Policy Proposal: Rooftop Solar for Low- and Moderate- Income Puerto Rican Households October 2022

Preface

The following policy proposal is the product of a graduate student infrastructure practicum offered by the MPA Program in the Cornell Jeb E. Brooks School of Public Policy. The purpose of this practicum is to present students with a real-world infrastructure challenge. The product of the practicum is policy proposal to address the challenge.

The Spring 2022 challenge was, what Federal, State, municipal and NGO policies and actions need to be put in place in Puerto Rico to enable low- and moderate-income households (households that have an income less than 80% of the Area Median Income of Puerto Rico) to install and operate rooftop solar systems? Over the course of the semester the challenge was refined to, what policy interventions are required to provide low and moderate income (LMI) households equitable access to rooftop solar?

Eleven students (listed in the appendix) in masters programs in public administration, regional planning and engineering participated in the 2022 practicum. This course consisted of a semester long immersion in renewable energy and a week in Puerto Rico meeting with public officials, subject matter experts and NGO's. A list of organizations with whom we met is included in the appendix.

The following document lays out a policy framework. It is our hope that the ideas and concepts included in the proposal can contribute to the ongoing discussions in Puerto Rico as the Commonwealth proceeds with its energy transition.

The views and position included in this proposal are those of the students that conducted the research.

Executive Summary

Puerto Rico is in the midst of an electricity crisis:

• The per kWh hour charge for household electricity in Puerto Rico is almost twice as much as the U.S. average and escalating due to increasing energy (fuel) costs and the operating costs associated with the electricity transmission and distribution infrastructure

(including legacy costs). The residential price of electricity has increased from 18 cents per kWh in 2017 to 33.4 cents per kWh in July 2022 (an 85% increase).

- There is a significant energy burden (the percentage of gross household income spent on energy costs) disparity among households with different economic means. Very low income households spend more than 30% of their household income on energy; this is contrasted with 6% for middle income households.
- The private operator of the Commonwealth's electricity transmission and distribution system (LUMA Energy) said at an October 2021 Congressional hearing, "...the Puerto Rico electric system is arguably the worst in the U.S., and has been for some time, even prior to the tragic hurricanes of 2017. For context, the frequency and duration of outages is more than twice the next worst performer in the US, customer service scores are 50% worse than the average electric utility." (Source:_______https://naturalresources.house.gov/imo/media/doc/Testimony%20-

%20Mr.%20Wayne%20Stensby%20-%2010.6.21%20FC%20OIA%20Ovr%20Hrg.pdf.)

- Due to ongoing service problems there is a breakdown of trust and connection between residents of Puerto Rico and the Commonwealth-owned electricity utility, i.e., the Puerto Rico Electric Power Authority (PREPA) and its private partner, LUMA Energy.
- The externalities associated with the current electricity generation portfolio fall disproportionately on low and moderate income (LMI) households given most of the fossil fuel generation facilities are located in parts of Puerto Rico with a preponderance of LMI households.

While there is a consensus in Puerto Rico about the imperative to transition the energy portfolio to renewables (100% by 2050), plans currently in place and being considered do not address the other energy-related issues that plague the Commonwealth and may actually have a negative impact, e.g., adverse land use impacts associated with utility scale solar facilities (solar farms).

Further, there is no solution in sight that will alleviate two immediate concerns: the high cost of energy and the unreliability of the energy distribution system. These concerns are particularly acute for LMI households.

Puerto Rico has two assets that present the opportunity for large scale deployment of rooftop solar plus storage systems which would have an immediate positive impact on the consumers of electricity, particularly LMI households. These assets are a) rooftops that can accommodate solar panels and b) FEMA funds. With respect to the latter, FEMA has allocated over \$9 billion to rebuild Puerto Rico's electrical system, including renewable energy, storage, and microgrids. (See attached letters to a filing with the Puerto Rico Energy Board dated March 2, 2021. https://energia.pr.gov/wp-content/uploads/sites/7/2021/03/Opposition-to-PREPAS-Motion-Seeking-Preb-Approval-of-10-Year-Infrastructure-Plan-with-Attachments-NEPR-MI-2021-0002-1.pdf .)

This paper presents a proposal for a rooftop solar plus storage program focused on LMI households with the objectives of:

- Lowering electricity costs and reducing the energy burden for LMI households
- Providing reliable and distributed electricity to LMI households
- Providing financial support for PREPA's transmission and distribution infrastructure
- Helping Puerto Rico to achieve its renewable energy goals

Our proposal utilizes FEMA funds to pay for rooftop solar plus storage systems (S+S) for any and all LMI households that are able to install these systems on their roofs. These S+S systems are sized to meet the average consumption requirement of LMI households.

We also propose coopertivas, that are certified by the U.S. Treasury as community development financial institutions (CDFI's), play a central role in this program. This role has several aspects; being a) a conduit of FEMA grant monies, b) a lender, and c) the "place" where LMI households get information about rooftop solar plus storage.

The mechanics of the program are:

- FEMA will fund 100%, 85% and 70% of the cost of the S+S systems for Very Low-, Low-, and Moderate-Income households, respectively. FEMA monies will be distributed through and by CDFI's. These systems will be sized to just meet the electricity requirements of LMI households.
- The cost of the systems not funded with FEMA grants will be financed with loans provided by the CDFI's.
- Each household with a S+S system will make monthly payments to a solar savings account. Monies in this account will be used to pay for periodic maintenance of the systems and replacement of system components.
- Each household with a S+S system will pay a flat periodic connection fee to PREPA/LUMA for access to "grid" electricity in the event the S+S system is not able to meet the household's needs. If the household purchases power from PREPA, the household will pay the stated per kWh charge.

This proposal has the following outcomes:

- It facilitates the installation of S+S systems for 177,000 to 379,000 households depending on adoption. These systems, in aggregate power, represent 13% to 27% of Puerto Rico's current electricity generating capacity, respectively.
- LMI households will see lower all-in electricity costs.
- The S+S systems will improve the reliability of power for LMI households. These households will also have backup power through their continued connection to the PREPA grid.
- PREPA will receive a predictable stream of payments for transmission and distribution maintenance, as shown below. Also, this program requires only a portion of the available FEMA monies, making the balance available for improvements to the transmission and distribution system.

There are two key takeaways in our proposal. The first is making the reduction of the energy burden of LMI households a policy objective. The second is using CDFI's as a primary player in the deployment of S+S systems.

Section 1: The Solar Context in Puerto Rico

Solar energy deployment in Puerto Rico via distributed (i.e., rooftop) and utility scale systems is taking place amidst a dynamic and complicated backdrop of Federal and Commonwealth priorities. These priorities arise from the aftermath of Puerto Rico's bankruptcy in 2015 and Hurricanes Irma and Maria in 2017. The bankruptcy and the hurricanes have influenced directly

and profoundly the ways electricity is being thought about in Puerto Rico. The following narrative provides a context for our proposal to facilitate the installation of rooftop solar plus storage (S+S) systems by low and moderate income (LMI) households.

In June 2015, the governor of Puerto Rico acknowledged that Puerto Rico's "debt is not payable". A year later, the U.S. Congress passed the Puerto Rico Oversight, Management and Economic Stability Act (PROMESA) that established the Federal Oversight and Management Board (FOMB). FOMB's mandate is to a) restructure the Commonwealth's existing debt (including PREPA's \$8.6 billion of debt), and b) resize/reorganize the Commonwealth's financial framework to avoid a debt crisis in the future. While some of the Commonwealth's debt has been restructured, the resolution of PREPA's legacy debt (totaling over \$9 billion) is still being negotiated by PREPA, FOMB and the creditors (i.e., bondholders, pensioners, etcetera).

Hurricane Maria made a direct hit on Puerto Rico in September 2017, leaving Puerto Rico without power for days and thousands of households and businesses without power for several months—see Figure 1 below. The human and economic toll was devastating.



Figure 1. Post-Maria Power Restoration (Source: "The Puerto Rico Renewable Microgrid Toolkit: A Data-Driven Approach to Resilience", Rocky Mountain Institute, December 2018. <u>https://rmi.org/the-puerto-rico-renewable-microgrid-toolkit-a-data-driven-approach-to-resilience/</u>)

Hurricane Maria caused public officials, the energy regulator and residents to rethink the structure of Puerto Rico's electricity infrastructure. This infrastructure is characterized by the following:

• A single state-owned enterprise, Puerto Rico Electric Power Authority, generates, transmits and distributes electricity. (Transmission and distribution are now being done by a private entity, LUMA Energy, via a public-private partnership.)

- Over 96% of the electricity consumed in Puerto Rico is generated with imported fossil fuels. (Source: <u>https://www.eia.gov/state/?sid=RQ</u>.)
- An extensive transmission and distribution system that is fragile and vulnerable to disruption as shown by Hurricane Fiona in September 2022.

A number of governmental actions have been taken post-Maria that are designed to address the vulnerabilities of Puerto Rico's electricity infrastructure, including, but not limited to, increasing the amount of renewable energy generated:

• In May 2019 the Puerto Rico Energy Public Policy Act-Law 17-2019 (Act 17) was enacted for the purpose of "setting the parameters for a resilient, reliable, and robust energy system with just and reasonable rates for all customer classes; making it feasible for energy system users to produce and participate in energy generation; facilitating the interconnection of distributed generation systems and microgrids, and unbundling and transforming the electrical power system into an open system."

The renewable portfolio goals set forth in Act 17 are 20% by 2022, 40% by 2025, 60% by 2040, and 100% by 2050. (Source: <u>https://energycentral.com/news/transformation-puerto-rico-electric-power-authority</u>.)

• In August 2020 Puerto Rico's energy regulator, the Puerto Rico Energy Bureau (PREB) approved PREPA's Integrated Resource Plan (IRP). This IRP is a blueprint for investments PREPA will make over a specified period that are "focused on ensuring the development of the electric power system in Puerto Rico, as well as reliability improvement, efficiency and transparency of the system. In this case, the IRP plan will take into account all the reasonable resources to satisfy the demand for electric power services during a twenty year period." (Source: https://energia.pr.gov/en/integrated-resource-plan/.)

The 2020 IRP includes the following:

- A plan to obtain by 2025 at least 40% of electricity from renewable sources, including solar. (Source: <u>https://www.nrel.gov/docs/fy20osti/76607.pdf</u>.)
- Deployment of distributed (in addition to utility scale) solar and storage installations.
- The use of appropriate programmatic, market-based, and tariff-based tools to test the availability and cost of distributed storage resources.

Source: https://earthjustice.org/sites/default/files/files/puerto_rico_irp_highlights_august2020.pdf

- In June 2021, the government of Puerto Rico and PREPA entered into an Operation and Maintenance Agreement with a private company, LUMA Energy. Under this 15-year agreement LUMA operates, maintains and modernizes PREPA's transmission and distribution (T&D) system.
- In February 2022, The US Department of Energy announced a two-year study titled "Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy (PR100)". This study will include "a comprehensive analysis of stakeholder-driven pathways to Puerto Rico's clean energy future." Participants in the study include U.S. Department of

Energy's Office of Electricity, Federal Emergency Management Agency, National Renewable Energy Laboratory, PREPA, LUMA Energy, Puerto Rico Energy Bureau, Puerto Rico Department of Housing, and various stakeholders from academia, community-based organizations, private solar and storage developers, the business community, and municipalities. <u>https://www.energy.gov/oe/puerto-rico-grid-resilience-and-transitions-100-renewable-energy-study-pr100</u>

There has been significant activity in the energy sector over the last two years focused on the deployment of solar power generation capacity in Puerto Rico. A number of NGO's are actively promoting rooftop solar installations, while private solar companies are installing rooftop systems for households and commercial entities with the economic means to enter into leases and other financing arrangements. Also, PREB, on behalf of PREPA, has issued several requests for proposals for privately owned and operated utility scale solar facilities.

Our work on this project causes us to believe that for institutional, financial, technical, and regulatory reasons, Puerto Rico will not commit itself to meet its Act 17 renewable goals solely through the deployment of rooftop solar; utility solar and other renewable sources such as wind and hydro will be in the mix. That being said, and as discussed more fully below, there are many positive aspects to rooftop solar that argue for it to be a significant source of electricity.

Finally, a key consideration in the planning of Puerto Rico's electricity system reconstruction, renewal and transition is the large amount of FEMA money that has been allocated to these activities. While it is difficult to pinpoint a precise dollar figure, it is in the range of \$9 to \$12 billion. Further the use of this money is not prescribed by FEMA; FEMA funds "can be used to build a more resilient and environmentally friendly electrical grid that simultaneously ensures Puerto Rico can be less energy import dependent and have cleaner air." (Source: <a href="https://www.schumer.senate.gov/newsroom/press-releases/schumer-velzquez-announce-94-billion-fema-grant-recently-awarded-to-puerto-rico-electric-power-authority-prepa-can-be-used-to-build-micro-grids-underground-transmission-lines-and-power-grid-that-supports-clean-renewable-electricity-clean_reliable-energy-can-be-part-islands-ongoing-recovery--reconstruction-efforts

Section 2: Solar in the Low- and Moderate-Income Community

In the context of electricity in Puerto Rico two statistics stand out:

- 43% of the residents in Puerto Rico live in poverty (ranking Puerto Rico last among the fifty states and the District of Columbia with two times the poverty percentage of the next closest state) (Source: US Census.)
- The per kWh charge is almost twice as much as the U.S. average. (Source: U.S. Energy Information Administration.)

These statistics are the context for an "energy-poverty nexus" that is endemic in Puerto Rico. This nexus is defined as a:

Self-reinforcing, dynamically interacting feedback loop that occurs in contemporary societies between energy insecurities and poverty. For low-income communities, in general, and especially for communities living in extreme poverty, these feedback loops

make it more difficult to either escape poverty or to resolve energy insecurities. In other words, the organization of energy systems helps to perpetuate poverty and vice versa. Many factors contribute to the energy-poverty nexus, including:

- high energy burdens, including high electricity prices;
- lack of access to financial resources among low-income households for investing in energy innovation or infrastructure upgrades that could lower longterm energy costs;
- trade-offs between energy and other critical household needs, such as food; and
- health difficulties that arise due to the inability to pay energy bills or the impacts of energy insecurities on critical aspects of wellbeing.

Source: "The Evolving Solar Energy Innovation Ecosystem in Puerto Rico." http://cohemis.uprm.edu/solar2020/pdf/EvolvingSolarEnergy_March2021.pdf.

One measure of this energy-poverty nexus is energy burden, defined as the percentage of gross household income spent on energy costs. The current energy burden profile for Puerto Rico is shown below.



AMI: 0% - 30%, 30% - 60%, 60% - 80%, 80% - 100%, 100% + Building Age: Before 1940, 1940 - 59, 1960 - 79, 1980 - 99, 2000 - 09, 2010+ Heating Fuel Type: Utility Gas, Bottled Gas, Electricity, Fuel Oil, Coal, Wood, Solar, Other, None Building Type: 1 unit detached, 1 unit attached, 2 units, 3 - 4 units, 5 - 9 units, 10 - 19 units, 20 - 49 units, 50+ units, Boat/RV/Van, Mobile/Trailer Rent/Own: Renter-occupied, Owner-occupied

Figure 2 (Source: <u>https://www.energy.gov/eere/slsc/maps/lead-tool</u> and Low-Income Energy Affordability Data (LEAD) Tool Methodology. Golden, CO. National Renewable Energy Laboratory, 2019. <u>https://www.nrel.gov/docs/fy19osti/74249.pdf</u>.)

In Puerto Rico, distributed photovoltaic, commonly referred to as rooftop solar, has been identified as a way to:

- Lower the cost of electricity, and consequently lower the energy burden.
- Insulate households from grid- related problems
- Provide consumers (and Puerto Rico itself) a greater measure of self-determination.

The challenge is LMI households cannot participate in rooftop solar in a meaningful way without policy interventions. As observed by GRID Alternatives and Vote Solar, which are two organizations that work in the area of low-income solar policies and programs,

"There are many effective policy tools for supporting solar adoption among consumers at large, and nearly all of them help expand low-income access to solar power to some extent. However, fully enabling low-income solar participation requires policies and programs that are specifically designed to address the unique barriers faced by these communities." (Source: https://www.lowincomesolar.org/about-this-guide/

Policies and programs need to address two key barriers:

- The high cost of the systems; and
- Difficulty in accessing information about the technical, economic and financial aspects of solar energy.

With respect to cost, the household decision to install rooftop solar plus storage (S+S) is based primarily on economics. In other words, will S+S result in lower household energy costs? (Two notes: First, while there are non-economic reasons for installing rooftop solar such as reliability, for LMI households these reasons are subsidiary to the out-of-pocket costs. Second, we are including storage as an integral and essential part of the rooftop system in order for households to be self-sufficient, i.e. to operate using only the energy it has produced over a 24-hour period, under most conditions.)

The economic decision is shown in the chart below.

LMI Average Monthly Power Usage (kwh)	324	kwh	(a)
Per kwh hour charge	\$ 0.219	per kwh	
Average Monthly Electric Bill	\$ 71.00		(a)
Annual Electric Bill	\$ 852.00		
Cost of System	\$ 15,000		
Financing Term	15	years	(b)
Annual Interest Rate	5%		(b)
Annual Loan (Lease) Payment	\$1,445		
(a) Table 11 https://ieefa.org/wp-			
content/uploads/2019/12/PREPA-RSA-Cordero-			
Guzman-UTIER-REPORT-9-10-19-FIN-			
ENGLISH.pdf			
(b) Based on conventional mortgage rates on the			
Island (May 2022)			
https://www.popular.com/en/mortgages/			

Figure	3
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LMI households in Puerto Rico pay in the range of \$750 to \$900 annually for electricity. (Source: <u>https://www.energy.gov/eere/slsc/maps/lead-tool</u>,) Assuming an installed cost of S+S of \$15,000, LMI households are unlikely to have the necessary savings to pay for the system out right, and, if they are able to qualify for some type of financing (loan or lease), the annual debt service costs would be greater than their current electricity bill.

Installed cost is a function of a number of variables, including size of the system and technical sophistication. It is important to note that our assumed \$15,000 installed cost is significantly less than the quoted prices for S+S systems in Puerto Rico. These prices are in the range of \$20,000 and \$25,000. We have used a lower figure that reflects smaller and more basic systems, as described more fully below.

While there are a number of solar projects planned or in process focused on LMI communities, these projects are funded by some combination of private grants, concessionary lending and offshore investment tax credits. The limited supply of these resources and the complexity of these financing arrangements makes scaling this approach difficult. The bottom line is that LMI households will not install S+S unless these systems are heavily subsidized either publicly or privately (i.e., with philanthropy).

Our conclusion is that some portion of the \$9 billion of FEMA funds available for rebuilding Puerto Rico's electricity system is required to allow LMI households to install rooftop solar in a way that will lessen their energy burden.

Information is also a barrier to LMI participation. Rooftop solar is still a relatively new "product." Further, understanding the technical, economic and financial aspects of rooftop solar requires some level of foundational knowledge. Getting LMI households "up to speed" is essential to their moving from being a consumer to a prosumer.

Section 3: Guiding Principles

Our proposal was developed using several guiding principles:

• Policies should lower electricity costs, as well as reduce the energy burden for LMI households. The annual energy costs and energy burden for three economic strata that make up the LMI population in Puerto Rico are shown below. We established a target energy burden of 7% for LMI households.

	AMI	Average Income	Current Average Annual Electricity Bill (a)	Current Energy Burden	Target Annual Electricity Cost	Target Energy Burden
Very Low Income	0% to 30%	\$ 2,400	\$ 746	31.1%	\$ 168	7.0%
Low Income	30% to 60%	7,100	818	11.5%	\$ 497	7.0%
Moderate Income	60% to 80%	12,000	892	7.4%	\$ 840	7.0%
Middle Income	80% to 100%	16,666	1,000	6.0%		
(a) https://www.ene	rgy.goy/eere/slsc	/maps/lead-tool.				

Figure 4	4
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- Policies should result in a more reliable electricity service for LMI households. Electricity blackouts of various durations have become commonplace in Puerto Rico over the last several years. LMI households are particularly and adversely affected by these outages. Popular sentiment is reliability of service for life safety purposes is an important objective.
- A continued connection to the PREPA transmission and distribution infrastructure is important for LMI households with S+S in the event of a disruption in the rooftop solar system or a need for electricity in excess of what the rooftop solar system is able to produce. (As discussed below, the S+S system for LMI households is designed to produce sufficient power to meet the household's needs; it is expected that very little power will be either purchased from or sold to PREPA.) Further, LMI households should pay for this backup service via a monthly access, or connection, fee. These monies will be used to pay for both legacy costs and ongoing costs associated with PREPA's transmission and distribution system.
- Policies should contribute to achieving Puerto Rico's stated intermediate and long-term renewable goals. The deployment of rooftop solar by any residential or commercial customer will contribute to the renewable energy portfolio.
- Policies should have a strong community component. Based on our discussions, we believe that for an LMI initiative to be successful there needs to be strong and effective community involvement in the areas of information dissemination and technical assistance.

Section 4: Proposal

Our proposal utilizes FEMA funds to pay for rooftop solar plus storage systems (S+S) for any and all single family LMI households that are able to install these systems on their roofs. These funds make up a portion of the \$9 billion that FEMA has allocated to "build a more resilient and environmentally friendly electrical grid".

We estimate there are 440,000 single family (owner and renter occupied) LMI households in Puerto Rico, as shown below. Our proposal assumes three take-up, or deployment, scenarios.

	Total LMI	Suitable						
Category	Households	Buildings (a)	S+S Deployment Scenarios					
Very Low Income (0-30% AMI)	267,761	172,242	25%	50%	80%			
Low Income (30-50% AMI)	151,221	112,133	50%	75%	90%			
Moderate Income (50-80% AMI)	203,337	155,448	50%	75%	90%			
Total	622,319	439,823	176,851	286,807	378,617			
(a) Suitability refers to the characteristics of the household roof, e.g., orientation (azimuth and tilt), shading, and size.								

Source: U.S. Census and National Renewable Energy Laboratory (NREL) data.

Figure 5

These S+S systems are sized to meet the average consumption of LMI households, i.e., approximately 324kWh per month (Source: Table 11 <u>https://ieefa.org/wp-content/uploads/2019/12/PREPA-RSA-Cordero-Guzman-UTIER-REPORT-9-10-19-FIN-ENGLISH.pdf</u>.) We estimate the installed cost of these S+S systems to be \$15,000, as shown below.

Cost of hardware	
Panels (a)	\$ 2,250
Battery (b)	5,500
Miscellaneous equipment (controllers, etcetera)	1,000
Installation hardware	1,000
Installation cost	3,750
Community Development Financial Institution (CDFI) fee (c)	1,500
Total Installed Cost	\$ 15,000
(a) Nine 290 W panels that will produce 360 kWh per month assuming a	
capacity factor of 19.2%.	
(b) 11 kWh of storage, representing approximately 1 day of usage.	
(c) Fee associated with arranging and overseeing installation.	

Figure 6

The justification for this S+S cost estimate (which is significantly lower than the average cost of a typical household system being installed in Puerto Rico) is:

- LMI systems are smaller (given they are sized to approximate the energy profile of the household).
- These systems will have a basic and standardized design. (Given the number of potential systems, we believe that a vigorous value engineering effort will result in a lower cost.)
- Bulk purchasing of components.

The cost of these LMI S+S systems will be paid for primarily with FEMA funds allocated to PREPA. These funds will be disbursed through local cooperative financial institutions (e.g.,

cooperativas) that are certified by the U.S. Treasury as community development financial institutions (CDFI's), described in more detail below.

If the LMI household is in the very low-income category, it will receive a grant to cover 100% of the cost of the S+S. Households in the low-income and moderate-income categories will receive grants in the amount of 85% and 70% of the cost of the S+S system, respectively. The balance of the cost may be borrowed from the particular CDFI that passed the FEMA funds through to the household.

Based on the three deployment scenarios, the net FEMA allocation for the S+S installations (excluding the initial deposit to the solar savings account discussed below) is \$2.2 billion (low) to \$4.8 billion (high), as show in Figure 7. (Note: If the cost of the S+S systems is \$20,000, as opposed to the assumed \$15,000, the range of required FEMA funds is \$2.9 billion (low) to \$6.4 billion (high).)

				 S+S I	Deploy	ment Scer	nario	s
		Tota	l Suitable					
	Total LMI	Sing	le Family	Low	Μ	edium		High
Category	Households	H	Iouses					
Total LMI Households	622,319		439,823	176,851		286,807		378,617
Total Investment (\$ billions) @ S+S system cost of:		\$	15,000	\$ 2.65	\$	4.30	\$	5.68
Less: CDFI loans-aggregate (\$ billions) (a)				0.48		0.71		0.86
Allocation from FEMA for S+S system cost (\$ billions)				2.18		3.59		4.82
Plus: Initial FEMA Deposit to Solar Savings Account (\$ bi	illons)			0.64		1.03		1.36
Total Allocation from FEMA (\$ billions)				\$ 2.81	\$	4.62	\$	6.19
(a) Assumes CDFI's make loans to finance the following percentages	of the S+S System co	ost:						
Very Low Income (0-30% AMI)	0%							
Low Income (30-50% AMI)	15%							
Moderate Income (50-80% AMI)	30%							

Figure 7

Each LMI household that installs a S+S system under this program will make monthly payments to a "solar savings account" (SSA) held by the CDFI that was the conduit for the grant (and is the lender). Monies in this account will be used to pay for periodic maintenance of the household systems, as well as scheduled replacement of system components, as shown below. Note: FEMA will make an initial deposit to the SSA in the amount of \$3,600 per household to ensure there are sufficient funds to cover the replacement of batteries, as shown in Figure 7 and 8.

				L	lifecyc	ele C	osts				
Year	Initial Deposit to Solar Savings Account	Annual Payment to SSA)	Roi Ma	utine aint.	Sy Re me	/stem place- ents	Inte Earn SSA	erest ed on A @	E Ba	nding
								3	%		
0	\$ 3,600									\$	3,60
1		\$ 14	12	\$	100			\$	108		3,75
2		14	12		100				113		3,90
3		14	12		100				117		4,06
4		14	12		100				122		4,22
5		14	12		100				127		4,39
6		14	12		100				132		4,57
7		14	12		100				137		4,74
8		14	12		100				142		4,93
9		14	12		100				148		5,12
10		14	12		100				154		5,32
11		14	12		100	\$	5,500		160		2
12		14	12		100				1		6
13		14	12		100				2		10
14		14	12		100				3		15
15		14	12		100				5		20
16		14	12		100				6		24
17		14	12		100				7		29
18		14	12		100				9		34
19		14	12		100				10		40
20		14	12		100				12		454

Figure 8

Each household also will make a flat monthly connection, or access, fee to PREPA.

The payments to the solar savings account and the connection/standby fee will be set so the sum of these payments plus the loan repayment (if applicable) will result in an energy burden of 7%, as shown below.

		% of System			Grid				
		Debt Financed	Amount of Debt	Annual Debt	Connection	Solar Savings	Total Annual	Average	Energy
	AMI	(a)	per Household	Service (a)	Fee	Acct (O&M)	Payments	Income	Burden (b)
Very Low Income	0% to 30%	0%	\$ -	\$0	\$ 26	\$ 142	\$ 168	\$ 2,400	7.0%
Low Income	30% to 60%	15%	\$ 2,250	\$217	\$ 138	\$ 142	\$ 497	\$ 7,100	7.0%
Moderate Income	60% to 80%	30%	\$ 4,500	\$434	\$ 264	\$ 142	\$ 840	\$ 12,000	7.0%
(a) Financing assum	ptions:								
Term	15	years							
Interest Rate	5%								

Figure 9

Role of CDFI's

Based on our observations we believe that a community approach (as opposed to direct Federal or Commonwealth involvement) would contribute to the program's success measured in terms of participation. Specifically, we envision utilizing the community development financial

institutions (CDFI's) in Puerto Rico as the conduit for the FEMA monies, as well as taking a direct role in the program.

As of April 2022, there were 81 CDFI's in Puerto Rico. These CDFI's are primarily coopertivas which are community-based cooperative financial institutions similar to credit unions in the U.S. Their mission is "to serve people who have been excluded from the financial mainstream and offer quality community-owned financial services." (Source: "Puerto Rico CDFI Initiative," Inclusiv, April 2022.)

A cooperativa can be certified by the U.S. Treasury as a CDFI if it meets the following requirements:

- Is a legal entity at the time of the certification application;
- Has a primary mission of promoting community development;
- Is a financing entity;
- Primarily serves one or more target markets;
- Provides development services in conjunction with its financing activities;
- Maintains accountability to its defined target market; and

• Is a non-government entity and not under the control of any government entity. Source: https://www.cdfifund.gov/programs-training/certification/cdfi).

Once certified as a CDFI, a cooperativa can participate a variety of programs offered by the CDFI Fund administered by the U.S. Treasury. (We are assuming that, by extension, CDFI's can act as conduit for FEMA funds.)

The role of the CDFI's in the program has several aspects:

- Acting as the conduit of FEMA monies,
- Being the lender (with support from the CDFI Fund's Small Dollar Program which provides grants to CDFI's for Loan Loss Reserves and Technical Assistance associated with loans to consumers in amounts not to exceed \$2,500).
- Being the "place" where LMI households get information about S+S.

These activities are summarized below. Participating CDFI's will be compensated through a fee arrangement (approximately 10% of the installation cost) that will be included in the cost of installation.

- Program Responsibilities
 - a. Distribute FEMA funds to LMI households—The CDFI's will requisition funds from FEMA (possibly through PREPA) on a household-by-household basis for households and systems that meet a prescribed set of eligibility criteria. These funds will be used to pay the costs of installation and make an initial deposit to the household's Solar Savings Account.
 - b. Make loans to households, where necessary, to augment the FEMA grant—The CDFI's will provide loans, as the lender, to low- and moderate-income households (30%-80% AMI) in the amount of 15% and 30%, respectively of the cost of the systems. The CDFI's will service these loans.
 - c. Ensure/certify installed S+S systems meet prescribed requirements—The CDFI's, as the grant conduit and lender, will provide inspection services during the

installation period, similar to the practice followed with new home construction loans.

- d. Receive and hold household payments to Solar Savings Account (SSA) and debt service payments (where applicable)—The CDFI will establish an account(s) for each household for which an S+S system is installed. The first account is the Solar Savings Account (SSA) which will be used to pay the lifecycle costs of the S+S system. The second account (if applicable) will be used by the household to make debt service payments on the loan made by the CDFI.
- e. Disburse funds from SSA for qualified expenses (maintenance, etcetera)—The CDFI will disburse funds from the SSA for qualified maintenance expenses.
- Community Responsibilities—CDFI's that want to participate in this program will be trained in the fundamentals of rooftop solar plus storage, as well as the particulars of the program. We envision this being facilitated by an organization such as Inclusiv, a trade group representing CDFI's. Inclusiv has an initiative called the Center for Resiliency and Clean Energy which is a professional training and certificate program for CDFI's that are interested in participating in the solar "business."

(<u>https://www.inclusiv.org/initiatives/center-for-resiliency-and-clean-energy/</u>). Further, the U.S. Treasury, through the CDFI Fund, provides capacity building grants to CDFI's.

CDFI's will be responsible for:

- a. Energy education—The CDFI's will design and implement outreach initiatives focused on the LMI communities in their market areas. The objectives of these initiatives will be to disseminate information about and promote of the program.
- b. Help desk—The CDFI will maintain a relationship with the household that will include being a "first call" help desk for issues related to the S+S system.

Section 5: Outcomes

This proposal has the following outcomes:

• It facilitates the installation of S+S systems for 177,000 to 379,000 households. These systems, in aggregate power, represent 13% to 27% of Puerto Rico's current electricity generating capacity, as shown below.

			S+S	Installation Scer	narios
	Total LMITotal SuitableHouseholdsSingle Family		Low	Medium	High
Total LMI Households	622,319	439,823	176,851	286,807	378,617
Net FEMA grant allocation (\$ billions) (a)			\$ 2.18	\$ 3.59	\$ 4.82
Monthly Household Solar Production (kWh)			360	360	360
Yearly Household Solar Production (kWh)			4,320	4,320	4,320
Aggregate Production (tWh)			0.76	1.24	1.64
Percent of Total Island Production (b))			13%	21%	27%
(a) Does not include the initial deposit in the Solar Saving	gs Account.				
(b) Based on annual Island generation capacity of approx	imately 6 tWh. (Sou	urce: U.S. Energy Inf	Formation Admin	istration)	

Figure 10

• LMI households will see lower all-in electricity costs as shown below:

	Cu	rrent	N	ew				
	Electricity		Electricity		ectricity Annual		Percent	
AMI	Bill		Cost		Savings		Reduction	
0% to 30%	\$	746	\$	168	\$	578	77%	
30% to 60%	\$	818		497		321	39%	
50% to 80%	\$	892		840		52	6%	
(3 5	AMI 0% to 30% 0% to 60% 0% to 80%	AMI Elec 0% to 30% \$ 0% to 60% \$ 0% to 80% \$	AMI Electricity Bill 0% to 30% \$ 746 0% to 60% \$ 818 0% to 80% \$ 892	Electricity Electricity AMI Bill C 0% to 30% \$ 746 \$ 0% to 60% \$ 818 C 0% to 80% \$ 892 C	ElectricityElectricityAMIBillCost0% to 30%\$ 746\$ 1680% to 60%\$ 8184970% to 80%\$ 892840	Electricity Electricity Arr AMI Bill Cost Sav 0% to 30% \$ 746 \$ 168 \$ 0% to 60% \$ 818 497 0% to 80% \$ 892 840	Electricity Electricity Annual AMI Bill Cost Savings 0% to 30% \$ 746 \$ 168 \$ 578 0% to 60% \$ 818 497 321 0% to 80% \$ 892 840 52	

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- The S+S systems will improve the reliability of power for LMI households. These households will also have backup power through their continued connection to the PREPA grid.
- PREPA will receive a predictable stream of payments for transmission and distribution maintenance, as shown below. Also, this program requires only a portion of the available FEMA monies, making the balance available for improvements to the transmission and distribution system.

	S+SDeployment Scenarios		
	Low	Medium	High
Aggregate Annual Connection Fees	\$ 25,112,842	\$ 40,726,559	\$ 53,763,543

Figure	12
1 ISult	14

Another way to evaluate the potential of this proposal is using the "Puerto Rico Test." This test was formulated by the Center for Impact Finance at University of New Hampshire Carsey School of Public Policy and presented at an April 2021 webinar titled "Community-Based Solar Lending: Bringing Clean Energy to Low-Income Communities"

(https://media.unh.edu/media/Community-

Based%20Solar%20Lending%3A%20Bringing%20Clean%20Energy%20to%20Low-Income%20Communities/1_vqsqtt8x).

The Puerto Rico Test has five parts:

- Is the energy resilient?
- Is it affordable?
- Who gets to build wealth from it?
- Who owns it? Can you trust them?
- Does it create quality job opportunities for low-income workers?

Our responses to each of these is:

- Is the energy resilient? The S+S systems are energy resilient by design; in the event of a localized or widespread electricity outage, households with S+S systems will have an uninterrupted source of electricity. Further, with the back-up connection to the PREPA system, these households have an effective electricity "insurance policy."
- Is it affordable? The S+S systems are affordable from the perspective of the household because the systems are funded largely with FEMA grants. Also, one of the design

parameters of this proposal is to reduce the energy burden of the participating households.

- Who gets to build wealth from it? LMI households will build wealth as a consequence of this program in two ways. The first is lowering the household's energy burden which will free up financial resources for other purposes including savings. Second, S+S systems should increase the value of the house which will accrue to the benefit of the homeowner.
- Who owns it? Can you trust them? The S+S systems will be owned by the homeowner. The trust question comes into play if the systems are leased, which is not the case in our proposal. Also, an important reason to involve the CDFI's is because of their credibility in the communities they serve.
- Does it create quality job opportunities for low-income workers? One aspect of the proposal which we did not address is the human resources necessary to install and maintain up to 375,000 S+S systems. Given the nature of these S+S systems there certainly is the opportunity to mobilize and train members of the LMI community to assume installation and maintenance roles.

Section 6: Next Steps

This proposal is a framework for a public program that is designed to have specified and explicit outcomes. This framework is based on a number of assumptions and does not include certain details that need further research.

The key assumptions underpinning the proposal are:

- 1. The FEMA monies granted to PRPA for the reconstruction of Puerto Rico's power infrastructure can be used for rooftop solar installations as articulated in the Bipartisan Budget Act of 2018.
- 2. Our proposal will require several things:
 - a. PREPA allocates a money from its FEMA grant for the S+S systems; and
 - b. PREPA distributes these monies through participating CDFI's.
- 3. The CDFI's, as certified by the U.S. Department of the Treasury, can act as conduits of FEMA grant monies.
- 4. The cost of appropriately sized S+S systems can be reduced to approximately \$15,000 and there is a workforce that can be mobilized to install and maintain these systems in a timely fashion.
- 5. Households that participate in the program will make the required periodic SSA and connection fee payments and debt service payments (as applicable). Recourse by the CDFI's and PREPA in the event of non-payment has not been investigated.

Additional work is required in the following areas:

- 1. PREPA, as the FEMA grantee, will need to be convinced of the efficacy of the program.
- 2. The CDFI's, which are an integral part of the program, will need to be willing participants. Direct discussions with these institutions should be conducted to gauge their interest and to collect feedback that could be incorporated into the program design.

Appendix

This policy proposal was prepared by the following students who are master's degree candidates in public administration. regional planning, and engineering; Caleb Smith, Besjon Tanuzi, Nina Borja, Mariam Fatima, Ben Katz, Norielis Perez, Waqar Akhtar, Sarah Carillo, Zahra Khuwaja, Jack Schwab, and Olafare Olagbaju. The faculty lead was John Foote. Also, participating as a resource was Mark Fagan, Lecturer in Public Policy at the Harvard Kennedy School. Questions should be directed to John Foote at jhf25@cornell.edu.

Over the course of the semester, the students met with the following organizations and individuals to which we express our appreciation for their time, interest and insights.

- Barrio Eléctrico
- CAMBIO
- Center for a New Economy
- Estudios Tecnicos
- Financial Oversight and Management Board
- Inclusiv
- LUMA Energy
- Puerto Rico Builders Association
- Puerto Rico Solar Power Business Accelerator
- Resilient Power Puerto Rico
- Ruth Santiago
- Solar and Energy Storage Association of Puerto Rico
- Sunrun
- Jeff Sward-Cornell University
- Telos Energy, Inc.

The views and position included in this proposal are those of the students who conducted the research and do not necessarily reflect the opinions of the organizations and individuals above.

Foundational source materials used in preparation of this document are listed below:

- We Want Sun and We Want More: 75% Distributed Renewable Generation in 15 Years in Puerto Rico Is Achievable and Affordable, March 2021. <u>https://ieefa.org/wp-</u> content/uploads/2021/03/We-Want-Sun-and-We-Want-More March-2021.pdf
- Puerto Rico Distributed Energy Resource Integration Study—Achieving a Renewable, Reliable, and Resilient Distributed Grid, Telos Energy, December 2020._ https://cambiopr.org/wp-content/uploads/2021/03/Puerto-Rico-Distributed-Energy_ Resource-Integration-Study-Telos-Energy.pdf
- The Evolving Solar Energy Innovation Ecosystem in Puerto Rico, March 2021 http://cohemis.uprm.edu/solar2020/pdf/EvolvingSolarEnergy_March2021.pdf
- An Assessment of Opportunities and Barriers to Solar Finance in Puerto Rico (EDA Program # 01-79-14864), April 2021. <u>https://storage.googleapis.com/productionconstantcontact-v1-0-</u> <u>7/167/283167/DN7VChXr/62c41e52e8434e0ab6498cee3c6a75d7?fileName=FinanceRep</u> ort%20Completed 5-13.pdf

- U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020, National Renewable Energy Laboratory <u>https://www.nrel.gov/docs/fy21osti/77324.pdf</u> and_ https://www.nrel.gov/solar/market-research-analysis/solar-installed-system-cost.html
- Low-Income Solar Policy Guide, <u>https://www.lowincomesolar.org/about-this-guide/</u>
- Dataset: Puerto Rico Solar-for-All: LMI PV Rooftop Technical Potential and Solar Savings Potential, U.S. Department of Energy, July 28, 2020. <u>https://www.osti.gov/biblio/1676962-puerto-rico-solar-all-lmi-pv-rooftop-technical-potential-solar-savings-potential</u>

The Puerto Rico Solar-For-All dataset provides Census Tract level estimates of residential low-to-moderate income (LMI) PV rooftop technical potential as well as solar electric bill savings potential for LMI communities at the municipality level. Each dataset is broken out by income group, defined by the Area Median Income (AMI), by tenure, and by building type.