

## **Beyond Technology: Increasing the Use of Renewable Energy in Puerto Rico**

Josué E. O'Neill Maldonado, Hiram Vera, Andrea Miranda

undergraduate engineering students

University of Puerto Rico-Mayaguez

The consequences of electric energy choices in Puerto Rico are evident in the recent protests against the disposal of coal ashes in a Peñuelas landfill <sup>1</sup>. On one hand, the company that produces coal ash claims this is not a dangerous material, while the community and environmental leaders show evidence to the contrary. One thing is certain, generating electricity from fossil fuels produces by-products: solid like ash or gaseous like the emissions from burning oil. Another lesson we can learn from the current dispute about coal ash, and from past environmental and social conflicts, is the lack of proper methods to analyze technological choices in the Puerto Rican society, methods that can be accepted (or at least tolerated) by all involved. This article proposes the Appropriate Technology framework as a tool for a civilized and level-headed discussion of Puerto Rico's electric energy choices. The focus is on renewable energy sources because Puerto Rico has an abundance of such resources, and their use represent a less damaging and more sustainable alternative than fossil fuels which are non-existing in Puerto Rico <sup>2</sup>. The aim of the article is to inspire change on the way energy choices are made through a work of investigative journalism and the dissemination of its results.

### *Renewable energy challenges*

Using interviews with five energy stakeholders (representing community and environmental groups, academia, government and private sector) we were able to assess the present status and challenges of renewable energy in Puerto Rico. The organizations that were mentioned more frequently as having the most influence regarding electric energy where: PREPA, the Energy Commission, political parties, and the industrial sector. Mrs. Ruth Santiago an environmental lawyer and community counsel points out that community and environmental groups have influenced various decisions relating to the siting, construction and operation of electric energy projects such as the "Gasoducto del Sur" and "Via Verde" natural gas pipelines, coal-fired power plants, windfarms, waste to energy incinerators and other projects. This shows that even though individual consumers lack influence within the electric energy area, gathering and joining behind a common cause can have an impact on energy decisions.

Existing citizen participation practices received mixed evaluations from the persons interviewed. Some pointed out that the law requires a public comments period in many instances. Public hearings are also mandated by law on most energy-related projects. Act 57 (May 2014) makes citizen participation a focus in the reform of the electric sector, creating a utility consumer advocate office to represent consumer interests. Furthermore, citizen participation was required in PREPA's integrated resource plan (IRP) evaluated by the Energy Commission. Even though there are opportunities for citizen participation, the structure of many of those opportunities does not encourage ample or effective participation. In many instances, participation is minimal, has little effect and even turns into "venting sessions" where citizens or groups deliver an oral or written testimony with little impact on the outcome of the issue at hand. Mr. Ernesto Rivera, an engineer with over 10 years of experience as a local PV installer, comments that even though the processes in the Energy Commission provide for public participation, the structure makes it hard for the general public to have effective, "close" participation. Social media and collaboration with academic entities or NGOs were suggested as ways to truly broaden citizen participation on energy issues.

There is ample support from key stakeholder groups for renewable energy. Furthermore, some of the persons interviewed pointed out to a UPRM study that showed the potential of using renewable energy to generate electric power <sup>3</sup>. Nevertheless, the power grid has limitations on the amount of renewable energy

it can withstand. Dr. Cecilio Ortiz, from INESI's steering committee calls this the technological and physical barrier: the grid was built to support PR's industrialization and electrification, it was not designed to operate with intermittent energy sources such as the wind or the sun. Thus, the grid must be modified in order to increase the use of renewable energy. A key question relates to an economic barrier to renewables: who pays for those infrastructure changes? Dr. Agustin Irizarry, former VP of PREPA's Board and engineering professor at UPRM states that almost everybody wants renewable energy, but nobody wants to pay for the electric improvements needed in the system. A redistribution of available funds is not trivial, especially with the Oversight Board imposed by PROMESA (federal law for PR's debt restructuring). Dr. Ortiz also talks about a "lock in mentality" among consumers which many times makes it hard for them to change their consumption patterns even if that change could help society move towards more renewable energy use. Finally, there are groups with political and economic power that obstruct any effort that could change a real or perceived advantage they may have in the present energy model. Fear of change was also mentioned as a barrier to increasing the use of renewables. Such is the case of PREPA's organizational culture, which "has not been able to embrace renewables as the main source of energy in PR", as stated by Mr. Rivera. A short-term solution, he said, is not possible because of the time it takes such a large organization to complete a cultural change. Mrs. Santiago provided a quote from the USVI energy roadmap document, that fits us perfectly: "One of the greatest hurdles to energy transformation is the instinct to 'go with what we know.' Consumers buy based on habit, cultural norms, and old ways of thinking. Utilities make decisions based on their existing knowledge of 'tried and true' technologies. Legislators create policies based on political expedience and party-line thinking. Financiers make investments based on traditional methods of risk assessment and analysis"<sup>4</sup>. USVI has an electric infrastructure weaker than PR's but has committed to 65% use of clean energy by 2025. As a requirement "consumers will need to expand their knowledge of clean energy technologies and make informed, sustainable choices" and "people will need to understand the criticality of energy security, embrace the concept of sustainability, and actively support clean energy goals. Energy transformation involves a revolutionary shift in how entire communities think about and use energy." Thus, an informed, engaged and active citizenry is an essential component in any serious plan to achieve a successful energy transformation.

There was unanimous consensus among the five persons interviewed that our best renewable energy source is solar. There is good wind in some places (particularly in the East), there are opportunities for biomass, and wave energy has a great potential but the technology is not mature enough. However, "Solar energy technologies are by far the most robust and cost effective, and they keep improving" commented Mr. Rivera. There was also consensus that the best location for solar photovoltaic systems are the rooftops, which are closer to the user, empowering even whole communities to take the reins of their energy future. Rooftops are especially recommended for photovoltaic systems in Puerto Rico due to geographical limitations and less energy losses from the use of large transmission lines. Photovoltaic (PV) systems on 65% of the roofs of residential structures could generate all the electricity used in Puerto Rico in 2006, the highest demand in record<sup>2</sup>. Distributed systems are usually favored in social acceptance evaluations, and even pass basic ethical tests<sup>5</sup>. Sources from government that preferred anonymity also favor distributed rooftop solar systems, recommending large solar farms only for contaminated areas like closed landfills or brownfields.

Unfortunately, PREPA is still not supporting the transformation to a more distributed energy infrastructure, even though Act 57-2014 mandates PREPA to do so<sup>6</sup>. Mr. Rivera states that many persons in PREPA dedicate much more resources to finding reasons for not integrating renewable energy than on actually innovating by researching for solutions to our infrastructure shortcomings. The authors hypothesize that PREPA might be favoring large projects, not only because there are many power purchase agreements pending, but also because the experience in many mainland utilities seems to favor large scale projects. This is aligned to a comment from a government source: "A tendency from U.S. utilities is to favor large-scale projects over smaller distributed, because large projects provide higher profits". Mrs. Santiago makes reference to one of the main conclusions from a IEEFA study: the high cost of electricity in Puerto Rico

and uncertain economic and population growth do not favor large-scale capital projects with questionable costs and benefits. Instead, Puerto Rico should invest in resources that reduce dependence on imported fuels, allow flexibility and take advantage of innovative solutions on both the supply side and energy demand”<sup>7</sup>.

The persons interviewed provided advice to college students interested in renewable energy. Mr. Rivera thinks that renewable energy, especially rooftop PV is economically-feasible and positive for PR, and also addresses environmental and social challenges. “Future professionals should prepare to innovate, to find non-traditional solutions (in all fields: technical, environmental, economic) to the existing challenges that keep the use of renewables at a minimum,” pointed Rivera. Mrs. Santiago states that most people would like to see the Puerto Rico electric energy system totally transformed with demand management, conservation, energy efficiency, and real integration of renewables, especially rooftop solar. “These things are doable and many people in Puerto Rico are willing and able to make it happen if only there were less impediments from vested economic interests, and ‘captured’ government agencies,” declared Santiago. Dr. Marla Perez, from INESI’s steering committee, and Dr. Ortiz suggest that a social acceptance approach could help to increase renewable energy use in PR. They argue that communities might oppose renewable energy projects not because they are against the technology, but because of the shortcomings from the practices or methods followed by the developer (they mention as an example the Santa Isabel wind turbines project). Social acceptance theory recommends to seek a balance among the institutional, community and market dimensions of a project. If one dimension is poorly addressed, projects will face problems, they said.

A recurring theme was the importance of understanding the advantages and challenges of renewable energy. Mrs. Santiago believes citizen groups must do serious research and fact-finding on the best way to achieve renewable goals while taking into consideration not just technical but also social, cultural, political and other realities. On a similar note, government sources said that it is still a “mystery” how to motivate consumers to change their energy use patterns so that conservation and efficiency are pursued aggressively. “Using our local energy resources will eventually drive cost down of services and technologies and will have a great environmental benefit”, pointed the source. Mr. Rivera concluded with a summary of our present status regarding renewable energy: “There is still a long road ahead, longer that I once expected; but I believe Puerto Rico offers the best laboratory”.

### *The appropriate technology framework*

We now turn our attention to an analysis framework that could help to sort out the various technological energy options in a more holistic way. Appropriate Technology, as a movement, has seen an increase in popularity since its conception by Dr. Friedrich Schumacher in his 1973 book *Small is Beautiful: A Study of Economics as if People Mattered*. To some, appropriate technology represents the minimum level of technology that can be used to achieve a certain goal; others see it as a way of doing things that involves taking into account the environmental and social consequences the implementation of a technology can have on a specific community. A definition that brings together most of all the others is: “a technology tailored to fit the psychosocial and biophysical context prevailing in a particular location and period”<sup>8</sup>. Appropriate Technology stands by some basic beliefs such as the fact that technology is not neutral. Technology cannot be neutral because it influences and at times significantly alters the way in which we live our lives.

Regardless of their purposes, technologies will always have some social, political or environmental repercussion wherever they are implemented. This leads us to the first aspect of Appropriate Technology explored during this action project: Environmental Fit. Appropriate Technology states that in order for a technology to be considered appropriate it must cause the least side effects to the people and the environment. This includes effects due to its construction at a site as well as those that come from its use. This aspect was introduced into the interviews with questions which focused on the environmental repercussions renewable energy technologies might have wherever implemented and how these effects

might be minimized. The second aspect of Appropriate Technology that was considered by the authors is Technology Choice. It is crucial that citizens have a voice in the decisions regarding what technologies are implemented in their society. The authors felt that if we were to analyze renewable energy technologies based on Appropriate Technology then we had to determine in some way during our research if the technology choice criteria were being met on the island. The interviews included questions focused on determining the individuals and groups responsible for decision making, and determining whether the community has any actual representation in said decisions or the capability to effectively participate in the few citizen engagement forums available. From the interviews and the research carried out, PV systems in rooftops seem to comply with the criteria mentioned above, as its environmental impact is minimal (once manufactured) and people have more control over their rooftops. However, as discovered during the interviews, citizen energy knowledge and participation in energy matters must be improved if the Technology Choice criterion is to be fully met, and if renewable energy is to see an increase in use in Puerto Rico. This research work also showed us that engineering students can contribute towards achieving this energy transformation.

### *A call for action*

In Puerto Rico many key public debates are obscured by technical jargon, leaving the public confused and sometimes apprehensive of expressing an opinion or participating in such debates. This work made the authors realize the potential that undergraduate engineering students have to contribute to the solution of Puerto Rico's problems, even before graduation. Engineering students gain technical knowledge that is not readily accessible to non-engineers, and thus are in a position to share that knowledge with the public, orient them about the positive and negative aspects of technological opportunities so that they can truly have a "technological choice". Such knowledge can empower citizens to engage in actions for the solution of social issues. Engineering students can also study and share information about the potential environmental consequences of energy technologies or processes, enabling citizens to determine if a particular technological option has "environmental fit". It would be a very interesting project to combine journalism students and undergraduate engineering to report on some of PR's pressing problem areas. Technical knowledge combined with journalistic skills would yield very helpful and necessary investigative reports.

This article concludes with areas that need further work, in order to promote the use of appropriate technology criteria to study energy alternatives, aid in policy decision-making and increase renewable energy use in Puerto Rico:

- Beyond technology - education is needed. People need to understand the current state of electric energy in Puerto Rico, and the advantages and disadvantages of energy alternatives.
- Beyond education – involvement is needed. Involvement needs education, but it goes beyond education. It also goes beyond participation. Involvement means a commitment to take action, short and long term actions.
- Beyond PROMESA – appropriate technology. The short-term future of energy projects might be determined by critical projects defined in the federal law PROMESA <sup>9</sup>. Appropriate Technology provides a framework to reduce the unintended consequences of such critical projects, if used as part of the selection criteria.

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