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Puerto Rico: Infrastructure

### **Puerto Rico: Assessing hurricane damage and rebuilding electric grid**

In the fall of 2017, Puerto Rico suffered a great hit in the form of a natural disaster. In a year when there were many hurricanes, the one in Puerto Rico was almost overshadowed, but the effect Hurricane Maria had on Puerto Rico's agriculture is something that should be taken very seriously. According to most statistics, Puerto Rico lost 80 percent of its crop value. (Nace).

Puerto Rico has a population of 3.4 million, with about 23 percent of Puerto Ricans living in a rural community. Puerto Rico has a republican form of government that is subject to the jurisdiction and sovereignty of the United States, as it is a United States territory. This means that their President is Donald Trump, but they have a governor, Ricardo Rosselló, who has held the office since January of 2017. Arable land was reported at 6.8771% in 2014. While Puerto Rico's main trading partner is the United States, they also export to the Netherlands, the Dominican Republic, the United Kingdom, Japan, and Ireland. Most agricultural products are kept domestic within the territory, as their major exports are chemicals, clothing, electronics, rum, beverage concentrates, and medical equipment. In the 2012 agricultural census, it was reported that the average Puerto Rican farm is around 43 acres, which had grown from the previous year. The climate is described on the Köppen climate scale as similar to a tropical rainforest. It is warm to hot year round, with temperatures ranging from 85 degrees Fahrenheit in lower elevations to 70 degrees Fahrenheit in the mountains and higher elevations. (Trading Economies).

The average household in Puerto Rico has about three people. In rural areas, most families live in conditions not much above that of a shanty or shack. This is an early example of the class divide in Puerto Rico, as there is also a lot of very expensive and luxurious beachfront real estate in Puerto Rico as well. The typical, native food of Puerto Rican families include a lot of carbohydrates, like bread and grains. They also include proteins and calcium, mostly from rice, beans, chicken, pork, and beef. Most ethnic meals are either bought at a marketplace or raised by the family. Because of the close vicinity of the United States, many Puerto Rican families have Americanized their diets, which now include pizza, hot dogs, and spaghetti. (Data USA).

The average household income in Puerto Rico is around \$18,626 (Data USA). 45% of citizens live in poverty and 10.5% of Puerto Rican citizens are unemployed (Goldstein). Most Puerto Ricans do not hold jobs directly related to agriculture, as the most held job is an administrative assistant (Data USA). When it comes to education, however, we can see that there is a more direct line drawn to agriculture, as Puerto Rico has a relatively high number of Bachelor's degrees for agricultural business operations and agricultural economics (Data USA). The healthcare situation in Puerto Rico could be considered a crisis (Robles). Immediately following the hurricane, there were less than 10 heart surgeons on the island, whose population is 3.4 million (Robles). Of the 69 hospitals, 64 were operating, with even less operating at 100 percent capability (Robles). After the hurricane, 80 percent of the Islanders were without power for over a week, and more than a million did not have access to clean drinking water as the water supply was contaminated by hazardous waste and animal excrement (Robles). Many families in Puerto Rico are still feeling the effects of the storm that lasted only a few short days. Thousands of homes were destroyed and emergency relief response is steady, but slow-going. While Puerto Rico can get back on its feet, how long will it be before it can be a safe and comfortable place for the everyday people?

Several months after Hurricane Maria ravaged Puerto Rico and the U.S. Virgin Islands, a majority of the country was still without power. Many officials and experts from the mainland United States and Puerto Rico have said that to save Puerto Rico's electric grid, it will need to be rebuilt from the ground up. The

length of Puerto Rico's blackout is surprising, given that it is a territory of the most advanced country in the world. But from this tragedy, an exciting and interesting opportunity has arisen. In short, Puerto Rico could be a perfect example of a country deriving most of its power from renewable energy. As it stands now, there are very few countries that get most of their power from renewable energy, and only a few are in the Western hemisphere. If the United States truly wanted to throw support behind the future of renewable energy, we would rebuild Puerto Rico as the perfect example. (Heal).

Before the hurricane, Puerto Rico got a massive majority of its power from oil, coal, and natural gas, but only 2 percent from renewable sources like solar and wind power. Puerto Rico generates 48 percent of its power from oil-fire powered plants, which can cost between 15 and 20 cents per kilowatt-hour. This puts Puerto Rico in a position where they are paying almost twice as much for power as any other state or territory, none of which use oil-fire powered electricity plants as their main source of power. Current estimates say that rebuilding this nonrenewable energy system will cost billions of dollars. (Heal).

The cost of electricity in Puerto Rico could drop drastically if they made a full commitment to renewable energy. On an average day in the Caribbean, the sun shines for about 7.44 hours per day, maximizing the capability of solar power in Puerto Rico. Strong, tropical winds known as the trade winds would provide the perfect conditions for wind energy. These two practices of renewable energy are the cheapest options for renewable energy and would reduce the typical price for power to 5 cents per kilowatt-hour, at a maximum. (Heal).

This low cost for energy would be useful for all the people of Puerto Rico, driving down the usually high cost of energy in their country. While paying less for power, it would give them more to spend on food and other necessities. It would also create a more attractive Puerto Rico, where low energy costs would attract more businesses and clean air would boost tourism in new areas of the island country. Puerto Rico could also implement rooftop solar panels and low-voltage power lines, which can be buried beneath the ground. These would replace the long-range power lines that were ultimately destroyed in Hurricane Maria. (Heal).

On the topic of electricity costs in Puerto Rico and the potential for solar energy, there was a very interesting story to come out of Puerto Rico in April of 2018. CNN interviewed a man that had grown tired of the unpredictable and constant blackouts and decided to take matters into his own hands (Murphy). Instead of relying in the spotty electrical grid or buying gas for his generator, he invested in a solar energy kit (Murphy). Deciding the \$7,500 to buy and install the system was cheaper and more convenient than paying \$350 a month for gas (Murphy). And although he did say that the Tesla model battery would have been more expensive (around \$10,000), that is the price for a personal battery and Tesla offered to install industrial-sized batteries across Puerto Rico for free (Murphy).

The only problem that Puerto Rico faces is the same problem facing all renewable energy countries. The storage of solar and wind energy is a hole that many skeptics point to about renewable energy. But thanks to recent technological advancements, it looks like that worry may be a thing of the past. Southern Australia has a substantial amount of wind power, but that business was failing because of the near-unpredictable weather patterns. Tesla has recently installed the world's largest lithium-ion battery in Southern Australia to store power and release it when wind power is not being generated. The automaker company has also publicly stated they would be willing to do the same for Puerto Rico. (Heal).

Tesla's battery in Southern Australia really is quite impressive. The project began in December of 2017, and allowed for Neoen, the wind energy company who operates the battery, to make over one million dollars in profits in just a few days. The battery is able to charge itself in times of overproduction of power and can switch to discharging power in a fraction of a second. The very same month the battery went into operation, a coal plant in the area crashed. The battery was able to respond within milliseconds and started releasing stored energy to stabilize the shortage in the grid. Due to Australia's fluctuating

energy market, having a reliable source of electricity is very desirable, allowing Neoen to sell electricity for over \$10,000 per megawatt hour. (Lambert).

As of June 2018, Elon Musk revealed that Tesla is currently working on 11,000 projects across Puerto Rico (Brown). This revelation follows Tesla sending over 1,000 batteries to the island nation in April, which are now powering about 662 different locations (Brown). These batteries are being used to store power gained from already existing solar power arrays in sewer treatment plants, hospitals, elderly communities, and orphanages (Brown). Each of these powerpacks reportedly hold 550-kilowatt-hours each (Brown). One of the new June projects was photographed and reported on by a resident, who reported that the newly built battery and solar array created sufficient energy and even put about 40-kilowatt-hours worth of power in a single day (Brown).

The one major downside of the prospect of completely converting Puerto Rico to renewable energy is the fact that the setup of new renewable energy systems largely involves the use of fossil fuels and other nonrenewable resources. This first step is another retort from renewable energy skeptics. While it should be no secret that the construction and transport of the equipment needed for solar and wind energy does rely on the use of nonrenewable resources, the world governments should think of it as prepaying for the next few decades of clean, safe renewable energy. Wind and solar energy have no subsequent operating or fueling costs. They can run for the next 25 years with some basic maintenance every now and then. Any upfront costs should be covered by the lack of billing after the renewable energy systems have been established. (Heal).

Puerto Rico also has the possibility for many other benefactors to help them achieve total renewable energy. Number one is the United States, followed by many other federal agencies. All are very likely to give Puerto Rico financial aid due to it being ravaged by hurricanes. This is necessary for the island country as it is unlikely they will be able to recoup the money needed to get the project rolling because of the lack of an electric grid, being \$70 billion dollars in debt, and the lack of a stable nationwide infrastructure altogether. It is also possible that the federal government could provide Puerto Rico with a loan or allow private renewable energy companies to set up the systems there and the federal government could provide a tax exemption to them for an extended period of time, to allow the rebuilding of the electrical grid. (Heal).

Nearly six months after Hurricane Maria, the patchwork electric grid is very fragile and unreliable. Just one day before an annual meeting to showcase Puerto Rico's business opportunities, parts of San Juan were left without power suddenly after an explosion and subsequent fire at a struggling power station. The meeting already had to be rescheduled because of the slow road to recovery. The message that came from Puerto Rico's Investment Summit was that Puerto Rico was "open for business," but of course this seems far from the truth. 10,000 small businesses throughout Puerto Rico are still out of operation. As of March 5, the best estimates put Puerto Rico at a two-year recovery, assuming the electric grid and finances are rebuilt and the island territory is not hit by another storm. The latter seems unlikely as March is only a few short months from the beginning of hurricane season. (Goldstein).

Now, after eight months of Puerto Rico reeling from the devastation of Hurricane Maria, things may be starting to look brighter for the small island territory. From the information released, we can see that the U.S. government has spent about \$3.8 billion in federal funds to rebuild both the electrical grid and structure on the island (NewsHour, PBS). Though original estimates to completely rebuild were around \$10 billion, that number has now risen to \$17 billion (NewsHour, PBS). FEMA (Federal Emergency Management Agency) has been deployed to Puerto Rico by the United States government to help residents rebuild (NewsHour, PBS). Unfortunately, more than 48,000 Puerto Rican residents have reportedly been refused assistance by FEMA (NewsHour, PBS).

The people of Puerto Rico were once again victims to another tropical storm in early July. While much

less powerful than Hurricane Maria, Tropical Storm Beryl brought flash flooding to most of the island and increased the number of daily power outages Puerto Ricans have faced over the past several months (Levenson). A report released by the crews currently overseeing the rebuilding of the electrical grid says that the average number of daily power outages during Beryl were up to 13,000 (Levenson). The wind and rain was particularly troubling for those citizens whose roofs had been replaced with tarps for the past 10 months (Levenson). The effects of Tropical Storm Beryl are just further proof of how fragile the infrastructure of Puerto Rico is during this time of rebuilding and restructuring.

On the note of black outs, however, there is some positive news. Power has been restored to 99% of Puerto Rico's population is some capacity (Irfan). A current survey says that only about 1,942 customers are still completely without power, most of whom reside within the mountainous central region of the island nation (Irfan). This is quite an accomplishment seeing as Puerto Rico fell victim to a historic, island-wide blackout in April (Irfan). The devastating event was also the second largest blackout in the world, second only to Typhoon Haiyan striking the Philippines in 2013 (Irfan). The rolling blackouts the island has experienced also impacted important medical equipment, adding more to the death toll of Hurricane Maria (Irfan). An academic estimate puts this death toll around 4,600 people (Irfan). Perhaps the most interesting revelation to come from the reconstruction was the Stafford Act being enacted by FEMA, which limited the federal aid to restoring the grid to where it was and prevented them from storm-proofing the electrical grid (Irfan).

I understand that, at the time of writing this, Puerto Rico is moving forward in the realm of rebuilding the electrical grid as well as infrastructure as a whole. As previously stated, though it would be quite unfortunate to think of this outcome, it is not outside of the realm of possibility for Puerto Rico to be devastated by another tropical storm or hurricane. If this were to happen in the process of rebuilding, it would be disastrous to both the well-being of the Puerto Rican people and the undertaking of restoring the island to its former state. In light of this, I would like to stress how Puerto Rico is not the only location where an undertaking like this is possible. Rather it is a location in the western hemisphere where the first complete flip from non-renewable to renewable power could be the most achievable.

In conclusion, the entire process of rebuilding Puerto Rico's electrical grid to completely incorporate renewable energy would cost around \$17 billion (NewsHour, PBS). While this may seem like a lot, keep in mind that Hurricane Maria dealt almost \$100 billion worth of damage to the entire island nation and that there are many options that can be used simultaneously to make the process of rebuilding seem more approachable (Heal). Investing in the future of renewable energy would secure Puerto Rico's, or any nations, future of nationwide, affordable power and make it safer from larger, inevitable storms to come in the future. We, as a country, should take advantage of the situation we were dealt and use it to make Puerto Rico the picture of a society run on renewable energy.

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