# Multi-sectoral perceptions toward a sustainable energy transition in Puerto Rico
# Implications for the Post 2017 Atlantic Hurricane Season

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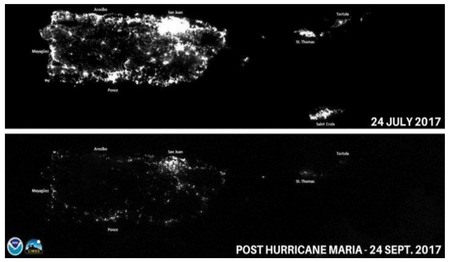
## OVERVIEW

Puerto Rico undergoes an energy transition catapulted by a financial crisis and the disastrous 2017 Atlantic Hurricane Season. After Hurricane Maria hit there is a pressure to build back "better" as soon as possible; however, the recovery process cannot only be assessed by the system's ability to absorb the shock and maintain its previous state, but also by the degree to which the system increases its adaptive capacity to more frequent atmospheric events in Puerto Rico. Transitioning away from fossil fuel dependence will require not only a substantial financial investment but also support from those that have a role in energy policy and the decision-making process. Post-disaster major reconstruction can be that unique opportunity to leverage technology innovation and social awareness to create a thriving and more sustainable future for the Puerto Ricans.

This qualitative research summarizes stakeholders' visions for the Archipelago's energy transition using data collected over two years (2015-2016). It describes shared values, and barriers and opportunities identified before the Hurricanes Irma and Maria plummeted the power grid. This research suggests that there is an opportunity to explore options that go beyond merely building back the power grid. The result of this study could nourish the constructive dialogue and conscious decision-making towards a sustainable energy transition. Indeed, deliberation is more a process than an outcome, and it is more effective without the time constraints. Understanding the 'visions of the future' that stakeholders held before the hurricane Irma and Maria is a reference point to scrutiny the pathway to the future electric system build.

## WINDOW OF OPPORTUNITY

Neither climate change effects nor the instability in fossil fuel prices pushed Puerto Rico towards more sustainable forms of energy generation at the level of commitment required. Even though Puerto Rico does not produce fossils fuels, 98% of the electric mix used to power the grid relies on a combination of oil (47%), natural gas (34%) and coal (17%); and the existing electrical infrastructure and technological capabilities were built around fossil fuels.[8] Post-disaster processes offer a window of opportunity for a sustainable energy transition but these time windows require having a vision in place when the economic investment is available.[1,2] While the power plants in Puerto Rico suffered minor damages due to the Hurricanes Irma and Maria, key transmission lines and most of the distribution grid went down causing a cascading effect where all essential services were severely compromised.[3,6]




The damage to Puerto Rico's electrical grid summoned the Puerto Rico Electric Power Authority (PREPA) to explore options that go beyond merely repairing the grid. The collapse of Puerto Rico's electrical system might be an opportunity for a sustainable energy transition, but there are socio-eco-technical aspects interacting as forces and influencing the rate and direction that the transition can occur.[5,7] Any large change to the electrical system should be planned considering a useful lifespan of several decades. An estimated 1.4 million customers will be affected by any decision that takes over the future of the PREPA. It has been suggested that islands like Puerto Rico should leverage its geographic position, local resources, and technological capabilities to focus its sustainable transformation around renewable energy.[3,6]

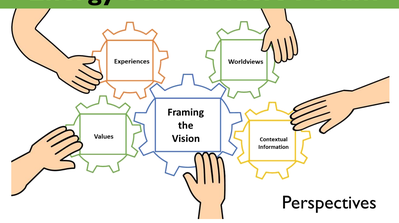
## PRE-DISASTER PUERTO RICO'S ENERGY ARENA

Public deliberation during pre-disaster or "normal times" can accelerate the ability of institutions and stakeholders to make timely decisions to maximize recovery efforts toward sustainability. [1,2] The purpose of this multi-method study was to examine stakeholders' visions, values, and perceived barriers, and opportunities for a sustainable transition in Puerto Rico before the 2017 Atlantic Hurricane Season. Two data sources are the core of this analysis, 1) the working documents done in the Energy Stakeholders Forum, and 2) thirty-one semi-structured interviews with key stakeholders in the Puerto Rican energy policy arena.

Three central visions that emerged from the analysis of the semi-structured interviews are the 'diversification of energy sources,' 'distributed energy generation,' and 'community-based grids.' Most interviewees strongly believed that transitioning away from current energy fossil sources is vital for the sustainability of the energy sector (Table 1). Most of the participants believed that distributed energy generation and community-based grids are the best pathways to introduce renewable energy in Puerto Rico. Twenty-four values were identified across stakeholders and sectors (Table 2). The primary values to which the interviewees agreed to were summarized as 'renewable,' 'sustainability,' 'responsibility,' 'cooperation,' 'awareness,' 'clean,' and 'reliable.' The primary barriers for energy transition are non-technical and dominant ones include governance, mindset and behavior patterns, major economic interests, and resource mismanagement (Figure 1). Combined results suggest that opportunities are perceived for community empowerment, better resources management, market expansion, and education (Figure 2).

# STAKEHOLDERS' PERSPECTIVES

### Energy Stakeholders Forum




The Energy Stakeholder Forum (ESF) is a series of meetings to promote multi-sectoral dialog about energy issues and to identify research needs for decision-making. The ESF officially started by a partnership between the National Institute of Energy and Island Sustainability (INESI, for its Spanish acronym), the Puerto Rico State Office of Energy Public Policy (OEPPE, for its Spanish acronym) and the *Fundación Agenda Ciudadana*. It is the foundation of INESI's policy work since it was created in 2014 by the University of Puerto Rico's Central Administration. INESI is a platform for interdisciplinary and multi-campus research and collaboration that seeks to effectively integrate academia in the development of energy policy.

### Semi-structured interviews

The interviews were part of the CRISP Project - Critical Resilient Infrastructure Systems and Processes - sponsored by the National Science Foundation. The objective of these interviews was to identify stakeholders' perceptions of the island's electrical system. There were 31 semi-structured interviews conducted which included the following sectors: Energy Regulatory Agencies, Legislature, Executive Branch, Local Governments, Industrial Sector, Renewable Energy Companies, NGOs, Academia, Federal Government, Professional Organizations, Labor Unions, Environmental Organizations, and Community Leaders. All interviews were recorded, transcribed, and imported into NVivo 12 for content analysis.

**TABLE 1:** Meta matrix - summary of visions by stakeholder id and sectors

| | | Interviews by Sector | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Academia | | | Legislature | | | | | Renewable Energy Industry | | | Electric power Industry | | | | Energy Regulator | | | Government | | | NGO | | | | Communities Leaders | | | | | |
| Vision | Frequency | C01 | C07 | C14 | C08 | C09 | C10 | C11 | C12 | C16 | C23 | C29 | C02 | C06 | C15 | C31 | C03 | C13 | C30 | C17 | C18 | C25 | C05 | C19 | C22 | C28 | C04 | C20 | C21 | C24 | C26 | C27 |
| Diversification of energy sources | 29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Community Based Grid | 17 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Distributed Energy Generation | 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Technological Advancements | 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PREPA's Transformation | 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**TABLE 2:** Meta matrix - summary of values by stakeholder id and sectors

| | | Academia | | | Legislature | | | | | Renewable Energy Industry | | | Electric power Industry | | | | Energy Regulator | | | Government | | | NGO | | | | Communities Leaders | | | | | | ESF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Values | Frequency | C01 | C07 | C14 | C08 | C09 | C10 | C11 | C12 | C16 | C23 | C29 | C02 | C06 | C15 | C31 | C03 | C13 | C30 | C17 | C18 | C25 | C05 | C19 | C22 | C28 | C04 | C20 | C21 | C24 | C26 | C27 | |
| Renewable | 28 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sustainability | 17 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Responsibility | 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cooperation | 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Awareness | 16 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clean | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reliable | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Accessibility | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Transparency | 13 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Efficiency | 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Democracy | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Willpower | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Conservation | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Justice | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Flexible | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wellbeing | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Local | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Accountability | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solidarity | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Professionalism | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Empowerment | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Happiness | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Excellence | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Stewardship | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**FIGURE 1:** Barriers for a sustainable energy transition




**FIGURE 2:** Opportunities for a sustainable energy transition




## TAKEAWAYS TO THE POST MARÍA SCENARIO

The results of this study suggest that visions and values were consistent with the prerequisites for a transition to renewable energy before the 2017 Atlantic Hurricane Season. Even though the conditions of vision and values were present, there was also pre-disaster inertia from non-technical barriers preventing the sustainable transition that still prevails in post-disaster Puerto Rico. Barriers and opportunities have a tight cause-effect relationship, and while this study characterizes them, stakeholders must identify measures and plan to overcome said inertia. There is not a pathway to maximize opportunities and enhance the socio-eco-technical processes in the energy transition without systemic interventions (Figure 3). Indeed, a major setback for the sustainable energy transition was not having a shared national vision in place for Puerto Rico and its energy system before the disaster struck. Even worse is not to have a collective strategy to knock down the long-lasting and very resilient barriers to make the most of the post-disaster windows of opportunity toward sustainability.

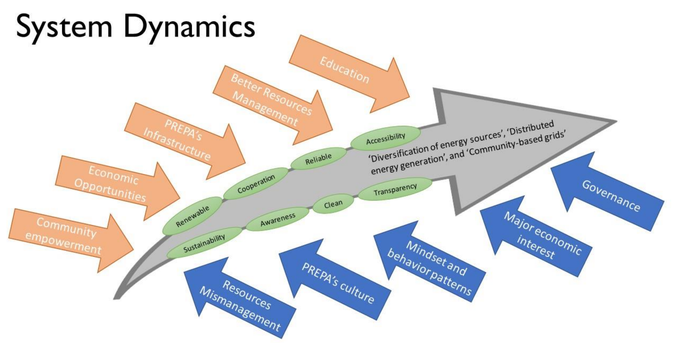



**FIGURE 3:** Stakeholders' perspectives, barriers and opportunities interacting as forces

Although Puerto Rico's financial crisis and PREPA's debt may be perceived as the most critical barriers, it is evident that other non-technical aspects may also play an important role in the sustainable energy transition. The disaster recovery process may unleash the transition and open a financial window of opportunity that can be leveraged to solve long-standing problems and move forward agendas that were difficult to accept and implement before the disaster.[1,2] However, the window of opportunity toward sustainability may close due to PREPA's privatization process, and the shortsighted, short-term profit-seeking investments associated with existing fossil-fuel-based infrastructure, moving forward the path for natural gas being portrayed as a "cleaner and cheaper" energy source, and the allocation of post-disaster funding to other goals.[4]

## REFERENCES

1. Brundiers, K., & Eakin, H. C. (2018). Leveraging post-disaster windows of opportunities for change towards sustainability: A framework. Sustainability (Switzerland), 10(5), 1–18.
2. Johnson, L. A., & Olshansky, R. B. (2016). After great disasters: How Six Countries Managed Community Recovery. Cambridge, MA.
3. Kwasinski, A., Andrade, F., Castro-Sitiriche, M. J., & O'Neill-Carrillo, E. (2019). Hurricane Maria Effects on Puerto Rico Electric Power Infrastructure. IEEE Power and Energy Technology Systems Journal, 6(1), 85–94.
4. Layzer, J. A. (2016). Chapter 1: A Policymaking Framework: Defining Problems and Portraying Solutions in U.S. Environmental Politics. In The environmental case: Translating values into policy (Fourth, pp. 1–30). Washington, DC: CQ Press.
5. O'Brien, G., & Hope, A. (2010). Localism and energy: Negotiating approaches to embedding resilience in energy systems. Energy Policy, 38(12), 7550–7558. ISSN 0301-4215
6. Puerto Rico Energy Resiliency Working Group. (2017). Build Back Better: Reimagining and Strengthening the Power Grid of Puerto Rico.
7. Sovacool, B. K. (2016). How long will it take? Conceptualizing the temporal dynamics of energy transitions. Energy Research & Social Science, 13, 202–215.
8. U.S. Energy Information Administration (2017), Puerto Rico - Territory Energy Profile Overview.

## ACKNOWLEDGEMENT

Thank you to the Governance Team from the CRISP Project at the University of Puerto Rico, Mayagüez Campus, who conducted and transcribed the interviews analyzed in this study. The CRISP Project was funded by the National Science Foundation Grant #ACI-1541106. Thank you to the Puerto Rico Science, Technology and Research Trust for the financial support received through the Post Hurricane Maria Aid for Researchers Grant Program in partnership with the Caribbean Division of the American Association for the Advancement of Science, Ciencia Puerto Rico and Society of Neuroscience.

Background photo: Solar panels in Las Piedras, Puerto Rico by Dennis M. Rivera Pichardo.