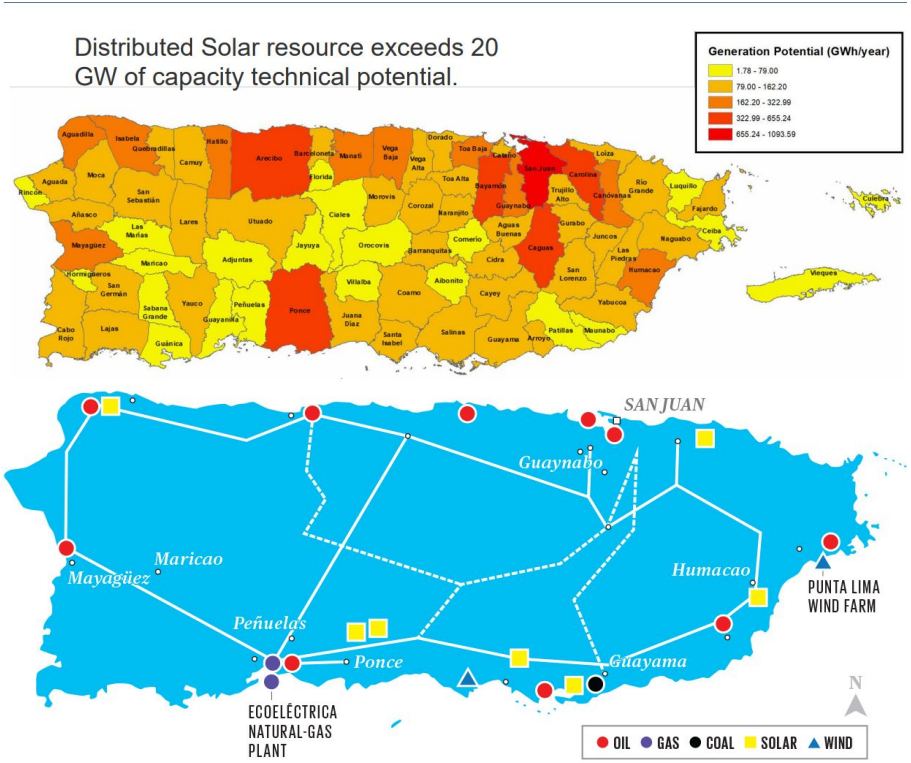
Photovoltaic Feasibility in Puerto Rico

Isaac Buettner, Adam Curtis, Hannah Nelson, Manuel Perez-Colon, & Larry Trinh
- Advised by Prof. Vikram Dalal
- SDDEC23-16, contact: hgnelson@iastate.edu

Problem Statement

Our project aims to provide a plan for ensuring reliable and affordable power to all Puerto Rico using photovoltaics combined with battery storage units.

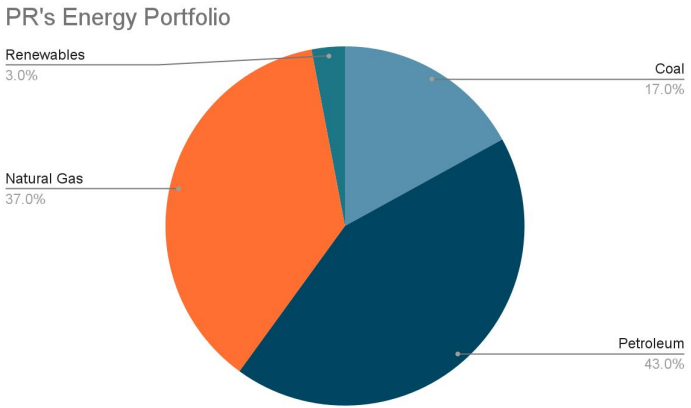
- Puerto Rico's grid is very unstable as a result of frequent hurricanes, outdated power plants, and poor management.
- Renovation and modernization of the transmission, distribution, and generation systems.



Context

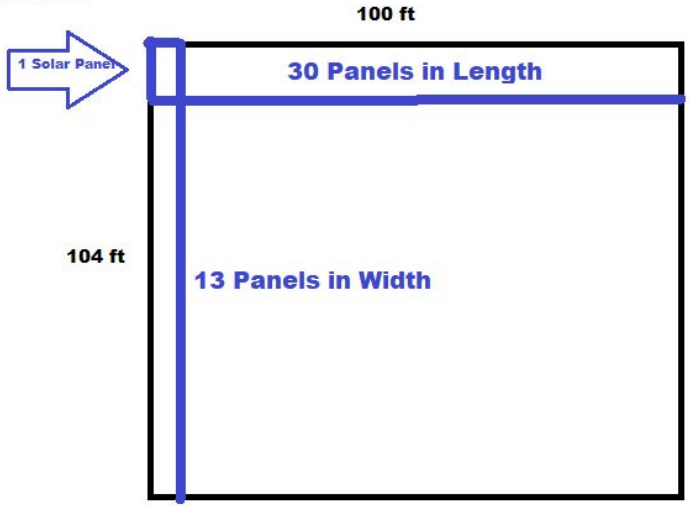
PR’s government set a goal to be 100% reliant on renewable energy by 2050.

- Action is not being taken at the level it needs to be in order to achieve this goal
- Price of electricity is incredibly high: 23 cents/kWh in residential sector (closer to 12 cents/kWh in Iowa)
- Necessary to bring communities together under goals of reliability and sustainability



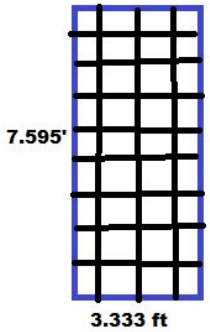
Diagrams/plans

Dean Steel Buildings Inc.
LR 100 x 104 x 31
Covered Basketball Court



390 Total Panels, Each generating 490W, overall 191100W, or .1911 MW

Trina Solar
TALLMAX
490W
DE15V(II)
7.595' x 3.333'



$9,920 per pallet of 31 Panels, 320$ per panel = $124,800

Rough Estimate of $100,000 for labor, inverters, mounting, wire = $225,000 total investment

Current rough estimate for 1 installation on basketball court roof

LR 100x104x31

Existing Public Infrastructure in Puerto Rico

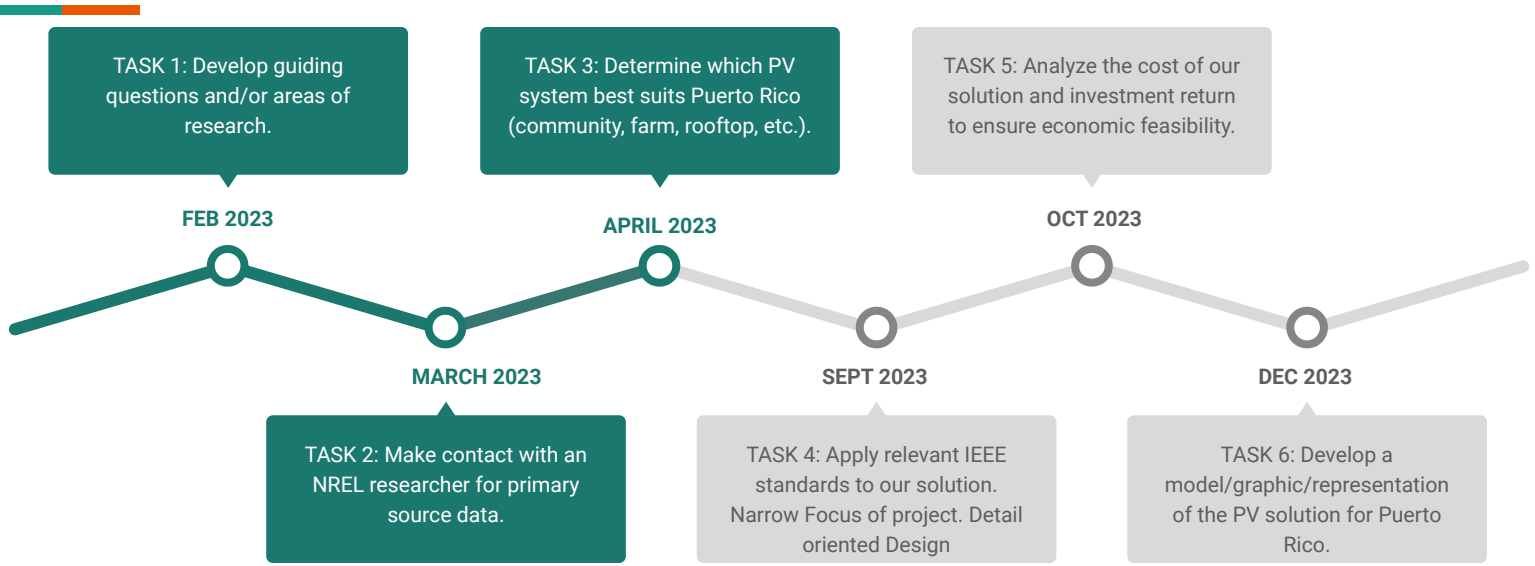
Goals for the semester

- Further narrow scope of solution regarding either panels on basketball courts or commercial centers
- Plan for connecting microgrids to Puerto Rico's infrastructure
- Specific, quantitative data regarding energy offset, number of microgrids that could be built, battery storage capacity, etc.
- Small, physical model and appropriate infographics to relay project's final design

Technical Challenges

- Electrical schematic
  - Planning for grid connection (if happened in real-world)
  - Layout of solar installation, including dimensions, bill of materials, cost, expected generation, and time until initial investment is recouped.
  - Required switchgear, inverters, safety standards, and all other components related to connecting our microgrids to Puerto Rican homes/businesses.
  - Battery Backup connection/isolation from grid until it is needed. Maintenance requirements/costs

TIMELINE


TASK 1: Develop guiding questions and/or areas of research.
FEB 2023
TASK 2: Make contact with an NREL researcher for primary source data.
MARCH 2023
TASK 3: Determine which PV system best suits Puerto Rico (community, farm, rooftop, etc.).
APRIL 2023
TASK 4: Apply relevant IEEE standards to our solution. Narrow Focus of project. Detail oriented Design
SEPT 2023
TASK 5: Analyze the cost of our solution and investment return to ensure economic feasibility.
OCT 2023
TASK 6: Develop a model/graphic/representation of the PV solution for Puerto Rico.
DEC 2023

PROJECT TIMELINE

WBS NUMBER	TASK TITLE	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
1	**Developing Key Areas of Research**				
1.1	Introductorty Research	1/30/23	2/13/23	13	100%
2	**Primary Research**				
2.1	Scope and Goal Setting	2/13/23	3/27/23	4	90%
2.2	Research	2/13/23	4/14/23	60	60%
3	**Determine the Correct PV System**				
3.1	Indetifying Alternatives	3/30/23	4/3/23	4	10%
3.2	Comparing Options	3/30/23	4/17/23	18	0%
3.3	Assessing Viability	4/17/23	5/1/23	14	0%
4	**Apply relevant IEEE standards**				
4.1	IEEE Standards	8/18/23	9/18/23	31	0%
5	**Analyze Cost and Detremine Feasability**				
5.1	Cost Analysis	9/15/23	10/23/23	38	0%
6	**Develop Model**				
6.1	Model Creation	10/9/23	12/4/23	56	0%