Program in the CDBG-MIT Action Plan provides for community installations that may include larger kilowatt, bimodal systems that can support health, lighting, communication, and other backup energy needs of area residents with awards of up to $2,000,000. Units of general local government/ Local and Municipal Governments, Community-Based Development Organizations and private not-for-profits, and non-governmental organizations (501(c)(3)) are encouraged to evaluate the program as described in the CDBG-MIT Action Plan beginning on Page 363 of the HUD-approved plan. The plan may be found at: https://cdbg-dr.pr.gov/en/download/cdbg-mit-action-plan-effective-on-april-19th-2021/ (English) and https://cdbg-dr.pr.gov/en/download/cdbg-mit-action-plan-effective-on-april-19th-2021/ (Spanish).

Figure 47 - Complementary CDBG-DR Portfolios

Community members are encouraged to learn about the variety of program options by participating in PRDOH outreach events, visiting the website at https://cdbg-dr.pr.gov/, or contacting the PRDOH using one of the many options provided in the Citizen Participation section at the end of this Action Plan.

Summary of Budgets

The Electrical System Enhancements and Improvements Programs consist of two (2) lines of effort. The Energy Grid Rehabilitation and Reconstruction (**ER1**) Cost Share Program is designed to meet the non-federal cost-share need of FEMA's unprecedented PA allocation for PREPA's Island-wide FEMA Accelerated Award Strategy (**FAASt**) Project. The Electrical Power Reliability and Resilience Program (**ER2**) will serve the needs of communities by funding projects that are not currently anticipated to be funded from other federal or local sources.

In regard to Planning, electric vehicles will quickly become an important consideration for the energy improvements on the Island. The DDEC outlined an initiative for a three-phase approach to planning for EV integration, including research and planning, an infrastructure deployment program, and community engagement and education. PRDOH will fund these activities under the planning funds, starting with Phase one (1) for Research and Strategic Planning, and funding Phases two (2) to three (3) upon successful completion of Phase one (1), while also allowing DDEC to explore funding options through DOE or other sources.

The LMI Benefit requirement is applied as a 70% LMI Goal by each of the two programs. However, PRDOH will apply the goal in a fungible manner so long as the target for the allocation as a whole is met.

ENERGY PROGRAM	PROGRAMMATIC BUDGET	% OF BUDGET	LMI GOAL	LMI BUDGET
Energy Grid Rehabilitation and Reconstruction (**ER1**) Cost Share Program	**$1,055,811,031**	**55%**	**70%**	**$739,067,722**
Electrical Power Reliability and Resilience Program (**ER2**)	**$760,595,149**	**39%**	**70%**	**$532,416,604**
ADMINISTRATIVE				
Administrative Budget	**$96,617,350**	**5%**	**N/A**	
PLANNING				
Planning	**$19,323,470**	**1%**	**N/A**	
Total	**$1,932,347,000**	**100%**	**70% LMI***	**$1,271,484,326**

*Table 18 - Summary of Program Budgets. *LMI Calculation does not include Administration and Planning.*

System Components

The Federal Register requires that grantees account for the planned expenditures of components of the electrical power system. These components include the following items (marked in underline from an excerpt of the Federal Register):

> *"(i) An electrical power system shall be defined as an interconnected or autonomous set of <u>transmission lines, distribution lines, substations, central power</u>*

> *generation stations, other sources of power, distributed energy resources, or enabling technologies and services, such as industry standard billing, accounting information technology, cybersecurity enhancements, microgrids and fuel transfer delivery systems, that are necessary for the provision of reliable, resilient, stable, and cost effective electrical service;"*[189]

Because several of the components are overlapping, or can have the same or similar meaning, (e.g. distributed energy, other sources of power, and microgrids) PRDOH organizes the components into functional groupings. Groupings, such as, the renewable/ microgrid/ other energy components, so that they can align with each program. A project for instance, a microgrid, may include localized improvements to transmission and distribution assets, which would be considered ancillary to the microgrid improvement.

The component groupings are:

1. Transmission & Distribution
2. Substations
3. Central Power Generation
4. Other sources of power, distributed energy, microgrids
5. Enabling Technology

PRDOH has established a threshold for fungibility between components, since budgeting at the component level for the FEMA cost-share is currently unfeasible due to the scopes of work that will be developed over time, not simultaneously, and scopes may have minor fluctuations in budget from what is currently anticipated. In order to facilitate the pace of the recovery and ease the administrative burden associated with the Action Plan amendment process, PRDOH will reallocate budgets between components at 10% or less of the budget for each component. This will allow for minor adjustments in expenses between component categories without having to amend the Plan. More than 10% but less than 25% would trigger a non-substantial amendment; and greater than 25% in change between component budgets would require a substantial amendment. For the traditional CDBG-DR action plan process, the budget revision amendment process addresses a change in budgets between eligible CDBG-DR activities. In this Action Plan, however, the activity will always be Electrical Power System Improvements, so the component categorization is a finer level of detail not related to the eligible activity.

[189] 86 FR 32681, 32692.

Energy Grid Rehabilitation and Reconstruction (ER1) Cost Share Program

PROGRAM BUDGET	ADMINISTERING ENTITY	NATIONAL OBJECTIVE
$1,055,811,031	PRDOH	LMI/ UN 70% LMI GOAL
MAX AWARD	**START – END DATE**	**ELIGIBLE AREA**
PER PROJECT AMOUNT	DURATION OF THE GRANT	PUERTO RICO

Table 19 - ER1 Program Budget

Hurricane Impact

As detailed throughout the Unmet Needs Assessment and as documented by FEMA in its approval of significant recovery funds related to the comprehensive recovery of the electrical system, the electrical grid must be rebuilt from the ground up. Additionally, the financial inability of PREPA to recover is a key component of the Fiscal Plans related to the energy grid.[190]

Many of the federal grant programs that have funded Puerto Rico's response, and will continue to provide for the Island's long-term recovery, are subject to cost-share requirements. Cost-share requirements generally consist of a 25% or 10% match, depending on the disaster. In some instances, where a disaster exceedingly overwhelms a state/local government's ability to respond and fund recovery, and for whom a high level of damage occurred, FEMA has supported PA at 100% Federal Cost. The cost-share for Hurricane María for FEMA PA permanent work is currently 10%.

On June 17, 2021, the Governor of Puerto Rico submitted a request to the President of the U.S. requesting FEMA consideration of 100% federal funding for all permanent work under the Major Disaster Declaration related to Hurricane María (FEMA DR 4339-PR). The request states, "[a] 100% federal cost share for FEMA public assistance permanent work would liberate a significant amount of CDBG-DR federal funds that were allocated to Puerto Rico due to the devastation caused by Hurricane María and that are currently destined for non-federal cost share purposes as permitted by the federal government. Those funds could then be repurposed for other CDBG-DR programs that the people of Puerto Rico desperately need to overcome the different crises that have affected us since 2017." This request is pending the evaluation and consideration of the Federal Government.

[190] PREPA. 2021 *Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on May 27, 2021.* https://drive.google.com/file/d/1dXFJldZpOIsAObMZDBd7T2P3j2xMPaaI/view.

Acknowledging that the request for 100% Federal Cost has not yet been determined, PRDOH will focus on meeting the non-federal cost share of FEMA's PA allocation for the PREPA Island Wide FAASt Project, which has a 10% cost-share requirement. The FAASt award, subaward number 6099 for PREPA, is approximately $10.5 billion. Depending on available funding, PRDOH may also consider the viability of matching the non-federal cost shares of other federal grant-in-aid programs related to electrical system improvements. The FEMA 406 mitigation components under FEMA PA have not yet been determined, as that evaluation is conducted when the architectural and engineering design is underway and mitigative components specific to that project are identified. Since the 406 components are currently unknown, they cannot be accounted for in the Unmet Needs assessment and may lead to an increased cost-share amount in the future. An increased cost-share amount may require an amendment to the ER1 program budget to account for those additional obligations.

Eligible Activities

HUD has determined that the aggregate of electrical power system improvements to be completed with CDBG–DR funds subject to 86 FR 32681 are critical components of the region's long-term recovery from Hurricane María and the resilience of the area to future weather events. As per the Federal Register Notice, HUD recognizes that the broad scope of these activities may limit the ability of grantees to categorize these CDBG–DR funds into discrete categories of CDBG eligibility and to appropriately assign a CDBG national objective to each component of the planned improvements.[191]

Therefore, eligible activities for the Energy Grid Rehabilitation and Reconstruction (**ER1**) Cost Share Program include:

Electrical Power Systems Improvements Activity

- HUD is waiving section 105(a) (42 U.S.C. § 5305(a)) of the HCDA and establishing an alternative requirement only to the extent necessary to create a new eligible activity, electrical power system improvements, which shall be applicable only for the grant-funded pursuant to this Action Plan.
- Under this activity, all uses of funds that meet the definition of electrical power system improvements and comply with the alternative requirements are both eligible under the waiver and alternative requirement and meet the statutory purpose of the funds.
- This activity includes the use of funds for payment of the non-Federal share required in connection with a Federal grant-in-aid program undertaken as part of an activity that meets the definition of electrical power system improvements and otherwise complies with grant requirements.[192]
- Electrical power system improvements that can be demonstrated to have a public benefit may be installed or applied on private lands.

[191] 86 FR 32681.
[192] This ER1 Program may support FEMA, COR3, or PREPA's efforts to innovate in reconstruction. As for the non-Federal share, this Program will fund the subrecipient recommended approach while collaborating to address risks of climate change.

Electrical Power System Improvements

86 FR 32681, 32692 defines electrical power system improvements as the acquisition, construction, reconstruction, rehabilitation or installation of facilities, improvements, or other components that are undertaken to extend, upgrade, and otherwise enhance and improve the cost-effectiveness, reliability, efficiency, sustainability, or long-term financial viability of the grantee's electrical power system including activities to increase the resilience of the electrical power system to future disasters and to address the impacts of climate change. This definition includes interim assistance and financing public or private acquisition for reconstruction or rehabilitation, and reconstruction or rehabilitation, of privately owned property .

The refinancing or paying down of debt shall be eligible only for the purpose of acquiring a facility and only upon HUD's consultation with the Federal agencies that comprise the TCT, co-led by FEMA and DOE. This will be considered on a case-by-case basis.

Ineligible Activities

The definition of an electrical power system and the use of funds for electrical power system improvements shall not include ineligible activities as provided at 24 C.F.R. § 570.207, including costs for the operation and maintenance of the electrical power system improvements.

This definition and the use of funds for electrical power system improvements shall not include the use of CDBG–DR funds for the operation and maintenance costs of a public utility or the costs of fuel or energy purchase contracts in effect prior to the applicability date of the Notice.

National Objective

Electrical Power System Enhancement and Improvement programs funded by CDBG-DR assistance must meet one (1) of the two (2) national objectives. These are either the LMI or Urgent Need National Objective. However, for purposes of this allocation, documentation of LMI is distinct. Eligible activities will be considered to meet the LMI National Objective if at grant closeout least 70% of the funds, not including planning and administrative cost, meet one of the following criteria:

- Provide at least 51% of the grantee's low- and moderate-income residents with either a subsidized rate for electricity below that charged to other residential ratepayers or a lower rate for electricity than was charged before complete implementation of the CDBG–DR funding electrical power system improvements; or
- Measurably improve the reliability of the electrical power system in low-and moderate-income areas that are primarily residential. Measurably improved reliability shall mean a documented decrease in power supply interruptions, excluding planned interruptions and interruptions caused by major events.

Eligibility Criteria

Projects must meet a National Objective and accomplish a CDBG Electrical Power System Improvement eligible activity as well as all requirements under the Program. Eligible projects to the Energy Grid Rehabilitation and Reconstruction (**ER1**) Cost Share Program will be those that were determined as eligible under FEMA or the Federal Agency acting as the primary source of funding to participate in the program.

Environmental Review

The federal environmental review requirements for the eligible projects under the ER1 scenario (cost share) will adopt the FEMA Environmental Review process, as authorized under the Appropriations Act, for the purpose of complying with the requirements of NEPA. PRDOH will submit the decision in writing to HUD stipulating the adoption of FEMA's environmental review process. Notwithstanding, PRDOH will comply with the state environmental review process enacted by the Puerto Rico Environmental Public Policy Act (Act 416).

Method of Distribution

Subrecipient Distribution Model

The Energy Grid Rehabilitation and Reconstruction (**ER1**) Cost Share Program is a central government-managed program that utilizes the Subrecipient Distribution Model as needed for specific projects. To achieve the objectives of this program, PRDOH will work closely with COR3 and other governmental agencies and applicants who are FEMA program subrecipients to provide their non-federal match. PRDOH will coordinate directly with that agency or the Puerto Rico agency administering federal grant-in-aid funds and their relevant applicants for any match agreements with federal agencies other than FEMA. Applicants must have been accepted into a Federal agency disaster recovery program and have been determined by the lead Federal agency to have eligible projects to participate in this program.

PRDOH will pursue implementing a Flexible Match approach for the PREPA FAASt award to ease the administrative burden and expedite the recovery, for which PREPA will be the Subrecipient. The Flexible Match approach seeks to streamline the cost-share match process by selecting specific projects within an overall Project Worksheet (**PW**). Costs for specifically selected projects will be covered 100% by CDBG-DR, up to the total corresponding cost share amount for the entirety of the PW.

Program Objective & Description

The purpose of this program is to maximize the benefit from federal grant programs by positioning CDBG-DR as the ideal local match program to other federal funding streams. This approach will relieve the financial burden related to the recovery efforts of Puerto Rico's Electrical Grid and Puerto Rico's long-term infrastructure resilience needs. Through the matching of funding provided by other federal agencies, critical infrastructure needs will be addressed making the island more adaptable to changing conditions and able to withstand and recover rapidly from disruptions caused by future disasters.

At this time, most long-term reconstruction projects are still in preparation. As a result, the exact amount of CDBG-DR funds necessary to meet the entire universe of non-federal match requirements is still being assessed.

PRDOH will collaborate with COR3 on strategies for long-term resilience to natural hazards and how infrastructure investments align with other planned Puerto Rican or local capital improvements.

Electrical Power Reliability and Resilience Program (ER2)

PROGRAM BUDGET	ADMINISTERING ENTITY	NATIONAL OBJECTIVE
$760,595,149	PRDOH	LMI/ UN 70% LMI GOAL
MAX AWARD	**START – END DATE**	**ELIGIBLE AREA**
PER PROJECT AMOUNT	DURATION OF THE GRANT	PUERTO RICO

Table 20 - ER2 Program Budget

Hurricane Impact

As detailed throughout the Unmet Needs Assessment and as documented by FEMA in its approval of significant recovery funds related to the comprehensive recovery of the electrical system, the electrical grid must be rebuilt from the ground up. On September 20, 2017, the Federal Government determined that the damage in all areas of Puerto Rico resulting from Hurricanes Irma and María was of sufficient severity and magnitude to warrant a major disaster declaration under the Stafford Act. Therefore, the major disaster declaration for Puerto Rico was issued with FEMA-4336-DR and FEMA-4339-DR. As of June 2021, HUD allocated a total of $1,932,347,000 for a portion of the unmet energy sector need.

Eligible Activities

HUD has determined that the aggregate of electrical power system improvements to be completed with CDBG–DR funds subject to 86 FR 32681 are critical components of the region's long-term recovery from Hurricane María and the region's resilience to future weather events. As per the Notice, HUD recognizes that the broad scope of these activities may limit the ability of grantees to categorize these CDBG–DR funds into discrete categories of CDBG eligibility and to appropriately assign a CDBG national objective to each component of the planned improvements.

Therefore, eligible activities for the Electrical Power Reliability and Resilience Program (**ER2**) Program include:

Electrical Power Systems Improvements Activity

- HUD is waiving section 105(a) (42 U.S.C. § 5305(a)) of the HCDA and establishing an alternative requirement only to the extent necessary to create a new eligible activity, electrical power system improvements, which shall be applicable only for the grant funded pursuant to this Action Plan.
- Under this activity, all uses of funds that meet the definition of electrical power system improvements and comply with the alternative requirements are both

eligible under the waiver and alternative requirement and meet the statutory purpose of the funds.

- This activity includes the use of funds for payment of the non-Federal share required in connection with a Federal grant-in-aid program undertaken as part of an activity that meets the definition of electrical power system improvements and otherwise complies with grant requirements.
- Electrical power system improvements that can be demonstrated to have a public benefit may be installed or applied on private lands.

Electrical Power System Improvements

86 FR 32681, 32692 defines electrical power system improvements as the acquisition, construction, reconstruction, rehabilitation or installation of facilities, improvements, or other components that are undertaken to extend, upgrade, and otherwise enhance and improve the cost-effectiveness, reliability, efficiency, sustainability, or long-term financial viability of the grantee's electrical power system including activities to increase the resilience of the electrical power system to future disasters and to address the impacts of climate change. This definition includes interim assistance and financing public or private acquisition for reconstruction or rehabilitation, and reconstruction or rehabilitation, of privately owned property.

The refinancing or paying down of debt shall be eligible only for the purpose of acquiring a facility only upon HUD's consultation with the federal agencies that comprise the TCT.

Ineligible Activities

The definition of an electrical power system and the use of funds for electrical power system improvements shall not include ineligible activities as provided at 24 C.F.R. § 570.207, including costs for the operation and maintenance of the system.

This definition and the use of funds for electrical power system improvements shall not include the use of CDBG–DR funds for the operation and maintenance costs of a public utility or the costs of fuel or energy purchase contracts in effect prior to the applicability date of the Notice.

National Objective

Electrical System Enhancement and Improvement programs funded by CDBG-DR assistance must meet one (1) of the two (2) national objectives. These are either the LMI or Urgent Need National Objective. However, for purposes of this allocation, documentation of LMI is distinct. Eligible activities will be considered to meet the LMI National Objective if at grant closeout least 70% of the funds, not including planning and administrative cost, meet one of the following criteria.

- Provide at least 51% of the grantee's low- and moderate-income residents with either a subsidized rate for electricity below that charged to other residential ratepayers or a lower rate for electricity than was charged prior to complete

implementation of the CDBG–DR funding electrical power system improvements; or

- Measurably improve the reliability of the electrical power system in low-and moderate-income areas that are primarily residential. Measurably improved reliability shall mean a documented decrease in power supply interruptions, excluding planned interruptions and interruptions caused by major events.

Program Objective and Description

The Electrical Power Reliability and Resilience Program (**ER2**) provides assistance to subrecipients to create electrical system reliability and resilience. The program will serve the needs of communities by funding projects that are not currently anticipated to be funded from other federal or local sources. For construction activities, the subrecipient must agree to budget the operations and maintenance activities for the long-term sustainability of the electrical power system improvements. These multi-year budgets for operations and maintenance shall apply for the useful life of the improvement or enhancement.

Program funds will be provided for infrastructure and physical assets that qualify as Electrical Power System Improvements. Projects are encouraged to integrate energy assets and contribute to the diversification of energy resources. Projects pursued as Microgrids shall conform to a minimum threshold of 75% of its energy output derived from renewable resources (plus storage) to ensure compliance with Act 82-2010. Projects will be evaluated for opportunities to align with efforts to increase energy efficiency. PRDOH anticipates that approximately 80% of the projects funded under ER2 will qualify as *Other sources of power, distributed energy, microgrids* components.

Cogeneration & Large Project Microgrids

Distributed renewable energy generation and industrial cogeneration are fast-growing markets that satisfy specific consumer sector energy needs. These behind-the-meter generation installations can be maximized by being integrated into district and community-level microgrids. Microgrid integration will extend the benefits of renewable energy and resiliency of the behind-the-meter generation projects across a broader population. The integration of the behind-the-meter generation installation to a microgrid represents customized technical challenges which include significant infrastructure cost, for which ER2 funds may contribute. Microgrids funded under the ER2 Program will foster renewable energy integration and community-level resilience. Projects pursued as Microgrids shall conform to a minimum threshold of 75% of its energy output derived from renewable resources (plus storage) to ensure compliance with Act 82-2010. Additionally, Microgrid projects conducted by for-profit entities/commercial enterprises shall be required to demonstrate leverage, with the ER2 award consisting of not more than 25% of the proposed project cost. Large-scale energy resilience installations, including those considered for public institutions such as those related to education, may also be evaluated for funding.

Small Project Microgrids

Small and moderately sized microgrids may provide much-needed energy resilience at the community level. These microgrids may be targeted to non-PRASA communities and vulnerable communities that were without power the longest, which tend to be hard-to-reach communities in the mountains or in rural areas. Additionally, PRDOH will consult criteria utilized in the comprehensive microgrid analysis conducted by Sandia National Laboratories[193] as a frame of reference for considering community access to critical services.

To address the specific HUD requirements for subrecipient capacity for this allocation for electrical power system enhancements and the requirement to document the availability of operation and maintenance plans for any funded improvements, PRDOH will collaborate with PREPA and P3A to procure renewable energy resources in bulk on behalf of these communities to gain economies of scale. This will allow vulnerable communities to be served in compliance with applicable regulations while meeting the needs of the people and integrating distributed energy improvements into the island-wide energy system. PRDOH will work closely with the DOE to ensure the technical specifications of the Scope of Work (SOW) meet federal requirements. In the scope of work and/or the written agreement, PRDOH will ensure that the most vulnerable communities are targeted for services in alignment with the prioritization criteria. Additionally, PRDOH will collaborate with PREPA and/or P3A to ensure opportunities for community participation and education are provided to support the long-term success of the microgrid.

PREPA will consult with communities on the planning and design of the electrical power system improvements to ensure alignment with community service areas and consideration of critical assets. This program will prioritize the communities near feeders that suffered the most extended delays in restoration after Hurricane María along with other remote or hard to reach communities.

PREPA may provide technical assistance and support to the impacted communities to aid in active participation in using and maximizing the benefits provided by the microgrid. The expertise acquired through training will enable communities to empower themselves in their energy resilience. PREPA and/or LUMA will be in charge of the operation and maintenance costs of these micro-grids due to the requirements of the Federal Register Notice.

For those organizations seeking to implement community-based installations of energy production and storage as subrecipients, PRDOH offers funding opportunities as part of the CEWRI Program in the CDBG-MIT Action Plan. Community installations may include larger kilowatt, bimodal systems that can support health, lighting, communication, and other backup energy needs of area residents with awards of up to $2,000,000. Units of general local government/ Local and Municipal Governments, Community-Based

[193] Jeffers, R.F. *et al.* (2018). *Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico*. United States. https://doi.org/10.2172/1481633.

Development Organizations and private not-for-profits, and Non-governmental organizations[194] are eligible applicants under the CDBG-MIT CEWRI Program and are encouraged to evaluate the program as described in the CDBG-MIT Action Plan. The CDBG-MIT Action Plan may be found at: https://cdbg-dr.pr.gov/en/cdbg-mit/ (English) and https://cdbg-dr.pr.gov/cdbg-mit/ (Spanish)

Centro Médico

As outlined in the Unmet Needs Assessment, key medical facilities across the island experienced cascading failures due to sustained loss of power after the hurricanes. As such, it resulted in the loss of life and compounded impact on public health. Centro Médico is a hospital complex that serves as the main center for trauma cases for Puerto Rico and the Caribbean. The hospital complex includes the University of Puerto Rico Medical Science Campus, Oncological Hospital, and Industrial Hospital. A microgrid project is essential for the hospital complex operation to receive essential energy savings and provide resilience to the facility. Targeted funds will provide concept design and turn-key development for the Centro Médico Complex Microgrid. The hospital complex will be required to demonstrate financial capabilities for the operations and maintenance of the microgrid.

Generation

Generation remains a critical pressing need for the stability of the Island system. In addition to the distributed energy, behind the meter integration, and community microgrid projects, PRDOH will work with PREPA and other stakeholders to develop innovative generation solutions that will propel the Island forward in terms of resiliency, sustainability, and efficiency while advancing goals in reducing Puerto Rico's carbon footprint. Proposed solutions for generation will be consulted with the TCT as applicable. They may be submitted for inclusion into the IRP as needed.

Method of Distribution

- Subrecipient Distribution Model
- Direct Distribution Model

Eligible Applicants

- Government of Puerto Rico Agencies, Authorities, Trusts and Boards (undertaking projects to support electrical power system improvements);
- Public-private partnerships as defined by Act 29-2009, as amended, known as "Public-Private Partnership Act";
- Units of general local government, Local and Municipal Governments (including departments and divisions) (undertaking projects to support electrical power system improvements);
- For-profit businesses (undertaking projects to support electrical power system improvements) (Note: Funds made available under this Action Plan may not be used to assist privately-owned utilities. A CDBG–DR grantee may seek a waiver of

[194] 26 USC § 501(c)(3).

this prohibition when it has identified an electrical power system improvement project that is a priority and where assistance to a privately-owned utility is proven to be necessary to implement the project); and
- Public Hospital and Health Systems

Eligibility

- Meets HUD Electrical Systems Eligible Activity definition;
- Meets HUD National Objective (Either LMI or Urgent Need);
- Non-Duplication of Benefit (project not proposed for funding under another federal program);
- Operations and Maintenance requirements are met;
- Cost Reasonable; and
- Other CDBG-DR requirements

Program Priority

Potential projects will be evaluated by PRDOH using the following criteria. Threshold Criteria are required as a baseline to make the project eligible for consideration. Prioritization Criteria will be used to select, prioritize, or otherwise award a project as part of the program design. This process will be outlined in the Program Guidelines. Selected projects must have a logical nexus with the Unmet Needs Assessment and consist of CDBG-DR Electrical Systems Improvement eligible activities under this Action Plan.

Threshold

1. Non-Duplication of Benefits: Funds are for uses that meet electrical power system needs that are not likely to be addressed by FEMA or other sources of funds.
2. Construction and Resiliency Standards: Project construction will meet quality, durability, resiliency, efficiency, and sustainability standards as defined by:
    - Puerto Rico Building Codes;
    - NERC; and
    - National Association of Regulatory Utility Commissioners and National Electrical Codes 2020.
3. Financial Viability: Project has identified non-CDBG fund sourcing for long-term operation and maintenance, including vegetation management as applicable.
4. Cost Reasonable: Controls for assuring that improvement costs are reasonable

Prioritization

A. Reliability: Noticeably improves the reliability of the system through reducing the:
    - Impact on the number of days without power; and/or
    - Documented decrease in power supply interruptions
B. Resilience: Noticeably improves the resilience of the system
    - Projected Impact on the number of total accumulated Customer Hours of Lost Electricity Service (**CHoLES**) after an event
C. High-Impact Area: Provides targeted service to a vulnerable population, underserved communities, and low-and moderate-income areas.

D. Cascading Impact: Demonstrated community benefits tied to electrification, i.e.
    - Economic (i.e., impact on economic activity)
    - Public Health (i.e., power + water connection)
E. Critical Facility: Provides targeted service to a critical facility, such as a Hospital or Elderly Home.

Award

- **Min Award**: $10,000,000
- **Max Award**: Per project amount

Regulatory Review

To allow for innovative and time-sensitive approaches to energy resilience, proposed CDBG-DR energy projects are not required to be approved in the IRP in order to apply for funding. However, depending on the impact of the project, the project may be required to undergo regulatory agency evaluation, and the project may need to be amended into the IRP before it can be implemented. An IRP amendment can take more than **seven (7) months**, and requests for an amendment may need to be supported with modeling that substantiates the request.

For example, if a non-PREPA/LUMA entity seeks to fund an energy project, it would have to establish a rate that covers operation and maintenance expenditures. That rate would then go to PREB for review and approval. In other instances, PREB may need to evaluate the impact of a project on the rest of the system or ratepayers. For example, the cost of fuel is paid and spread across ratepayers, so projects that would impact fuel consumption would need to be evaluated.

While the IRP does not have to be amended to include renewable energy projects, it is important to note that the current approved IRP does not have microgrids in the plan.

Even if a project is for a component already included in the IRP or otherwise identified as Public Policy, it may still need to be validated by the corresponding regulatory agencies in order to ensure there are no inconsistencies with the Public Policy. This review period is designed to be completed within **thirty (30) days**. PRDOH will maintain close coordination with the TCT in order to minimize the possibility of issuing CDBG-DR awards for projects that do not meet the required evaluation criteria for regulatory approval. PRDOH is working to align with the corresponding specific criteria for approval. The IRP is updated every three (3) years as a regular course of business.

Environmental Review

The federal environmental review requirements for the eligible projects under the ER2 scenario shall comply with the NEPA process regarding the consultation to state and federal agencies and the evaluation of environmental impacts in preparing the environmental document. Simultaneously, PRDOH will comply with the state environmental review process as enacted by the Puerto Rico Environmental Public Policy Act (Act 416).

Flood Insurance

PRDOH, and subrecipients will implement procedures and mechanisms to ensure that assisted property owners comply with all flood insurance requirements prior to providing assistance.

Application Status

For the complete description regarding applicant communication and Application Status Updates, please see the section of the same name on this Action Plan. In addition to the program-specific protocol for application status updates as published in Program Guidelines, applicants may contact PRDOH or the Program Subrecipient to request information when those become available.

Quality Construction and Green Building Standards

PRDOH will implement construction methods that emphasize quality and durability. All electrical power system enhancements will be designed to incorporate principles of sustainability, including energy efficiency, resilience, and mitigation against the impact of future natural disasters

Green Building Standards means that PRDOH will require that applicable construction meets an industry-recognized standard that has achieved certification under at least one of the following programs: (i) ENERGY STAR (Certified Homes or Multifamily High-Rise), (ii) Enterprise Green Communities, (iii) LEED (New Construction, Homes, Midrise, Existing Buildings Operations, and Maintenance, or Neighborhood Development), (iv) ICC–700 National Green Building Standard, (v) EPA Indoor AirPlus (ENERGY STAR a prerequisite), (vi) the "Permiso Verde," or (vii) any other equivalent comprehensive green building program acceptable to HUD. PRDOH will identify which Green Building Standard will be used in the program policies and procedures, as per HUD requirements.

Where feasible, Puerto Rico will follow best practices such as those provided by the U.S. Department of Energy's Guidelines for Home Energy Professionals. Where applicable, installed appliances must meet ENERGY STAR certification standards at a minimum.

Elevation Standards

As required in 86 FR 32698, PRDOH will apply elevation standards for nonresidential structures construction located in the Advisory 100-year (or 1% annual chance) floodplain. All Critical Actions, as defined at 24 C.F.R. §55.2(b)(3), within the 500-year (or 0.2 % annual chance) floodplain must be elevated or floodproofed (in accordance with the FEMA standards) to the higher of the 500-year floodplain elevation or three feet above the 100-year floodplain elevation. If the 500-year floodplain or elevation is unavailable, and the Critical Action is in the 100-year floodplain, then the structure must be elevated or floodproofed at least three feet above the 100-year floodplain elevation.

- Whether the cost of elevating an electrical power system component is at or below 30% of the cost for a newly constructed in place for an original electrical power system component that can be raised;

- Whether or not raising an electrical power system component to the Base Flood Elevation (BFE)[195] plus three feet is feasible when considering the potential for transferring flood risk to the surrounding area.

Duplication of Benefits (DOB)

In accordance with the Stafford Act, as amended, Puerto Rico will implement policies and procedures to ensure no individual, entity, or subrecipient receives a duplication of benefit for the same purpose and/or effect to recover from the hurricanes. Federal law prohibits any person, business concern, or other entity from receiving federal funds for any part of such loss as to which he has received financial assistance under any other program, from private insurance, charitable assistance, or any other source. The DOB guidance included in Federal Register Vol. 84, No. 119 (June 20, 2019), 84 FR 28836, updates the DOB guidance issued in Federal Register Vol. 76, No. 221 (November 16, 2011), 76 FR 71060, for CDBG-DR grants received in response to disasters declared between January 1, 2015 and December 31, 2021.

All duplicative assistance received must be accounted for and remitted to PRDOH or its subrecipient, regardless of when it is received by the awardee. CDBG-DR funds are designed to be funding of last resort. If additional funds are paid to a subrecipient or awardee for the same purpose, those funds must be returned to PRDOH. All subrecipients will be required to sign a Subrogation Agreement as part of their Grant Agreement. The CDBG-DR Duplication of Benefits policy is available in English and Spanish at https://cdbg-dr.pr.gov/en/download/duplication-of-benefits-policy/ and https://cdbg-dr.pr.gov/download/politica-sobre-la-duplicacion-de-beneficios/.

[195] BFE is defined by FEMA as the elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year. https://www.fema.gov/node/404233#:~:text=%E7%AE%80%E4%BD%93%E4%B8%AD%E6%96%87-,Base%20Flood%20Elevation%20(BFE),level%20in%20any%20given%20year.


Citizen Participation

CITIZEN PARTICIPATION AND STAKEHOLDER ENGAGEMENT

Citizen Participation

The citizen participation protocols described in the Electrical Power System Enhancement and Improvements Action Plan are detailed in the PRDOH Citizen Participation Plan. This Plan provides the opportunity for all Puerto Rico's residents to participate in the planning and assessment of PRDOH's CDBG-DR Electrical Power System Enhancement or Improvements activities.

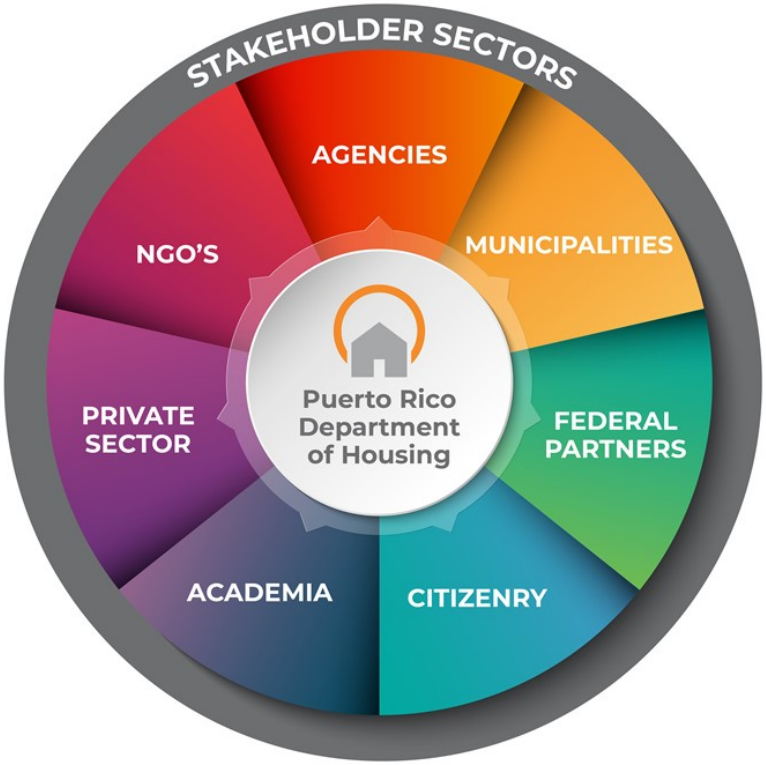


Figure 48 - Citizen Participation Matrix

Methods for Citizen Participation

The following paragraphs describe methods that will be used for citizen participation in relation to the CDBG-DR Electrical Power System Enhancement or Improvements activities. The methods described are not intended to be exclusive of other methods of citizen participation allowed by HUD.

Methods and Opportunities for Citizen Involvement:

- Public Hearings;
- Communication via the Internet;
- Information via the PRDOH Website;
- Citizen Advisory Committee(s);
- Participatory Engagement; and
- Other Methods for Citizen Participation

Through these methods, citizens may receive information about the following:

- The amount of assistance available to impacted communities;
- The range of eligible activities to be undertaken;
- Performance reports;
- Action Plan and Action Plan Amendments and comment periods;
- Program information, including how to request additional information;
- Upcoming Public Hearings, Webinars or other stakeholder sessions;
- Information to request and receive technical assistance;
- How to comment on the Citizen Participation Plan; and
- How to file a complaint.

Communication for Individuals with Disabilities

PRDOH is committed to ensuring that citizens with a disability, a record of having a disability, or are regarded as having a disability can participate and have access to any related activity or program. Consequently, PRDOH will also effectively communicate with citizens with disabilities regarding the Electrical Power System Enhancement and Improvements Action Plan, policies, and procedures. Interpretation services for sign language will be made available at Public Hearings. Notices for public meetings will include contact information for requesting a reasonable accommodation. [196] Additionally, PRDOH will ensure that program materials and meetings provide for ready access and meaningful participation by persons with disabilities through the use of assistive technology or auxiliary aids as necessary. Requests for communication aids or services should be requested at least **two (2) calendar days** in advance of the public meeting that PRDOH has a reasonable opportunity to coordinate the provision of the requested aids or services. PRDOH will make every reasonable effort to honor requests received later than **two (2) calendar days** before the public meeting.

The Electrical Power System Enhancement and Improvements Action Plan and other materials on the PRDOH website are provided in accessible formats, including those readable by screen readers to provide accessibility to the visually impaired. PRDOH will meet communications requirements at 24 C.F.R. § 8.6 and other Fair Housing and civil

[196] A change, exception, or adjustment to a rule, policy, practice, or service that may be necessary to avoid discrimination on the basis of disability and afford a person with disabilities an equal opportunity to use and enjoy a dwelling, public and common use spaces, or to participate in any government-assisted program or activity.

rights requirements, such as the effective communication requirements under the Americans with Disabilities Act of 1990, 42 U.S.C. § 12101, *et seq*.

The CDBG-DR Fair Housing and Equal Opportunity Policy and all CDBG-DR Program policies in English and Spanish at https://www.cdbg-dr.pr.gov/en/resources/policies/general-policies/ and https://www.cdbg-dr.pr.gov/recursos/politicas/politicas-generales/.

Program accessibility for individuals with disabilities may be requested at:

- Via telephone: 1-833-234-CDBG o 1-833-234-2324 (TTY: 787-522-5950)
  Attention hours: Monday to Friday from 8:00am-5:00pm
- Via email at: infoCDBG@vivienda.pr.gov – for all CDBG-DR inquiries,
- Online at: https://www.cdbg-dr.pr.gov/en/contact/ (English version)
  https://www.cdbg-dr.pr.gov/contact/ (Spanish version)
- In writing at: Puerto Rico CDBG-DR Program
  P.O. Box 21365
  San Juan, PR 00928-1365

Citizen Involvement in the Original Action Plan

The original Action Plan will be posted in English and Spanish in the PRDOH CDBG-DR Program website (https://cdbg-dr.pr.gov/en/) to allow an opportunity for public comment for no less than **forty-five (45) calendar days**, as required by 86 FR 32689. The posting will also be communicated via e-mail and/or postal mail, to non-profit organizations who work with vulnerable populations, municipalities, elected officials, and others and will be announced through the PRDOH social media site on Facebook. PRDOH will consider comments on the Action Plan or substantial amendments received in writing, via email, verbally via the Call Center, or expressed in - person or at official public hearing events.

Additionally, in an effort to permit public examination and accountability, PRDOH will make formal comments regarding the Electrical Power System Enhancement and Improvements Action Plan or substantial amendments publicly available at https://www.cdbg-dr.pr.gov/en/action-plan/ in English and https://www.cdbg-dr.pr.gov/plan-de-accion/ in Spanish. PRDOH responses to comments regarding the Electrical Power System Enhancement and Improvements Action Plan or substantial amendments will also be posted to the website. PRDOH will submit the summary of these comments or views and its response to each comment to HUD with the Electrical Power System Enhancement and Improvements Action Plan or substantial amendment.

Citizens accessing information via the CDBG-DR website in English and Spanish at https://cdbg-dr.pr.gov/en/ and https://cdbg-dr.pr.gov/ and who are seeking to comment on the CDBG-DR Energy Action Plan will be directed to the Action Plan links for public comment as outlined above.

The most current version of the approved Electrical Power System Enhancement and Improvements Action Plan, including any substantial amendments, will be posted as a stand-alone document in English and Spanish at https://www.cdbg-dr.pr.gov/en/action-plan/ and https://www.cdbg-dr.pr.gov/plan-de-accion/. Posting the Action Plan and any amendments as a single document allows the public to view the Action Plan as a whole, rather than the public having to view and cross-reference changes among multiple amendments. Citizens who cannot access the Electrical Power System Enhancement and Improvements Action Plan or proposed substantial amendments through the website may request assistance from PRDOH.

PRDOH will maintain an active website "landing page" specific to electrical system improvements in order to provide transparency on program-related updates.

Citizen Involvement in the Substantial Amendment Process

Substantial amendments are subject to a **thirty (30) calendar day** public comment period and shall be posted to the PRDOH website, where citizens will also be able to submit electronic comments or follow instructions for submitted written comments by alternative means listed on the website.

Citizen participation for substantial amendments to the Action Plan will follow the PRDOH Citizen Participation Plan, available in English and Spanish at https://cdbg-dr.pr.gov/en/citizen-participation/ and https://cdbg-dr.pr.gov/participacion-ciudadana/. Changes made via substantial amendments to the Action Plan will be highlighted or otherwise identified within the context of the entire Electrical Power System Enhancement and Improvements Action Plan. As required by 86 FR 32688, every substantial amendment will include the following:

- A section that identifies the content being added, deleted, or changed;
- Chart or table that clearly illustrates where funds are coming from and where they are moving to; and
- A revised budget allocation table that reflects all funds.

A substantial amendment is defined as an amendment that contemplates one (1) or more of the following:

- A Change in a program benefit or eligibility criteria;
- Addition or deletion of an activity or a component of the electrical power improvements; or
- Allocation or reallocation of more than 10% of grant funds.

Non-substantial Amendments to this Action Plan are not subject to a public comment period and will, therefore, follow HUD procedure requiring PRDOH to notify HUD at least **five (5) business days** before the amendment becomes effective. All non-substantial amendments will be posted to the PRDOH public website with changes to the text highlighted in grey.

Consideration of Public Comments

PRDOH will consider comments on the Action Plan or substantial amendments received in writing, via email, verbally via the Call Center or expressed in - person or at official public hearing events. Additionally, in an effort to permit public examination and accountability, PRDOH will make formal comments regarding Action Plans or substantial amendments publicly available in English and Spanish at www.cdbg-dr.pr.gov/en/action-plan/ and https://www.cdbg-dr.pr.gov/plan-de-accion/. PRDOH responses to comments regarding Action Plans, or substantial amendments, will also be posted to the website.

Communication via the internet

Public information for CDBG-DR Electrical Power System Enhancement or Improvements activities during Action Plan development can be found on a dedicated page within the CDBG-DR Program website in English and Spanish at https://cdbg-dr.pr.gov/en/ and https://cdbg-dr.pr.gov. From this page, entity and private citizen stakeholders can find more information, register for program-related notifications, and find a formal announcement for the opening of the CDBG-DR Electrical Power System Enhancement and Improvements Action Plan public comment period.

The Action Plan will be posted in its entirety to the CDBG-DR Action Plan and amendments page where all versions of the CDBG-DR Action Plan are currently located, and future CDBG-DR Action Plan and amendments will reside in English and Spanish at: https://cdbg-dr.pr.gov/en/action-plan/ and https://www.cdbg-dr.pr.gov/plan-de-accion/.

Once the CDBG-DR Electrical Power System Enhancement and Improvements Action Plan is approved by HUD and additional programs become available, all information will be integrated into the current CDBG-DR site.

Interested individuals are encouraged to comment at any time by sending an email to infoCDBG@vivienda.pr.gov for CDBG-DR Electrical Power System Enhancement and Improvements inquiries. Additionally, citizens may comment by using the "Contact Us" tool included in PRDOH's disaster recovery website. The "Contact Us" tool can be accessed directly at www.cdbg-dr.pr.gov/contact/ in English and https://www.cdbg-dr.pr.gov/contact/ in Spanish.

As part of the implementation of CDBG-DR Programs, PRDOH will regularly interact with agencies, municipalities, NGOs, and the citizens of Puerto Rico. These methods may include but are not limited to:

- Web-based surveys;
- Coordination with municipalities, non-profit or community organizations, faith-based or other organizations;
- Focus groups or interviews; and
- Other in-person meetings as requested by individuals or organizations.

The Citizen Participation Plan will continue to be updated as programs progress. Citizen comments are welcome on this Plan throughout the duration of this grant. Please contact PRDOH using the following methods:

- Via telephone: 1-833-234-CDBG o 1-833-234-2324 (TTY: 787-522-5950)
  Attention hours: Monday to Friday from 8:00am-5:00pm
- Via email at: infoCDBG@vivienda.pr.gov – for all CDBG-DR inquiries
- Online at: https://www.cdbg-dr.pr.gov/en/contact/ (English version)
  https://www.cdbg-dr.pr.gov/contact/ (Spanish version)
- In writing at: Puerto Rico CDBG-DR Program
  P.O. Box 21365
  San Juan, PR 00928-1365

Performance Report

Program performance reports, such as Quarterly Performance Reports (**QPR**), will be posted at https://www.cdbg-dr.pr.gov/en/reports/ (English) and https://cdbg-dr.pr.gov/reportes/ (Spanish) prior to submission to HUD. Citizens will be provided **fifteen (15) calendar days** to comment on performance reports, as required by 24 C.F.R. § 91.115.

Please submit your comments to PRDOH using the following methods:

- Via telephone: 1-833-234-CDBG o 1-833-234-2324 (TTY: 787-522-5950)
  Attention hours: Monday to Friday from 8:00am-5:00pm
- Via email at: infoCDBG@vivienda.pr.gov – for all CDBG-DR inquiries,
  CDBG-MIT@vivienda.pr.gov – for all CDBG-MIT inquiries
- Online at: https://www.cdbg-dr.pr.gov/en/contact/ (English version)
  https://www.cdbg-dr.pr.gov/contact/ (Spanish version)
- In writing at: Puerto Rico CDBG-DR Program/CDBG-MIT Program
  P.O. Box 21365
  San Juan, PR 00928-1365

Individuals with Limited English Proficiency

Program materials, including plans and program guidelines, will be available in English and Spanish at https://cdbg-dr.pr.gov/en/ and https://cdbg-dr.pr.gov/. For access to language access services in languages other than English or Spanish, citizens may contact PRDOH at:

- Via telephone: 1-833-234-CDBG o 1-833-234-2324 (TTY: 787-522-5950)
  Attention hours: Monday to Friday from 8:00am-5:00pm
- Via email at: infoCDBG@vivienda.pr.gov – for all CDBG-DR inquiries,
- Online at: https://www.cdbg-dr.pr.gov/en/contact/ (English version)

https://www.cdbg-dr.pr.gov/contact/ (Spanish version)

- In writing at: Puerto Rico CDBG-DR Program
  P.O. Box 21365
  San Juan, PR 00928-1365

Materials will also be disseminated among program partners, including municipalities, government agencies, non-profit organizations, and NGOs to ensure that these materials are accessible locally.

The CDBG-DR Language Access Plan will be posted in English and Spanish, along with all CDBG-DR Program policies at: https://cdbg- dr.pr.gov/en/resources/policies/ and https://cdbg-dr.pr.gov/recursos/politicas/.

Technical Assistance

PRDOH will provide technical assistance in order to facilitate public participation regarding CDBG-DR Programs upon request. The kind of technical assistance provided will be determined based on the needs of the community or of the individuals requesting assistance. This technical assistance may be requested at:

- Via telephone: 1-833-234-CDBG o 1-833-234-2324 (TTY: 787-522-5950)
  Attention hours: Monday to Friday from 8:00am-5:00pm
- Via email at: infoCDBG@vivienda.pr.gov – for all CDBG-DR inquiries,
- Online at: https://www.cdbg-dr.pr.gov/en/contact/ (English version)
  https://www.cdbg-dr.pr.gov/contact/ (Spanish version)
- In writing at: Puerto Rico CDBG-DR Program
  P.O. Box 21365
  San Juan, PR 00928-1365

Accessibility of Information and Transparency Portal

Information related to PRDOH's CDBG-DR Program, including Action Plans, Action Plan amendments, program policies and procedures, performance reports, citizen participation requirements, program information, and details of contracts and ongoing procurement policies, will be publicly available in English and Spanish at https://www.cdbg-dr.pr.gov/en/ and https://www.cdbg-dr.pr.gov/. Program information posted to the website will be available in accessible formats, including those readable by screen readers. PRDOH will make information available in alternate formats as needed and upon request to ensure effective communication to persons with disabilities.

Communication strategies will include a variety of tasks and invaluable two-way communication techniques that will provide opportunities for feedback. PRDOH may use various communication methods to notify the public of information regarding the CDBG-DR Programs and ascertain that programs are visible, accessible, and accountable to the citizens they seek to serve. The use of these methods varies based on region and

municipality. In addition to these methods of outreach and an active online presence, PRDOH regularly provides CDBG-DR written outreach materials for all municipalities to use and communicate to their constituents. These methods may include, but are not limited to:

- Print media, such as the newspaper;
- Social media;
- Radio or television advertisements;
- Letters or emails to municipalities, government agencies, non-profit organizations and NGOs;
- Notices posted to internet sites, including PRDOH's CDBG-DR and CDBG-MIT websites;
- Ads on billboards and bus stops;
- "Tumba coco" (a popular local method for communication which includes a vehicle with speakers used for promotion);
- Brochures and printed materials;
- Direct mail;
- Outbound call campaigns (live or automated);
- Email announcements;
- Community events or fairs;
- Webinars or web conferences;
- Web-based surveys;
- Focus groups or interviews;
- Community meetings;
- Press releases;
- Media events or interviews; and
- Other forms of communication accepted by HUD.

PRDOH will continue to coordinate outreach meetings with municipalities, government agencies, non-profit and community organizations, and other interested stakeholders to disseminate information related to PRDOH's CDBG-DR Electrical Power System Enhancement and Improvements Action Plan or its substantial amendments.

To promote access to information among LMI citizens, PRDOH will organize special orientation events throughout the Island or use broad-band media campaigns once the launch of the first CDBG-DR funded energy program is completed and dissemination initiatives begin. The use of direct communication with municipalities, government agencies, non-profit organizations, and NGOs as partners is intended to increase residents' access to information and is supplemental to communication between PRDOH and the residents. In addition to citizen involvement, PRDOH encourages the participation of regional and Island - wide institutions.

Simultaneously with the abovementioned efforts, PRDOH will distribute informational material through its regional offices and public residential administrators and strengthen the distribution of news information on the programs through regional media that

operate in areas where CDBG-DR funds will intervene. This is in accordance with the Plan's initiatives aimed to strengthen access to information among LMI citizens and members of minority or disabled groups.

The PRDOH CDBG-DR Communications Guide is available in English and Spanish at https://cdbg-dr.pr.gov/en/download/communications-guide/ and https://cdbg-dr.pr.gov/en/download/communications-guide/

Citizen Complaints

As part of addressing Puerto Rico's long-term recovery needs, citizen complaints on any issues related to the general administration of CDBG-DR funds are welcome throughout the duration of the grant. PRDOH aims to provide an opportunity to address all complaints received. Addressing these complaints is an essential responsibility for PRDOH, as it establishes the importance of open communication regarding citizens' concerns about the programs.

It is PRDOH's responsibility, as grantee, to ensure that all complaints are dealt with promptly and consistently and, at a minimum, to provide a timely, substantive written response to every **written** complaint within **fifteen (15) business days** where practicable, as a CDBG grant recipient. See 24 C.F.R. § 570.486(a)(7).

PRDOH aims to provide an opportunity to address all complaints received, either formally or informally. An informal complaint refers to those complaints that are verbally communicated through PRDOH program personnel. These are not subject to 24 C.F.R. § 570.486(a) (7). A complaint is a written statement of grievance. All formal complaints will be documented, processed, filed, and answered. Complaints with insufficient data or submitted by a third party with no standing in the matter need not be accepted or reviewed.

Citizens who wish to submit formal complaints related to the CDBG-DR funded activities may do so through any of the following means:

- Via email at: LegalCDBG@vivienda.pr.gov
- Online at: https://cdbg-dr.pr.gov/en/complaints/(English)
  https://cdbg-dr.pr.gov/quejas/ (Spanish)
- In writing at: Puerto Rico CDBG-DR Program
  Attn: CDBG-DR Legal Division-Complaints
  P.O. Box 21365

Although formal complaints are required to be submitted in writing, complaints may also be received verbally and by other means necessary, as applicable, when PRDOH determines that the citizen's particular circumstances do not allow the complainant to submit a written complaint. However, in these instances, PRDOH shall convert these complaints into written form. These alternate methods include, but are not limited to:

- Via telephone: 1-833-234-CDBG or 1-833-234-2324 (TTY: 787-522-5950) Attention hours: Monday to Friday from 8:00am-5:00pm
- In-person at: PRDOH Headquarters Office or Program Intake Centers

The Citizen Complaints Policy and all CDBG-DR Program policies are posted in both English and Spanish at https://www.cdbg- dr.pr.gov/en/resources/policies/general-policies/ and https://www.cdbg-dr.pr.gov/recursos/politicas/politicas-generales/.

Anti-Fraud, Waste, Abuse or Mismanagement

PRDOH, as grantee, is committed to the responsible management of CDBG-DR and CDBG-MIT funds by being a good advocate of the resources while maintaining a comprehensive policy for preventing, detecting, reporting, and rectifying fraud, waste, abuse, or mismanagement.

PRDOH implements adequate measures to detect and prevent fraud, waste, abuse, or mismanagement in all Programs administered with CDBG-DR funds. It also encourages any individual who is aware, or suspects, any kind of conduct or activity that may be considered an act of fraud, waste, abuse, or mismanagement, regarding the CDBG-DR Program, to report such acts to the CDBG-DR Internal Audit Office, directly to the Office of Inspector General (OIG) at HUD, or any local or federal law enforcement agency.

The Anti-Fraud, Waste, Abuse, or Mismanagement Policy (**AFWAM Policy**) is established to prevent, detect, and report any acts, known or suspected, of fraud, waste, abuse, or mismanagement of CDBG-DR funds. This Policy applies to any allegations or irregularities, either known or suspected, that could be considered acts of fraud, waste, abuse, or mismanagement, involving any citizen, previous, current or potential applicant, beneficiary, consultant, contractor, employee, partner, provider, subrecipient, supplier, and/or vendor under the CDBG-DR Program.

REPORT FRAUD, WASTE, ABUSE, OR MISMANAGEMENT TO PRDOH CDBG-DR	
CDBG-DR Hotline	787-274-2135 (English/Spanish/TTY)
Postal Mail	Puerto Rico Department of Housing CDBG-DR Internal Audit Office P.O. BOX 21355 San Juan, PR 00928-1355
Email	hotlineCDBG@vivienda.pr.gov
Internet	Filling out the AFWAM Submission Form available in English and Spanish at www.cdbg-dr.pr.gov or https://cdbgdr.pr.gov/app/cdbgdrpublic/Fraud

In person	Request a meeting with the Deputy Audit Director of the CDBG-DR Internal Audit Office located at PRDOH's Headquarters at 606 Barbosa Avenue, Building Juan C. Cordero Dávila, Río Piedras, PR 00918.

REPORT FRAUD, WASTE, ABUSE, OR MISMANAGEMENT DIRECTLY TO HUD OIG	
HUD OIG Hotline	1-800-347-3735 (Toll-Free) 787-766-5868 (Spanish)
Postal Mail	HUD Office of Inspector General (OIG) Hotline 451 7th Street SW Washington, D.C. 20410
Email	HOTLINE@hudoig.gov
Internet	https://www.hudoig.gov/hotline

The AFWAM Policy and all CDBG-DR Program policies are available in English and Spanish on the PRDOH website at https://www.cdbg-dr.pr.gov/en/resources/policies/general-policies/ and https://www.cdbg-dr.pr.gov/recursos/politicas/politicas-generales/.

Stakeholder Engagement Description

Stakeholder engagement includes gathering and sharing information, dealing with concerns and grievances from stakeholders, measuring the impact and importance of different stakeholder groups, communicating back and forth through various methods, and more. The target is to incorporate stakeholder engagement as part of the CDBG-DR Electrical Power System Enhancement and Improvements Action Plan strategic planning process, taking into consideration the following steps:

- Identify the diverse stakeholder groups as part of the initial screening process;
- Identify who the stakeholders' representatives are;
- Create a system to solicit their feedback;
- Incorporate their feedback into the strategic planning process;
- Use their feedback and concerns to prioritize their needs; and
- Report back

Stakeholder Engagement

As per HUD guidance found at 86 FR 32681, 32682, PRDOH conducted a series of stakeholder engagement and outreach activities to integrate data, research, and stakeholder input as part of the Electrical Power System Enhancement and Improvements Action Plan development phase. The stakeholder engagement efforts allowed PRDOH to consult with disaster-affected local governments and electric power authorities in determining the use of funds.

Additionally, other valuable stakeholders, such as municipalities, Federal partners, NGOs, such as the Puerto Rico College of Engineers and Surveyors, and the private sector, such as the Puerto Rico Manufacturers Association, academic sector, and other stakeholders, were incorporated into the draft development process to ensure the Action Plan's effectiveness.

The stakeholder engagement process conducted by PRDOH for the Electrical Power System Enhancement and Improvements Action Plan is included in [Appendix to be provided at Action Plan submittal] and is divided in two (2) phases: the efforts undertaken as part of the Action Plan development process, and the outreach and public engagement activities conducted as part of the Action Plan public comment period. The affected municipalities, PREPA (owner of the Transmission and Distribution Grid), and LUMA, as the operator, informed the unmet needs assessment and will continue to be engaged as critical stakeholders for the Action Plan preparation, as their participation is needed to support the implementation of the programs. Additionally, citizens and other affected entities also participated and provided valuable feedback on the Action Plan draft.

Certifications

ACTION PLAN CERTIFICATIONS

The Puerto Rico Department of Housing (PRDOH) makes the following certifications with its Action Plan:

a. The Puerto Rico Department of Housing certifies that it has in effect and is following a residential anti-displacement and relocation assistance plan in connection with any activity assisted with funding under the CDBG-DR Program.

b. The Puerto Rico Department of Housing certifies its compliance with restrictions on lobbying required by 24 C.F.R. Part 87, together with disclosure forms, if required by Part 87.

c. The Puerto Rico Department of Housing certifies that the Electrical Power System Enhancement and Improvements Action Plan is authorized under State and local law (as applicable) and that PRDOH, and any entity or entities designated by PRDOH, and any contractor, subrecipient, or designated public agency carrying out an activity with CDBG–DR funds, possess(es) the legal authority to carry out the program for which it is seeking funding, in accordance with applicable HUD regulations and the notice 86 FR 32681 ("**Notice**"). PRDOH certifies that activities to be undertaken with funds under this notice are consistent with its Action Plan.

d. The Puerto Rico Department of Housing certifies that it will comply with the acquisition and relocation requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (URA), as amended, and implementing regulations at 49 C.F.R. Part 24, except where waivers or alternative requirements are provided for the Notice.

e. The Puerto Rico Department of Housing certifies that it will comply with section 3 of the Housing and Urban Development Act of 1968 (12 U.S.C. § 1701u) and implementing regulations at 24 C.F.R. Part 75.

f. The Puerto Rico Department of Housing certifies that it is following a detailed citizen participation plan that satisfies the requirements of 24 C.F.R. § 91.115 (except as provided for in notices providing waivers and alternative requirements for this grant). Also, each local government receiving assistance from a State grantee must follow a detailed citizen participation plan that satisfies the requirements of 24 C.F.R. § 570.486 (except as provided for in notices providing waivers and alternative requirements for this grant).

g. The Puerto Rico Department of Housing certifies that it has consulted with affected local governments in municipalities designated in covered major disaster declarations in the non-entitlement, entitlement, and tribal areas of the State in determining the uses of funds, including the method of distribution of funding, or activities carried out directly by the State.

h. The Puerto Rico Department of Housing certifies that it is complying with each of the following criteria:

   1. Funds will be used solely for necessary expenses of electrical power system enhancements and improvements in the most impacted and distressed areas as defined by HUD in section II of the Notice.

   2. With respect to activities expected to be assisted with CDBG–DR funds, the Action Plan has been developed so as to give the maximum feasible priority to activities that will benefit low- and moderate-income families.

   3. The aggregate use of CDBG–DR funds shall principally benefit low- and moderate-income families in a manner that ensures that at least 70% (or another percentage permitted by HUD in a waiver published in an applicable Federal Register notice) of the grant amount is expended for activities that benefit such persons.

   4. PRDOH will not attempt to recover any capital costs of public improvements assisted with CDBG–DR grant funds, by assessing any amount against properties owned and occupied by persons of low- and moderate-income, including any fee charged or assessment made as a condition of obtaining access to such public improvements, unless:

      (a) Disaster recovery grant funds are used to pay the proportion of such fee or assessment that relates to the capital costs of such public improvements that are financed from revenue sources other than under this title; or

      (b) for purposes of assessing any amount against properties owned and occupied by persons of moderate income, PRDOH certifies to the Secretary that it lacks sufficient CDBG funds (in any form) to comply with the requirements of clause (a).

i. The Puerto Rico Department of Housing certifies that the grant will be conducted and administered in conformity with title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d), the Fair Housing Act (42 U.S.C. §§ 3601– 3619), and implementing regulations, and that it will affirmatively further fair housing.

j. The Puerto Rico Department of Housing certifies that it has adopted and is enforcing the following policies, and, in addition, certifies that it will require local governments that receive grant funds to certify that they have adopted and are enforcing:

   1. A policy prohibiting the use of excessive force by law enforcement agencies within its jurisdiction against any individuals engaged in nonviolent civil rights demonstrations; and

   2. A policy of enforcing applicable State and local laws against physically barring entrance to or exit from a facility or location that is the subject of such nonviolent civil rights demonstrations within its jurisdiction.

k. The Puerto Rico Department of Housing certifies that it (and any subrecipient or administering entity) currently has or will develop and maintain the capacity to carry out disaster recovery activities in a timely manner and that the grantee has reviewed the requirements of the Notice. The grantee certifies to the accuracy of its previously submitted CDBG–MIT Financial Management and Grant Compliance certification checklist and addendums, or other recent certification submission, if approved by HUD, and related supporting documentation referenced at V.A.1.a. in the Notice and Implementation Plan and Capacity Assessment and related submissions to HUD referenced at V.A.1.b. of the Notice.

l. The Puerto Rico Department of Housing certifies that it will not use CDBG–DR funds for any activity in an area identified as flood prone for land use or hazard mitigation planning purposes by the State, local, or tribal government or delineated as a Special Flood Hazard Area (or 100-year floodplain) in FEMA's most current flood advisory maps, unless it also ensures that the action is designed or modified to minimize harm to or within the floodplain, in accordance with Executive Order 11988 and 24 C.F.R. Part 55. The relevant data source for this provision is the State, local, and tribal government land use regulations and current hazard mitigation plans and the latest-issued FEMA data or guidance, which includes advisory data (such as Advisory Base Flood Elevations) or preliminary and final Flood Insurance Rate Maps.

m. The Puerto Rico Department of Housing certifies that its activities concerning lead-based paint will comply with the requirements of 24 CFR Part 35, subparts A, B, J, K, and R.

n. The Puerto Rico Department of Housing certifies that it will comply with environmental requirements at 24 C.F.R. Part 58.

o. The Puerto Rico Department of Housing certifies that it will comply with applicable laws.

Warning: Any person who knowingly makes a false claim or statement to HUD may be subject to civil or criminal penalties under 18 U.S.C. § 287, 1001 and 31 U.S.C. § 3729.

Signature:

THIS IS A DRAFT FOR PUBLIC COMMENTS – NO SIGNATURE REQUIRED

William O. Rodríguez Rodríguez, Esq.
Secretary Puerto Rico Department of Housing

LIST OF TABLES

Table 1 – Transmission and Distribution Baselines and Benchmarks 11
Table 2 - Customer Service Benchmarks 11
Table 3 - Number of Power Plants by Risk/Vulnerability 28
Table 4 - Number of Power Sub-stations by Risk/Vulnerability 30
Table 5 - Number of Power Transmission Centers by Risk/Vulnerability 33
Table 6 - Demographic Profile for Puerto Rico 46
Table 7 - Rotated Component Matrix for SoVI (All Puerto Rico Census Tracts). 49
Table 8 - Total Estimated Cost by Asset Category and Funding Source from PREPA 10-Year Plan 56
Table 9 - Photovoltaic projects proposed by PRASA 60
Table 10 - Non-PRASA Photovoltaic Projects 64
Table 11 - Impact Estimates 71
Table 12 - Resilience Projects 72
Table 13 - Available Funds 73
Table 14 - Unmet Needs Assessment 74
Table 15 - Summary of Applicable Puerto Rico Legislation 76
Table 16 - Applicable Federal Legislation 81
Table 17 - Funding Matrix 106
Table 18 - Summary of Program Budgets. *LMI Calculation does not include Administration and Planning. 109
Table 19 - ER1 Program Budget 111
Table 20 - ER2 Program Budget 116

LIST OF FIGURES

Figure 1 - CDBG-DR and CDBG-MIT Allocations for Puerto Rico related to Hurricanes..... ii
Figure 2 - Dos Bocas Hydroelectric Plant 3
Figure 3 - Puerto Rico Economic Activity Index, from the Government Development Bank of Puerto Rico (Source: U.S. Department of Energy; Energy Resilience Solutions for the Puerto Rico Power Grid, Final Report, June 2018).....6
Figure 4 - Existing Generation Mix in Puerto Rico [Pre-storm] (Source: NREL – https://https://www.nrel.gov/docs/fy15osti/62708.pdf) 7
Figure 5 - Map of Puerto Rico main Electric Power Generation and Transmission Infrastructure (Source: Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on June 27, 2019) ..8
Figure 6 – PREPA Electric System Heat Rate 2019-2020 10
Figure 7 - Electric Power Interdependency Examples (Source: ANL; U.S. Department of Energy: Energy Resilience Solutions for the Puerto Rico Power Grid, Final Report, June 2018; as modified by PRDOH) 12
Figure 8 - Chain Effect of the Financial Situation of PREPA (Source: 2020 Fiscal Plan for the Puerto Rico Electric Power Authority, as certified by the Financial Oversight and Management Board for Puerto Rico on June 29, 2020).....15
Figure 9 - Path of Hurricanes Irma and María passed through Puerto Rico, September 2017 (Source: GAO Analysis of National Oceanic and Atmospheric Administration data: Map Resources / GAO-20-221) 16
Figure 10 – Residents of Carolina seeking fuel for emergency generators after Hurricane María 17
Figure 11 - Puerto Rico illumination comparison before and after Hurricane María. 18
Figure 12 - Hurricane María's path across Puerto Rico and the Main transmission and generation assets of Puerto Rico's power grid (Source: Hurricane María Effects on Puerto Rico Electric Power Infrastructure- IEEE) 19
Figure 13 - Hurricane Wind Hazard Occurrences (1989-2018).....20
Figure 14 - Events larger than M 2.5 detected by the Puerto Rico Seismic Network between December 8, 2019 to January 7, 2020 (Source: Puerto Rico Seismic Network) 21
Figure 15 – Percent Land Area in Tsunami Hazard Zone 22
Figure 16 - Earthquake Hazard Areas.....23
Figure 17 - Representation of PREPA 230KV power transmission lines as a GIS "line" features and B.1-meter spaced GIS "point" features.....26
Figure 18 - A. Power Generation Stations across Puerto Rico and B. Red squares indicate stations located in at risk or vulnerable areas 27
Figure 19 - A. Power Sub-Stations across Puerto Rico and B. Red squares indicate stations located in at risk, low-income, or vulnerable areas 29
Figure 20- Sea Level Rise Scenario - Three Meters Flood – Arecibo's Coastline 31
Figure 21 - A. Power Transmission Centers across Puerto Rico and B. Red squares indicate stations located in at risk or vulnerable areas. 32
Figure 22- Sea Level Rise Scenario - Three Meters Flood – Ponce's Coastline.....32

Figure 23 - Fallen wooden and concrete electric distribution pole at Puerto Rico Highway 65 34
Figure 24 - Guaynabo, Puerto Rico – Power lines remain broken and down along roads and residential areas nearly three months after Hurricane María 35
Figure 25 - Inoperable and damaged wind turbines at Punta Lima wind farm after Hurricane María in Naguabo, Puerto Rico 36
Figure 26 - Wooden electrical distribution pole damaged by Hurricane María at Trujillo Alto, Puerto Rico 38
Figure 27 - Electric Infrastructure Power Distribution Lines & Health Services Providers 39
Figure 28 - Population per Hex Grid 43
Figure 29 - Electric Infrastructure Power Distribution Lines and LMI Population 44
Figure 30 - Social Vulnerability (2018) 47
Figure 31 - Functional Diversity Descriptions 50
Figure 32 - Regional Power Recovery in Puerto Rico after Hurricane María (Source: Castro-Sitiriche, M., Cintrón-Sotomayor, Y., and Gómez-Torres, J. (2018). The Longest Power Blackout in History and Energy) 51
Figure 33 - Municipalities in Grey had 0% Electric Power on November 20, 2017 (Source: M. Castro-Sitiriche, Y. Cintrón-Sotomayor and J. Gómez-Torres, "The Longest Blackout in History and Energy Poverty") 52
Figure 34 - PRASA Potable Water Distribution System & Electric Distribution 38KV Power Line 61
Figure 35 - PRASA PV Proposed Projects Locations 62
Figure 36 - Drinking Water and Wastewater systems serviced by PRASA.[38] 63
Figure 37 - Non-PRASA System with PV Solar System 65
Figure 38 – Non-PRASA System with Energy Storage 65
Figure 39 - LUMA Hosting Capacity Dashboard 68
Figure 40 – Types of Renewable Energy Sources 77
Figure 41 - Total U.S. Greenhouse Emissions by Sector. Percentages may not add up to 100% due to independent rounding. 80
Figure 42 - Oversight Structure 85
Figure 43 - CDBG-DR Eligibility Criteria 89
Figure 44 - Optimized O&M Program 99
Figure 45 - Management Distribution Models 103
Figure 46 - FEMA's Public Assistance Procedure 107
Figure 47 - Complementary CDBG-DR Portfolios 108
Figure 48 - Citizen Participation Matrix 126


Appendices

Appendices to the Action Plan can be found on the PRDOH website at: www.cdbg-dr.pr.gov/en/action-plan/ in English; and at https://www.cdbg-dr.pr.gov/plan-de-accion/ in Spanish. Appendices include:

- Appendix A – [Reserved for Public Comments and Answers – Public Comment Period]
- Appendix B – Public Comments and Answers – First Public Hearing.
- Appendix C – [Reserved for Public Comments and Answers – Second Public Hearing].
- Appendix D – Stakeholder Engagement Report.
- Appendix E – Projections of Expenditures and Outcomes
- Appendix F – Bibliography
- Appendix G – Main Reports

DEPARTMENT OF
HOUSING