

# *Puerto Rico Solar Jobs in 2050*

Solar energy employment projections  
based on PR Act 17 of 2019

*A white paper by The Solar Foundation as part of the Puerto Rican Solar  
Business Accelerator*



### About The Solar Foundation

The Solar Foundation is an independent 501(c)(3) nonprofit organization whose mission is to accelerate adoption of the world's most abundant energy source. Through its leadership, research, and capacity building, The Solar Foundation creates transformative solutions to achieve a prosperous future in which solar and solar-compatible technologies are integrated into all aspects of our lives. Learn more at [TheSolarFoundation.org](http://TheSolarFoundation.org).

### About the Puerto Rican Solar Business Accelerator

The Puerto Rican Solar Business Accelerator (PRSBA) is a program to support solar workforce development, finance, and microgrid development in Puerto Rico. Led by The Solar Foundation in partnership with Pathstone Corporation, Inc., it will expand and strengthen the Puerto Rican solar industry and spur the development of a highly qualified workforce. This program is bringing together businesses, community members, other nonprofit organizations, academic institutions, and solar energy advocates to transform Puerto Rico's energy system, working together to achieve a renewable and sustainable future. Learn more at <http://www.thesolarfoundation.org/prsba/>.

## Introduction

Puerto Rico's Energy Public Policy Act, approved in 2019, establishes a renewable portfolio standard (RPS) of 100% renewable energy generation by 2050. Forward progress towards the 100% RPS will result in significant capital investment and talent development in Puerto Rico for the benefit of the economy, people, and the planet. This ambitious target will require unprecedented growth for all types of renewable energy, but especially solar, the most abundant renewable energy source in this US territory. To meet Puerto Rico's RPS goal, The Solar Foundation estimates that solar installed capacity would have to grow exponentially from the current of 386 MW to 16,275 MW by 2050.<sup>1</sup> Such a sizable growth requires strategic planning for workforce development, solar financing, land use planning, energy law, community development plans, and economic development incentives in Puerto Rico.

This white paper is intended to provide all solar stakeholders in Puerto Rico actionable numbers they can point to when describing the economic and social benefits that can be achieved as Puerto Rico moves towards a 100% renewable energy future. These projections could be useful to the solar financing industry as they analyze participation in the development of energy future in Puerto Rico. These numbers could be useful to lawmakers, both in Puerto Rico and at the federal level, as they determine how to enact public policy that encourages renewable + storage deployment. This report is also useful to educators, professional associations, and Universities as they develop the training programs of the future.

On the workforce development front, The Solar Foundation's annual *National Solar Jobs Census 2019* indicates that Puerto Rico has 1,949 solar-related jobs. (TSF, 2020) Currently, just 3% of all energy generation capacity installed in Puerto Rico comes from renewable energy. From day to day, however, there are fluctuations in sources of generation, and renewable energy reaches 7% of all the sources producing power and energy for Puerto Rico's grid. (AEEPR, 2020) New job creation is clearly needed if the islands are to reach 100% generation from renewables. The US Bureau for Labor Statistics estimates that on a national level, solar occupations will increase 63% over the next ten years. (Bureau of Labor Statistics, 2018). That would mean 407,500 solar-related jobs nationally by 2028. How many of those jobs would be needed in Puerto Rico? Based on The Solar Foundation's research, we estimate that the number of solar related jobs it will take to get Puerto Rico to 100% renewable energy in thirty years will be about 12,359 by year 2025, climbing to about 19,905 by the year 2030 and then tapering back down to 11,918 and below by year 2040.

### Methodology and Assumptions

The exercise of estimating future jobs growth potential is rather complex and depends on multiple variables. The Bureau of Labor Statistics uses six variables to make job projections: labor force demographics, aggregate economic growth, final demand for product or service, input-output model as a function of GDP, employment productivity index, and the ratio of occupational employment to openings. The methodology employed here uses reliable proxies to estimate future job growth in the solar industry. We start with the installed capacity needed to meet Act 17 Renewable Portfolio Standard (RPS) and work our way back to the number of solar related jobs it will take to accomplish the RPS by milestone years mandated by Act 17, namely 2025, 2040, and 2050. For the jobs projection, we use a "solar installation jobs" to "new capacity added per year" ratio that we calculated from states in the continental United States with a mature solar market. To minimize climate related seasonal variability, we only chose states

with climate zones similar to Puerto Rico. We define "mature solar markets" as states that have at least twice the amount of solar as a percentage of total electricity generated than does Puerto Rico. The states of Arizona, California, Nevada, and Hawaii met these parameters.

### Installed Capacity needed

1. Average daily consumption (GWh): According to the PREPA's Integrated Resources Plan 2019 (IRP 2019), Exhibit 3.6 Gross Energy Demand for Generation, Puerto Rico needed 18,351 GWh for yearly total energy consumption. Averages out to 50.28 GWh daily.
2. Average Peak sun hours: Assumption 4.8 hours
3. DC-AC derating: 0.20 inefficiency<sup>2</sup>
4. We have assumed a 30% oversizing in PV generation to account for predictable periods of peak demands and reduction in size of storage.<sup>3</sup>
5. Historical reduction tendency: According to the IRP 2019, Puerto Rico will have a Compound Aggregated Growth Rate (CARG) of -.22% from 2019 to 2038. Assumption the reduction trend will remain linear until 2050. (IRP, 2019).

	Average daily consumption (GWH)	Average peak sun hours	DC-AC Derating factor	DC System size MW	30% Oversizing MW	CAGR
<b>2019</b>	<b>50.28</b>	4.8	.80	13,150	<b>17,095</b>	-0.22%

Table 1. Summary of calculation assumptions

Data in Table 1 shows that if Puerto Rico had to generate all the electricity consumed in 2019 with solar, PR would need around 17,095 MW in solar installed capacity. This report does not consider spatial distribution, type of installation, nor the incorporation of distributed storage around the islands, although storage is the critical component of any significant transformation to renewable energy in any energy grid.

### Estimating the energy need projection

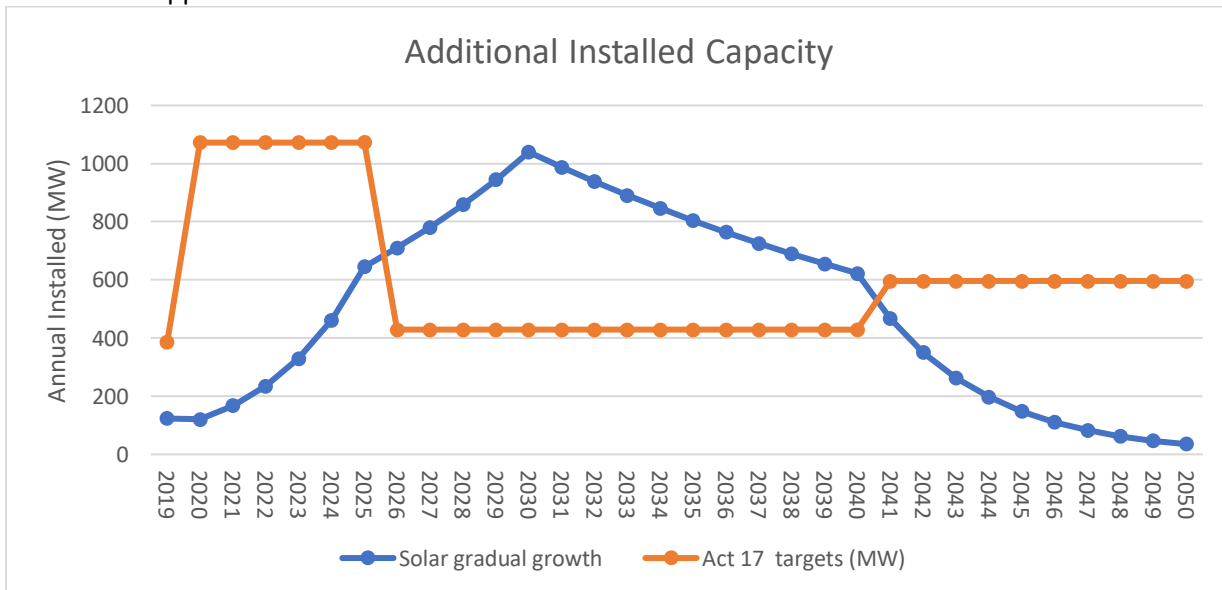
Using 17,095 MW as the base number for the year 2019, we estimate the installed capacities needed in order to meet the 2025, 2040, and 2050 Act 17 targets. The CAGR used in PREPA's IRP was applied to several years in a reverse format.

CAGR -.22%	Act 17 Mandate % of RPS	Total Installed Capacity Targets	Additional Installed Capacity to meet Act 17 targets (MW)
<b>Current</b>	n/a	*386	
<b>2025</b>	40%	6,819	6,433MW in 5 years
<b>2040</b>	60%	10,320	3,501MW in 15 years
<b>2050</b>	100%	16,275	5,955 MW in 10 years

Table 2. Act 17 RPS mandate timeline

\*As of 2020 there are 386 MW of solar installed in Puerto Rico in distributed generation and solar farms

Table 2 shows the formidable challenge the solar industry faces in meeting the 2025 installed capacity target of 40%. The ramp up would have to be astronomical, more that 1,100 MW per year in order to reach 6,800 MW by the year 2025. A more likely scenario is to ramp up gradually, increasing installed capacity 40% over the previous year, until we reach a peak between the years 2028 and 2035. Graphic 1 presents the difference between the two approaches. A third approach calculated was to assume an even distribution of 532MW per year for the next thirty years. Calculations to support our conclusions are attached as Appendix A.



Graphic 1 Comparison of scenarios for additional Installed capacity (MW)

### Estimating workforce size required

The workforce size estimation is based on an analysis of job growth in relation to installed capacity added between 2015 – 2019 in four states that have a mature solar markets.

State	Installed Capacity added last 5 years (MW)	Solar install jobs SUM last 5 yrs	Mature market solar job ratio (Jobs/MW)
Arizona	2,582	16,706	6.47
California	17,417	235,218	13.5
Nevada	2,635	28,911	10.97
Hawaii	872	10,454	11.98
<b>Average Mature solar job/MW ratio</b>			<b>12.39</b>

Table 3. Job/MW ratio in 4 southern states with mature solar market

What the mature market solar job ratio indicates is that for every MW capacity installed, a certain number of solar installation jobs are created. As new solar capacity is added, we will experience sustained solar jobs growth. In states with a mature solar market there is an average of 12.39 solar installation jobs added to the economy per year for every 1 MW of installed capacity added. The Solar Foundation believes this is a good proxy indicator to use for Puerto Rico's solar jobs outlook as the islands' solar market matures and becomes a greater proportion of the total energy generated and consumed.

According to the *National Solar Jobs Census 2019*, the United States' solar related jobs distribution was 65% installation and project development, 12% wholesale trade and distribution, 4% operation & maintenance (O&M), 14% manufacturing, and 5% others (TSF, 2020a).

Interestingly, the 2019 *Solar Jobs Census* figures for Puerto Rico showed a different breakdown between the categories: 34.4% installation and project development, 30% wholesale trade and distribution, 18.8% O&M, 9.3% manufacturing, 7.5% other (TSF, 2020). For the projections in this report, we will use the United States' breakdown, because as the Puerto Rican solar industry ecosystem matures, it will likely more closely reflect the job distribution of the rest of the United States.

#### Solar related jobs potential accumulated by sector Puerto Rico

Year	Total Solar Related Job Potential	Installation and Project Development	Wholesale Trade & Distribution	Operations & Maintenance	Manufacturing	All others
<b>2019</b>	1,949					
<b>2025</b>	12,359	7,996	1,483	531	1,706	643
<b>2030</b>	19,905	12,878	2,389	856	2,747	1,035
<b>2040</b>	11,918	7,711	1,430	512	1,645	620
<b>2050</b>	<b>671</b>	334	34	168	67	67

Table 4. Solar jobs growth projections for Puerto Rico

What this report demonstrates is that if Puerto Rico is to meet its RPS under Act 17 of 2019, significant job growth in the solar industry is necessary. It implies that solar workforce training must be ramped up significantly to meet the solar job needs of the future. It also should be a strong motivation for a robust and diverse private and public investment into solar + storage finance.

In closing, it is also important to emphasize what this report is not predicting. This document is not predicting that Puerto Rico will install 16,275 MW of solar over the next 30 years. It is also not stating that the solar related jobs market will grow to almost 20,100 strong by year 2030. It is also not predicting that the RPS will be reached using solar photovoltaic technology alone. In fact, we recognize that energy efficiency, wind energy, hydroelectric energy, ocean wave energy, and biomass probably have a very important role in the future of Puerto Rico's energy portfolio. We also recognize that without an appropriated deployment of energy storage assets, no major transformation towards renewable energy is possible.

The Solar Foundation invites all stakeholders to participate in a robust debate and sharing of ideas about the different pathways that may lead us towards the enactment and implementation of a planned development and growth of the solar industry.

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### Footnotes

<sup>1</sup> A comprehensive estimate looking at a Ocean, Wind, Solar, Hydro and BioMass renewable resources was published by University of Puerto Rico-Mayagüez professors Agustin Irizarry, Jose Colucci and Efrain O'Neill in 2009. The study is titled *Achievable Renewable Energy Targets for Puerto Rico, Renewable Energy Portfolio Standards*.

<sup>2</sup> A comparison of different empirical PV system performance studies place the derating factor at anywhere from 0.77 to 0.861. The common derating variables were considered to include: wiring resistance, module VI tolerance mismatch, temperature variance, shading, soiling and system availability. Retrieved from [https://enphase.com/sites/default/files/Enphase\\_PVWatts\\_Derate\\_Guide\\_ModSolar\\_06-2014.pdf](https://enphase.com/sites/default/files/Enphase_PVWatts_Derate_Guide_ModSolar_06-2014.pdf)

<sup>3</sup> Previous studies have estimated total installed capacity for 100% solar at 12.8GW for baseline and 15.6GW for 30% overgeneration. Andrews, Roger. 2017. *Can Puerto Rico go 100% Solar*, Energy Environment and Policy. Retrieved from <http://euanmearns.com/can-puerto-rico-go-100-solar/>

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We express much gratitude for taking an interest in the future of Puerto Rico's solar industry.



### About the Authors



Loraima Jaramillo-Nieves is a Program Manager supporting The Solar Foundation's initiatives in Puerto Rico, such as a workforce needs analysis report, solar and storage demonstration microgrid projects, and the Puerto Rican Solar Business Accelerator. Dr. Jaramillo earned a master's degree in Operations Management and Marketing from the University of Puerto Rico, Río Piedras Campus. She went on to earn a magister in Energy Efficiency and Climate Change and a doctoral degree in Environment and its human and socio-economic dimensions from the University Complutense of Madrid.

Since 2010, Loraima has been studying Puerto Rico's power sector and renewable energy market evolution. Her research explored the pioneers of the renewable energy industry and the community experience, as well as the barriers, market failures, and perceptions related to this industry. She worked at the National Institute of Energy and Island Sustainability at the University of Puerto Rico, where she coordinated the Annual Energy Report of Puerto Rico for 2016 and 2017. In the 2017 report, she co-wrote the chapter with recommendations for rebuilding Puerto Rico's power system after Hurricane María. Dr. Jaramillo also collaborated with community aqueducts providing pollution prevention technical assistance.

Carlos Alberto Velázquez López is Program Director at The Solar Foundation, where he oversees Puerto Rico programs, including the Puerto Rican Solar Business Accelerator. As an environmental manager by education, Carlos Alberto has been able to bring an interdisciplinary perspective to problem analysis and solutions.



After having completed two tours in the United States Marine Corps, he was honorably discharged in 2006 and quickly transitioned to serving Puerto Rico in the capacity of advising environmental and political organizations on federal, environmental, and energy matters. Instrumental in the early coalitions that advocated for net metering and interconnection of distributed generation in Puerto Rico, he eventually became the managing partner for a local energy and photovoltaic design and installation company. After Hurricanes Irma and Maria, he led an exemplary team of engineers, financial experts, and community economic development professionals to put together a conceptual design for a community-based renewable energy microgrid. That initiative became the basis for an ongoing energy cooperative model that is in development in rural areas of Puerto Rico.

Carlos Alberto has accompanied the Department of Commerce to missions in Central America as an advisor on microgrid regulations and development. He is an active contributor as a subject matter expert to environmental and climate-related radio shows. He is an active contributor to the PR Bureau of Energy on issues such as energy efficiency, microgrid regulations, and the Integrated Resource Plan. In his free time, he serves as a visionary guidance panelist for the Americas for Conservation and the Arts NGO on their ecotourism and cultural tourism projects being developed in Puerto Rico.