Rural microgrids port vila

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In late September 2022, Hurricane Fiona slammed into Puerto Rico, unleashing torrential rain and winds of up to 110 miles per hour. During the resulting island-wide power failure, Sonia Sanchez needed a place to power her medical equipment for her pulmonary treatment. Fortunately, Sanchez lives in Castañer, a small town in the central Puerto Rican mountains that is home to the “Microrred de la Montaña” (Microgrid of the Mountain), a small, autonomous energy system consisting of solar panels and batteries. While everyone else on the island lacked power, she could plug her equipment into one of the establishments powered by the microgrid.

Having a microgrid in Castañer is important because it is so remote and difficult to access, particularly during extreme weather events. Heavy rains and strong winds from hurricanes result in flash floods, downed trees, and loss of power, preventing the operation of critical services like gas stations and water treatment plants. A microgrid, which is a small network of electricity users and distributed energy resources, can operate independently to supply electricity to these critical services when the main grid is not functioning.

Hurricane Fiona arrived precisely five years after Maria, hitting a power grid that still had not fully recovered. At the height of Fiona’s destruction, more than 1.3 million utility customers, or 3.1 million Puerto Ricans, were left without power. The already embattled Puerto Rico Electric Power Authority (PREPA), weakened by structural corruption, bankruptcy proceedings, and Hurricane Maria, struggled to provide power to Puerto Rican families and businesses.

Fiona’s devastation opened up old wounds from Maria that had not healed and revealed systemic weaknesses in Puerto Rico's power grid that have not been adequately addressed. After Maria, PREPA did not sufficiently increase the power and transmission system’s reliability and resilience against storms. Instead, PREPA sold its transmission grid to a private firm (LUMA) and continued pushing for more fossil fuel energy buildout, including a new natural gas power plant.

There is some good news coming out from Puerto Rico on solar adoption. While there were solar panels on the island before Maria hit, more than 45,000 panels have been installed in the years since. Puerto Rican households have placed more than 200 megawatts of solar panels atop roofs in the five years after Maria. These residential solar systems provide almost all of the solar energy going into the grid, as there are very few large-scale solar projects on the island. Most of these distributed solar arrays are paired with battery storage, allowing families and businesses to store energy when it is sunny and use it during power outages.

Rural communities in Puerto Rico are banding together to host solar-powered microgrid systems for emergencies like Hurricane Fiona and for day-to-day use. Electricity prices have increased to 33 cents per kWh in 2022—almost double the 2020 rate—due to global increases in the cost of natural gas, which needs to be imported to the island. Energy costs in Puerto Rico are more than two times the national

average for residential power—emphasizing the need to install more solar panels to decrease fossil fuel reliance and lower energy prices.

The Cooperativa Hidroeléctrica de la Montaña—the first rural electric cooperative on the island—is developing the Microrred de la Montaña to support these rural communities in case of power outages. After Maria’s devastation, C.P. Smith, executive director of the Cooperativa, was looking to empower rural communities and support them to become energy-independent, particularly from PREPA. Born in Utuado, he returned to this rural region to start the Cooperativa and his municipality is now served by a microgrid.

When fully completed, the Microrred de la Montaña will connect dozens of private and public buildings with up to five megawatts of solar and batteries so that community members can power their vital devices in case of a power outage.

The first microgrid has reliably provided power to seven buildings in Castañer—five commercial entities and two homes, including a bakery, a barbershop, a post office, an ice cream shop, and an apartment building. They are all located next to each other and share power stored in batteries. Solar panels provide power to the buildings and charge the batteries during daytime hours.

When designing a microgrid, it is key to understand the demand profile and energy usage of the buildings connected to it. A power analysis determined that the buildings in Castañer had an energy peak of 18 kW, so the battery packs were selected at that size to keep power flowing during a power outage. A manual transfer switch allows the Castañer microgrid to disconnect from the island-wide power grid when the power grid goes out. Grid inverters help regulate energy flows from the solar panels, particularly when the grid fails. At that point, the Cooperativa, through a monitoring system, can manage the 30-kW capacity solar system to optimize resources and avoid energy losses.

In October 2022, the second microgrid also in Castañer started operating with 74 kW of solar panels and 92.5 kWh of battery storage installed across five buildings.

"The microgrid, which is part of the first phase of the Microrred de la Montaña, operated before, during, and after the passing of Hurricane Fiona,” Smith said. “The hurricane left the region without electricity, but the business owners connected to the microgrid were able to provide services to the local community. Energizing these businesses served as inspiration for the community that better days are coming and that the community can support essential services to accelerate the recovery process."