
EE 492 Bi-Weekly Report 4 - sddec18-03

Design of a More Reliable Power Grid for Puerto Rico

10/8/18 - 10/22/18

Faculty Advisor: Vikram Dalal

Team Members

Logan Lillis - *Communications and Reports Lead*

Ricardo Rodriguez-Menas - *Webmaster and Project Plan Lead*

Heiqal Zamri - *Test Engineer Lead*

Pinjia Zhang - *Design Lead*

Weekly Summary

This period, the majority of time was spent further researching individual topic areas. Further research into natural gas development, microgrids for rural and metropolitan areas, renewable energy's future in Puerto Rico, and battery storage feasibility. Furthermore, presentations were prepared for a presentation to Professor Vikram Dalal showcasing the research. Generation research, led by Logan, is nearly completed, with a final focus area in natural gas generation and costs of updating generation required before this topic is completed.

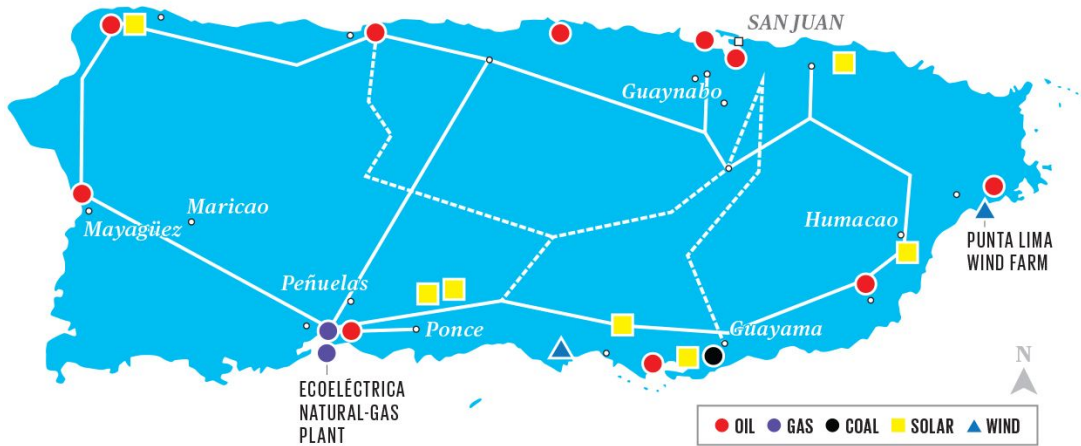
Past Week Accomplishments

Logan:

- ❖ Research on costs associated with updating generation to natural gas fire
 - Majority of generation is oil-fired.
 - Currently, only 2 generating facilities are equipped to be fired by natural gas
 - Palo Seco and Aguirre Plant
 - Aguirre Offshore Port and Roosevelt Roads Redevelopment
 - "The Aguirre Power Plant is the largest power producing facility owned by PREPA and has one of the highest fuel costs of all PREPA facilities. By achieving economies of scale, the Aguirre Plant can lower fuel cost and help reduce the cost of power sooner for Puerto Rico. In terms of the environment, the potential for reducing air emissions at this large facility and reducing the number of fuel

barges transiting the Jobs Bay Reserve provides invaluable protection to the biological diversity of this area.” *Source:* <http://en.aguirreoffshoregasport.com/>

- Roosevelt Roads is a retired naval station. A LNG port here would allow for easy access for the north of the island (where the highest population density is located) and allow for an easier transition to natural gas.



Source: <https://spectrum.ieee.org/energy/policy/rebuilding-puerto-ricos-power-grid-the-inside-story>

- https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf
- Natural Gas Deliquification Port
 - Looking further into costs associated with on-shore vs. offshore development

Ricardo:

- ❖ Working with professor Anne Kimber on making a new proposal for a different solution to power grids in Puerto Rico, on rural parts of the country.
 - Investigating on how to test life of batteries and how to optimize energy in some places changing the architecture and the material properties of the houses there.
- ❖ Researched Articles about microgrids, battery storage, and natural disaster prevention/preparedness
 - <https://patents.google.com/patent/US7251527B2/en>
 - <https://ieeexplore.ieee.org/abstract/document/6847201>
 - <https://www.accuweather.com/en/weather-news/2018-atlantic-hurricane-season-is-puerto-rico-at-risk-for-another-devastating-blow/70005073>
 - <http://www.aoml.noaa.gov/hrd/tcfaq/G11.html>
 - <https://patents.google.com/patent/US4311434A/en>
 - <https://patents.google.com/patent/US4342539A/en>

Heiqal:

- ❖ Research more on microgrids
 - Looked at the website Berkeley microgrids to have a better understanding of what is considered as a microgrid

- Microgrids are divided between two different types of connections: connected to traditional power grids or an electrical island while being controlled locally
- ❖ Implementation of a Smart Grid
 - microgrids which could be used to improve not only the functionality of it but also the user interface of the microgrids to make it easier to use
- ❖ Location of the microgrids are the most crucial part of implementing the design because it has to be fully efficient and also secure from most hazardous environment
 - Microgrids must also be spread out well enough to maintain constant power supply to the island
- ❖ Research sources:
 - <https://building-microgrid.lbl.gov/about-microgrids>
 - NYPA document

Pinjia:

- ❖ Read through Prepa's renewable energy annual plan. It includes W2e and waste processing solution for the recycling program. Also they provide a new approach for utilizing the existing infrastructure to support the solar PV plant. It was conducted by National Laboratory to show how distributed PV can be operated as virtual power plant to provide certain grid support service compare to traditional grid operations.
 - During the IRP process, PREPA is expected that about 300MW will come online in 2035 which shares a portion of 17% of total energy. And the permit of private investment in Solar industry will let more reliable power company come and solve local problem.

Pending Issues

- ❖ Need to determine a software capable of modeling load flows and microgrids
 - Pinjia will work with power professors
- ❖ Need to begin writing paper/deliverables
- ❖ Determine locations and styles for microgrids, both urban and rural.
- ❖ Logan:
 - Having a difficult time finding costs associated with upgrading generation facilities. Will continue researching and reaching out to companies for estimates.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Logan Lillis	<ul style="list-style-type: none"> ● Economic studies on conversion to natural gas compared to heavy oil-fueled generation <ul style="list-style-type: none"> ○ Importing LNG, ports, terminal, etc. ● Write Weekly Report ● Individual meeting with Professor Dalal <ul style="list-style-type: none"> ○ Discussed generation and deliverables 	5	25.5
Ricardo Rodriguez-Menas	<ul style="list-style-type: none"> ● Research on rural power grids with Professor Anne Kimber ● Battery Storage: How to implement in different areas, lifetime, etc. 	12	35.5
Heiqal Zamri	<ul style="list-style-type: none"> ● Research on microgrids <ul style="list-style-type: none"> ○ Smart Grid implementation ○ Locations throughout the country 	4	21
Pinjia Zhang	<ul style="list-style-type: none"> ● PREPA's energy plan <ul style="list-style-type: none"> ○ Waste processing, photovoltaics, grid support ○ Big focus on solar energy. 	3	13.25

Plan for Upcoming Week

All:

- ❖ Continue to read and research further reading on Puerto Rico redesign proposals.
 - NYPA
 - CRS
 - RMI
 - FEMA
 - PROMESA
 - PREPA

Logan:

- ❖ Costs associated with transitioning generation facilities
- ❖ Costs associated with constructing LNG terminals
 - Onshore vs. offshore
- ❖ Cost saving estimates between natural gas and oil
 - Efficiencies, fuel import pricing, facilities, etc.
- ❖ Begin to write transmission, distribution, and generation component of paper

Ricardo:

- ❖ Looking for articles and data to help determine the necessity of preventive measures since Puerto Rico can be struck again by another hurricane.

Heiqal:

- ❖ Work on potential report of the whole design including every issue from design to economy and implementations

Pinjia:

- ❖ Meet with Dalal and wait for next step research after the presentation
- ❖ Discuss more about the small microgrid design