Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy Study (PR100)

Puerto Rico's Energy Transition

Puerto Rico has committed to meeting its electricity needs with 100% renewable energy by 2050, along with realizing interim goals of 40% by 2025, 60% by 2040, the phaseout of coal-fired generation by 2028, and a 30% improvement in energy efficiency by 2040 as established in Puerto Rico Energy Public Policy Act (Act 17). To meet these goals and support widespread end-use electrification, Puerto Rico is exploring renewable energy and innovative technologies for energy storage, distributed generation, distribution control, electric vehicles, and energy efficient and responsive loads that can be deployed in each of Puerto Rico's cities and communities.

The PR100 Study

Since Hurricanes Irma and Maria in September 2017, DOE and its national laboratories partnered with the Federal Emergency Management Agency (FEMA) and the Government of Puerto Rico to provide Puerto Rico energy system stakeholders with tools, training, and modeling support to enable planning and operation of the electric power grid with more resilience against further disruptions. Launched in February 2022, a two-year study entitled Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy (PR100) will perform a comprehensive analysis of stakeholder-driven pathways to Puerto Rico's clean energy future. The robust and objective energy analysis entails five activities, with an emphasis on power system reliability, resilience, and generation planning.
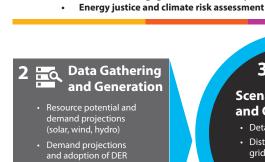
PR100 Core Activities

Activity 1—Responsive Stakeholder Engagement and Energy Justice.

The foundation of this study is extensive engagement with Puerto Rico energy system stakeholders to inform the development of scenarios to meet the Commonwealth's goal of 100% renewable energy by 2050. Energy justice considerations and climate risk assessments will be incorporated into the studies' modeling efforts.

Activity 2—Data Gathering and Generation.

Scenario decisions require high-quality input data on local renewable resources and demand projects. Renewable resources will be assessed for Puerto Rico to determine their potential, including solar, wind, and hydropower. Detailed demand projections will be produced and analyzed, including load shapes and expected load flexibility, distributed energy resource adoption, etc. Data-gathering and generation efforts will accurately assess generation and transmission portfolios.

1 Responsive Stakeholder Engagement and Energy Justice
- Stakeholder engagement inclusive of procedural justice
- Energy justice and climate risk assessment

2 Data Gathering and Generation
- Resource potential and demand projections (solar, wind, hydro)
- Demand projections and adoption of DER (considering load, EVs, energy efficiency, distributed PV and storage)

3 Scenario Generation and Capacity Evaluation
- Detailed scenario generation
- Distributed PV and storage grid capacity expansion
- Production cost and resource adequacy

4 Impacts Modeling and Analysis
- Bulk system analysis for enhanced resilience
- Distribution system analysis
- Economic impacts

5 Reports, Visualizations, and Outreach
- Scenarios for grid resilience and 100% renewable electricity for Puerto Rico
- Reports and outreach
- Implementation roadmap

The five steps of the PR100 process. Illustration by NREL.

KEY OUTPUTS OF THE PR100 STUDY

6 months	Established stakeholder group meets monthly to inform scenarios. Four initial scenarios to achieve Puerto Rico goals. (June 2022)
12 months	Three feasible scenarios, refined from original four, initial modeling and analysis results, and high-resolution wind and solar resource data sets for Puerto Rico.
24 months	Report and associated outreach materials, including workshops, web-based communications, and immersive visualizations, presenting the results of the component tasks and describing possible scenarios. (December 2023)

Activity 3—Scenario Generation and Capacity Evaluation.

Based on stakeholder input and data from previous activities, feasible scenarios for reaching the 100% renewable energy goal by 2050 will be selected. Capacity expansion analysis of the scenarios will optimize the generation, transmission, and storage portfolios to meet resilience, reliability, affordability and safety objectives, and resource adequacy analysis will assess adequacy of system capacities to meet contingencies. Production cost modeling will simulate resource dispatch based on cost and system constraints for energy generation, storage, and flexible loads (including demand management).

Activity 4—Impacts Modeling and Analysis.

Power flow and dynamic analysis will help system operators understand the implications of 100% renewable electricity on system resilience, reliability, and stability in the system models of feasible scenarios. Distribution system analysis will identify the impacts of these various scenarios on distribution system reliability (e.g., effects on voltage margins, power quality, and protection). The microeconomic and macroeconomic impacts of each scenario will be evaluated and incorporated into the final deliverables.

Activity 5—Reports, Visualizations, and Outreach

This activity encompasses integrated data management and visualization, reports and outreach, and an implementation roadmap for Puerto Rico stakeholders to implement the study recommendations.

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Contributors

- **Federal Agencies:** The project is led by the U.S. Department of Energy's Grid Deployment Office and funded through an interagency agreement with the Federal Emergency Management Agency.

- **National Laboratories:** World-class analysis performed by National Renewable Energy Laboratory (lead lab) with Argonne National Laboratory, Lawrence Berkeley National Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, and Sandia National Laboratories.

- **Steering Committee:** Federal recovery funders and local public implementers (e.g., the Puerto Rico Electric Power Authority, LUMA Energy, Puerto Rico Energy Bureau [PREB], and the Puerto Rico Department of Housing) help guide DOE's portfolio of technical assistance projects.

- **Advisory Group:** A panel of stakeholders convenes regularly to provide relevant external perspectives to the national laboratories. Types of organizations represented include universities and other research institutions; federal and Puerto Rico government entities; solar and storage industries; finance, legal, community-based, and environmental organizations; retail, manufacturing, and consultants; and others.

- **Other contributors:** University of Puerto Rico at Mayagüez and Hispanic Federation of Puerto Rico