
EE/CprE/SE 491 WEEKLY REPORT 8

4/2/23 - 4/9/23

Group Number: 16

Project title: Feasibility of Solar PV Energy for Puerto Rico

Client &/Advisor: Vikram Dalal

Team Members/Role: Adam Curtis, Hannah Nelson, Isaac Buettner, Larry Trinh, Manuel Perez-Colon

o Weekly Summary

We met as a team and came up with a game plan for the week. As our final presentation is drawing closer, it's becoming difficult to manage research and prepare our slides and design documents for the final documentation. For this week, we focused on doing an economic analysis of the convention center/large rooftop system and of a community system named Casa Pueblo. This will be helpful to get a rough estimate for the size of what we want to implement in PR.

o Past Week's Accomplishments

Hannah: Started economic analysis with Casa Pueblo. They had a very important document on their page that showed the basis and data of their decision-making, and it had a lot of good information regarding rooftop PV systems. Casa Pueblo has 1000 solar panels with a capacity of just over 1 MW. The battery storage also allows for 10 days of "off-grid" functionality in the case of an outage. In the community, Casa Pueblo estimates that homes should generate 1.68 kW, which is the equivalent of 6-330 Wp panels. This cost is around \$8000, if you include a battery system. This is standard with other research I did about the cost of a rooftop PV system.

Year	Residential	Commercial	Industrial
2014	969	189	8
2015	2,162	275	12
2016	4,670	382	19
2017	8,911	565	27
2018	11,879	646	27
2019	14,328	769	28
2020	17,411	857	25
2021	28,750	1,111	28
2022	40,830	1,340	29

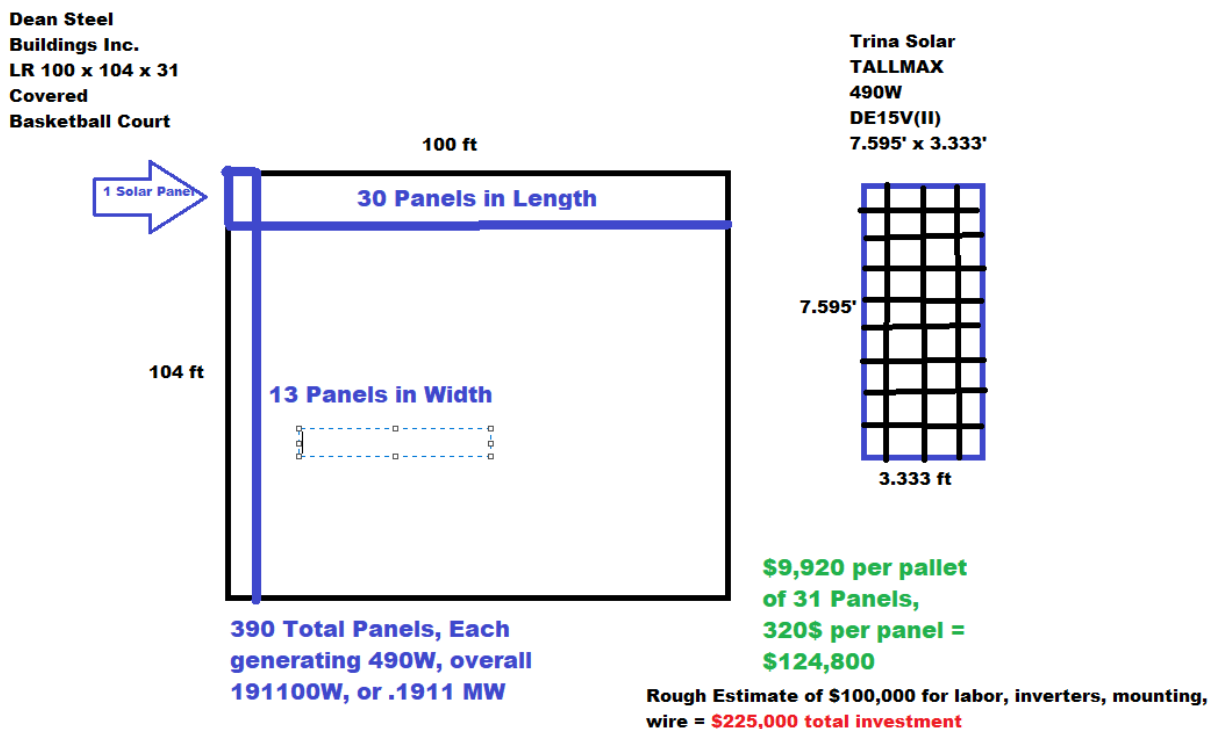
Chart showing the # of customers per sector.

In addition, a technical report analyzed the residential PV growth over the last 8 years. Assuming growth is similar to the exponential equation they developed. By January 2025, it is estimated that the residential sector will generate 1.055 GW. There are a lot of equations and estimates that will be very helpful to us. For instance, if we can determine what percentage of PR's consumption we want to meet with PV, we can work backward to see how many customers that would amount to, production per customer, and how many panels that equates to.

Manuel: Helped translate information from the Casa Pueblo study and researched information on the convention center with Isaac and Adam. Looked into a study from Solucar a European company making a 300MW solar farm outside of Sevilla, Spain with the purpose of powering the entirety of Sevilla. they utilized thermosolar energy by focusing mirrors into containers to heat up water and create water vapor for a steam turbine.

https://www.mapa.gob.es/ministerio/pags/Biblioteca/Revistas/pdf_AM%2FAM_2007_66_69_72.pdf

Adam: Compiled an estimate for installing a small community PV system on a common covered basketball court in PR with Isaac. Basic Estimate can be seen in the graphic below. There are many of these covered basketball courts in Puerto Rico near neighborhoods, and we feel installing solar panels on the roofs of these would help support small group of potentially low income homes with solar and battery backups without making them all invest in their own rooftop systems.



Note: 57.3 lbs per Panel =

22,347 lbs

$100 \times 104 = 10400 \text{ ft}^2$

$22347 / 10400 = 2.14875 \text{ lbs/ ft}^2$

In addition to this estimate, I worked with Manuel to find as much information as possible about the PR convention center and its rooftop solar system to determine how long it took for it to recoup its initial investment of 20,000,000. After some rough calculations, I found it took a little over 9 years.

Larry: Last week, I did some research on microgrid cost, and at the same time I was researching solar and storage costs. I found a paper from the NREL website talking about how solar and storage costs affect the new home market. Residential solar and storage markets are growing in the United States. With approximately 1 million new homes constructed every year, this represents a significant opportunity for solar and storage installations. Some home builders have begun to build new homes with solar and storage included as a standard offering. However, it is not clear how solar and storage are incorporated into the new construction process and at what cost. System costs fall into two general categories: hardware and soft costs. Hardware costs include the costs of the inverter, modules, and battery pack, whereas soft costs include permitting, inspection, and interconnection (PII), customer acquisition, quality control, labor, overhead, and other non hardware components. Both hard and soft cost categories have been declining, but not uniformly. For this project, if we want to design a new grid, we need to consider the potential housing market with new construction installed solar energy systems.

<https://www.nrel.gov/docs/fy22osti/82511.pdf>

Isaac: I spent this week performing a bit more research on the current state and capabilities of transmission and distribution (T&D) in Puerto Rico, as well as problems regarding T&D. Additionally I helped Adam out this week in figuring out a reliable model to set up for public infrastructure such as a standard roofed basketball court in Puerto Rico. Using the same company that helped install the photovoltaic system on top of the San Juan convention center as a case to base this study off of, we were able to look at commercial solar pricing, and how different cases require different treatment and unique solutions. For example, it wouldn't make too much sense to have tracking solar panels on rooftops, and conversely static panels wouldn't be achieving their full potential out in the field.

Individual contributions

<u>NAME</u>	<u>Individual Contributions</u> <i>(Quick list of contributions. This should be short.)</i>	<u>Hours this week</u>	<u>HOURS cumulative</u>
Adam Curtis	Research, estimates	5	42
Hannah Nelson		5	42
Isaac Buettner	Research	3	37
Larry Trinh		3	37
Manuel Perez	Research, transaltion	5	32

- o **Plans for the upcoming week** *(Please describe duties for the upcoming week for each member. What is(are) the task(s)?, Who will contribute to it? Be as concise as possible.)*

Hannah - Moving forward, I came across another document that I only briefly had time to glance over. https://ieefa.org/wp-content/uploads/2021/03/We-Want-Sun-and-We-Want-More_March-2021.pdf It references a study done by Telos Energy, with a PSS/E model to see how the added PV systems would affect T&D systems. Their goal is to show that PR can achieve 75% of its consumption by 2035 by using solar energy. I think this is a pretty ambitious goal, but I also think their data will be helpful and one that we can base assumptions on. I also will need to put together design documents and coordinate the organizing of our final presentation.

Manuel - Looking forward, I plan to talk to a manager from the company in PR GenEra to have more concrete understanding of what these installations and maintenance would cost. Organizing the final presentation, and communicating wiht the team on future plans to end the semester.

Adam - Work to organize the final presentation and design document, and continue to refine estimates of the various grids we hope to install. Look into inverter pricing, labor, and appropriate battery sizing.

Larry - Continue researching some more information about roof top and solar farm. We will have a meeting with Dr. Dalal next week , and I will prepare for the final presentation.

Isaac - For upcoming weeks, I would like to start looking into methods to analyze the total available space on rooftops and pricings for different sectors, (i.e. residential, commercial, and industrial.) I would also like to start working more on compiling past presentations and reports into one place to help us transition smoothly into writing for our final presentation.