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NATIONAL
LABORATORY
OF THE ROCKIES

Strategic Energy Plan: Playa de Ponce, Ponce, Puerto Rico

Alexa Carrera, Melanie S. Ramos Beltrán, Daniel Bernal, and Angela Ortega Pastor

National Laboratory of the Rockies

The National Laboratory of the Rockies is a national laboratory of the U.S. Department of Energy, Office of Critical Minerals and Energy Innovation, operated under Contract No. DE-AC36-08GO28308.

Technical Report
NLR/TP-7A40-96824
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National Laboratory of the Rockies
15013 Denver West Parkway
Golden, CO 80401
303-275-3000 • www.nlr.gov

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List of Acronyms

BESS	battery energy storage system
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ETIPP	Energy Technology Innovation Partnership Project
LED	light emitting diode
LFP	lithium-iron phosphate
NGO	nongovernmental organization
NPV	net present value
NLR	National Laboratory of the Rockies
O&M	operations and maintenance
PV	photovoltaic
SEP	strategic energy plan
SLOPE	State and Local Planning for Energy
UNA	Un Nuevo Amanecer Inc.

Executive Summary

Un Nuevo Amanecer Inc. (UNA), a community-based NGO (501C(3)), sought technical assistance through the U.S. Department of Energy's (DOE's) Energy Technology Innovation Partnership Project (ETIPP) to develop a strategic energy plan (SEP) for the community of Playa de Ponce on the south coast of Puerto Rico. A SEP helps communities identify energy goals and priority projects, and outline strategies and actions to build a shared path toward their energy vision. The primary goal of this SEP is to collaboratively explore pathways for the community's energy future. Researchers from the National Laboratory of the Rockies (NLR) engaged with the community for a period of seven months and facilitated a series of in-person community engagement workshops along with ETIPP regional partner Puerto Rico Hispanic Federation, UNA, and community leaders.

The SEP workshops were held twice, March 18–20 and June 24–26, 2025. Through facilitated discussions, the community worked together to define and articulate a clear vision for its short-, medium-, and long-term energy goals. The workshops played a key role in identifying the specific strategies and priority projects that would best suit the needs of the community. The discussions outlined the community's energy aspirations, establishing a shared vision, setting goals, and outlining the priority actions needed to bring them to fruition.

During the workshops, the community shared some of the most pressing energy challenges that they face on a regular basis, such as high energy costs that disproportionately impact an aging population and unreliable electricity during extreme weather events that result in frequent power outages. These issues have also exacerbated risks to public health and safety of the community. In response, UNA requested technical assistance through ETIPP to inform the development of a SEP tailored to Playa de Ponce to support its energy vision. This document explores four community-driven energy strategies aligned with that vision. Figure 1 shows the strategies outlined in this plan, which are categorized into three focus areas as identified by the community: energy reliability; safety and security; and stakeholder participation, education, and capacity building.

This document serves as a shared roadmap for developing and implementing energy solutions that meet the needs of Playa de Ponce. It is intended to serve as a public resource for the community, UNA, and local authorities—providing tools, information and a shared foundation to inform future implementation efforts. This plan is intended to complement ongoing planning frameworks at the municipal, regional, and island-wide levels. As a living document, this SEP can evolve alongside Playa de Ponce's changing energy goals, while offering a framework to help them realize their energy vision.

Energy Vision	**Establish community-led energy projects that strengthen energy security, enhance safety, and ensure reliable access to energy—all grounded in the needs and voices of Playa de Ponce residents. These efforts will be built through collaboration, local capacity building, and solutions that also support the community's long-term economic development.**			
Focus Areas	**Energy Reliability**		**Safety and Security**	**Stakeholder Participation, Education, and Capacity Building**
Goals	• Increased ability to prepare for, withstand, and recover from power outages during storms and heat waves. • Fast recovery for all areas of Playa de Ponce. • Functional water pumps during power outages. • Lower-cost and quitter backup energy options to replace noisy, expensive gasoline generators. • Accessible spaces for the community to go to during an emergency, focusing on serving those with medical vulnerabilities.		• Safe electrical connections to prevent fires and electric shock. • Reliable street lighting (e.g.. solar powered) to improve nighttime visibility, reduce crime, and ensure safe mobility during emergencies.	• Transparent, community-led planning processes to foster trust and reflect residents' true needs. • Education on how energy systems work (e.g.. how to operate and maintain). • Designated spaces for meetings and coordination to sustain community-led efforts.
Projects	**Development of a Resiliency Center**	**Community Microgrid on Abandoned Site**	**Public Solar Lighting in High-Priority Areas**	**Energy education and capacity-building workshops**
Strategies	Identify existing buildings that can serve as potential hubs during emergencies.	Repurpose abandoned sites to implement a community-wide microgrid project.	Install public solar lighting in high-priority areas to improve safety and security.	Identify topics of interest for future training and education workshops.
Actions	1. Identify key community areas that are accessible, such as community centers, schools, churches. 2. Conduct resilience studies to evaluate feasibility of microgrid implementation and outage survival potential, including conducting additional community engagement to understand the most critical loads during power outages. 3. Co-design with the community a emergency management plan that details the protocol that would need to be put in place (i.e. blue and black sky operations of the building). 4. Coordinate with local stakeholders to incorporate these hubs into broader disaster response plans. 5. Install solar and battery backup systems that can meet critical loads during emergencies.	1. Conduct an inventory and mapping of abandoned sites in the community. 2. Assess ownership status of selected sites in collaboration with the municipality of Ponce. 3. Conduct site assessments for potential microgrid implementation, including techno-economic feasibility studies that take into consideration geography, solar generation potential, and proximity to critical infrastructure. 4. Engage with utility LUMA early to initiate design, interconnection, and permitting process. 5. Define the project ownership model. 6. Build a financial plan through exploration of federal, local, and philanthropic funding sources. 7. Select engineering and construction partners in consultation with the community. 8. Build and commission the microgrid system. 9. Create a local O&M plan and workforce strategy that includes local job creation plans and governance structure.	1. Identify and map priority areas using resident feedback (e.g., streets near schools, hospitals, parks, elderly housing). 2. Assess technical feasibility such as sun exposure, pole placing, terrain, among other factors. 3. Develop a procurement strategy in consultation with the community to select vendors that meet the community's expectations. 4. Coordinate installation and permitting with the appropriate authorities. 5. Develop an Operations and Maintenance plan and track performance and impact through community reporting mechanisms.	1. Understand community training needs to better understand knowledge gaps. 2. Develop a training plan that considers frequency, format (i.e., in-person, online, hybrid), and intended audiences (i.e., youth, adults, technical learners). 3. Partner with universities and NGOs. 4. Identify existing community events where outreach efforts can take place. 5. Pilot initial workshops and collect feedback. 6. Refine approach and launch an ongoing training calendar. 7. Monitor participation and outcomes (e.g., number of certificates obtained, changes in employment).

Figure 1. Energy vision framework outlining focus areas, strategies, and actionable steps

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1 Introduction

Playa de Ponce is a coastal community located along the southern coast of Puerto Rico within the municipality of Ponce. It has a population of 11,489 residents, approximately 36% of whom are 65 years of age or older (U.S. Census Bureau, 2020). Playa de Ponce is made up of four census tracts, each with its own unique aspects and challenges: 716.01, 716.02, 721.01, and 721.02. Some sectors[1] that make up these census tracts include but not limited to: Sector Los Potes, Sector Loso Meros, Sector Villa Pampanos (before Comunidad La Guanchita), Residencial Lirios del Sur, Urb. Vistas del Mar, Urb. San Tomas Apto., Paseo del Puerto, Sector Amalia Marin, Sector Salistral/Playa Residencial, Bda. Caribe, Sector Puerto Viejo, Villa del Carmen, Urb. Costa Sabana, Urb. Tabaiba Gardens, Sector Playita, and Urb. Villa Tabaiba.

Within these census tracts, some households spend as much as 10% of their average annual income on energy (SLOPE 2020). These characteristics point to the critical need for energy strategies that enhance both affordability and resilience for older adults and other residents experiencing high electricity costs. For the aging population, reliable energy is particularly vital to sustain medical equipment and maintain safe living conditions during extreme weather events. At the same time, high energy costs can exacerbate financial hardships, particularly for households on fixed or limited incomes. These factors guided the development of this Strategic Energy Plan (SEP) to include targeted solutions.

Playa de Ponce is among the fourth cohort of communities participating in the U.S. Department of Energy's (DOE's) Energy Technology Innovation Partnership Project (ETIPP). ETIPP offers technical assistance to coastal, remote, and island communities seeking to increase their energy reliability. Over seven months, weekly meetings were conducted with a planning team that included technical and regional representatives from the National Laboratory of the Rockies (NLR), Hispanic Federation, Un Nuevo Amanecer Inc. (UNA), community leaders, and other stakeholders.

Stakeholders played specific roles throughout the process. NLR ensured communication and progress, Hispanic Federation led community engagement, UNA represented local interests and facilitated workshops, and community leaders provided critical feedback. Institutional stakeholders such as the Municipality of Ponce and Port Authority of Ponce contributed insights and confirmed alignment on regional energy reliability needs. This collaboration guided the development of actionable strategies for the SEP.

Strategic Energy Planning Process:

The process for developing this plan started with organizing a planning team and identifying key members who will lead the effort. The NLR team began by engaging with community leaders identified by UNA, who expressed early interest and commitment to this project. Through these initial conversations, it also became clear that the Ponce municipality was a key stakeholder that

[1] Sectors in Puerto Rico are local place names and often do not map 1:1 with U.S. Census tracts. A single sector can be split across multiple census tracts, and a single census tract can include many different sectors.

would need to be engaged at a later stage of the SEP process, as they hold the decision-making authority and have a direct role in implementing key aspects of the plan.

After establishing the core community energy planning team, the ETIPP technical team began meeting on a weekly basis. Initial conversations focused on learning the goals and motivation of the lead applicant for applying to ETIPP, as well as their broader vision for the community. Through this initial engagement, it was evident that one of the strategies the community wanted to focus on was the potential to use abandoned sites[2] as community assets—specifically, repurposing them for future energy projects. Additionally, the community emphasized their priority of exploring solar generation opportunities, which prompted the ETIPP team to conduct a SLOPE analysis to understand the feasibility and potential of such projects.

During the first in-person visit to the community, the NLR team visited several abandoned sites identified in a 2020 study (not publicly available), which documented an inventory of 170 abandoned sites within the community. Of the 170 sites that were initially inventoried, a smaller subset was selected for in-person visits based on recommendations from local stakeholders and community members. These sites were identified as particularly promising due to their proximity to critical infrastructure, visibility, or potential for community impact. Figure 2 summarizes the sites that were visited; more detailed information on the visited abandoned sites is provided in Appendix C.

Figure 2. Map showing the abandoned sites visited for potential energy projects in Playa de Ponce

Map created using ArcGIS by Melanie S. Ramos Beltrán, NLR

[2] In this context, "abandoned sites" refers to parcels of land or structures that are no longer in active use or maintenance. These sites were identified based on criteria outlined in a 2020 study, which used definitions aligned with Puerto Rico regulations and municipal standards. Examples include public nuisance properties, vacant lots, underutilized buildings or vacant homes. Ownership of these sites varies, with some being publicly owned by the municipality and others privately owned.

From January to February 2025, the NLR team focused on gathering the necessary information to develop an energy baseline assessment (see Section 3) to share with the community during the first in-person workshop. The goal of the first set of in-person workshops was to meet the community; review the baseline energy assessment; and identify local strengths and weaknesses. These workshops also facilitated the co-development of a shared community energy vision and the identification of key energy focus areas tailored to local priorities.

Taking the information gathered from the first set of workshops, the NLR team began brainstorming and identifying potential strategies that were technically, financially, and socially viable for Playa de Ponce. These strategies were then presented at a second set of in-person workshops, which focused on facilitating discussions to review the previously proposed strategies, explore specific projects and actions in greater detail, assess their benefits and risks, and prioritize these strategies according to the community's input—all of which shaped this plan.

2 Energy Vision and Goals

This section defines the community's aspirations for a reliable, secure, and informed energy future, primarily driven by enhancing safety and ensuring dependable access to energy. Developing the energy vision helped the community to establish priorities and goals that reflect their values, ensuring all strategies and actions align with the shared vision for Playa de Ponce's energy ability to prepare for, withstand, and recover from power outages.

Playa de Ponce's energy vision and goals were developed primarily based on insights and feedback gathered during the first set of community workshops held in March 2025.

2.1 March 2025 Workshops

Figure 3. Group photo of Villa del Carmen guided discussions during the March 2025 workshop

Photo by Melanie S. Ramos Beltrán, NLR

Three community workshops took place March 19–21, 2025. Each workshop was held at various census tracts within the geographic area of Playa de Ponce (Figure 5). These workshops played a critical role in defining the community's energy vision and informing the final plan. The discussions and insights gathered from residents during these workshops, through activities and feedback questionnaires, directly shaped the plan's priorities and goals by gathering insights on energy challenges, energy priorities, and goals within the region. The March workshop activities and the questionnaire can be found in Appendices A and B, respectively.

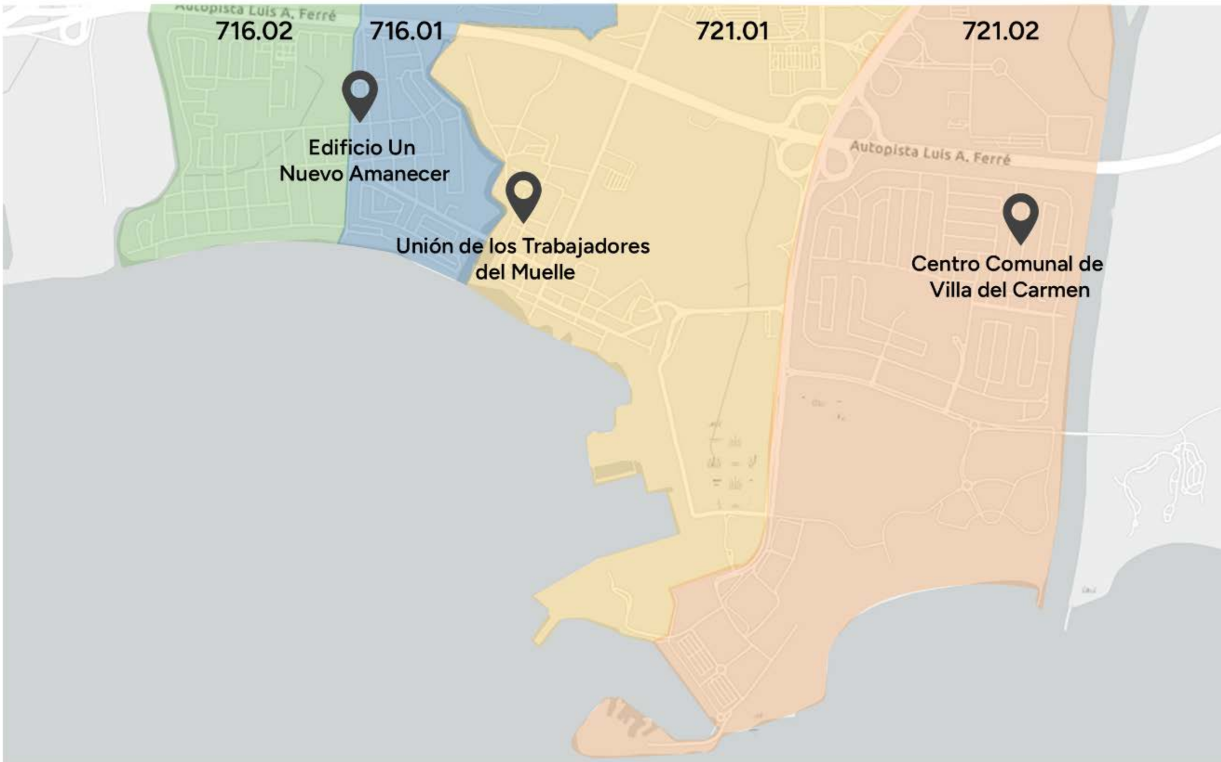

Figure 4. Map highlighting the three locations of the March 2025 workshops

Map created using ArcGIS by Melanie Ramos, NLR

The following values, priorities, strengths, and challenges were synthesized from the discussions held during the March workshops.

2.2 Community Values and Priorities

This section outlines the community values that were identified throughout the engagement process. These values act as the guiding principles for shaping the plan's priorities and ensuring alignment with the community's aspirations and needs.

The community of Playa de Ponce places a strong emphasis on several core values and priorities that include reliability, safety, and accessible energy solutions that serve the broader community. Frequent power outages—intensified by storms and extreme heat—disrupt daily life and pose serious risks to vulnerable residents, particularly older adults and those with health conditions. Residents prioritize solutions that foster trust, highlighting concerns over delayed recovery efforts, poor maintenance of essential systems, and an interest in greater participation in the decision-making process over their energy system.

Community members have also emphasized specific priorities such as transparent and participatory planning, alongside practical focus areas like education and community engagement. Many residents express a need for improved energy literacy, as they are unfamiliar with available energy technologies and lack access to clear, practical information regarding their operation and maintenance. There is a strong desire for educational initiatives that are actionable, empowering residents to make informed energy-related decisions tailored to their community's unique needs.

2.3 Strengths and Challenges

Playa de Ponce demonstrates notable strengths that reflect its internal assets, resources, and capabilities. During the workshops, the community showed strong support for local, community-wide energy projects. Participants expressed openness to repurposing abandoned community spaces for energy solutions, an approach supported by 97% of questionnaire participants. Sectors in Playa de Ponce, like Villa del Carmen, have a strong bond and prioritize community cohesion and collaborative approaches, all of which foster an environment conductive to community-based energy solutions.

The community faces specific challenges that could affect project implementation. Structural and ownership issues associated with many residential buildings in Playa de Ponce create barriers to deploying residential rooftop or ground-mounted solar systems. These challenges highlight the need for alternative approaches, reinforcing the suitability of community-based energy solutions in this context. Furthermore, the community has over 170 abandoned spaces, some of which may serve as viable locations for developing community-focused energy projects. Figure 6 illustrates the increasing percentage of vacant housing in Playa de Ponce, which includes some of these abandoned sites as of 2020.

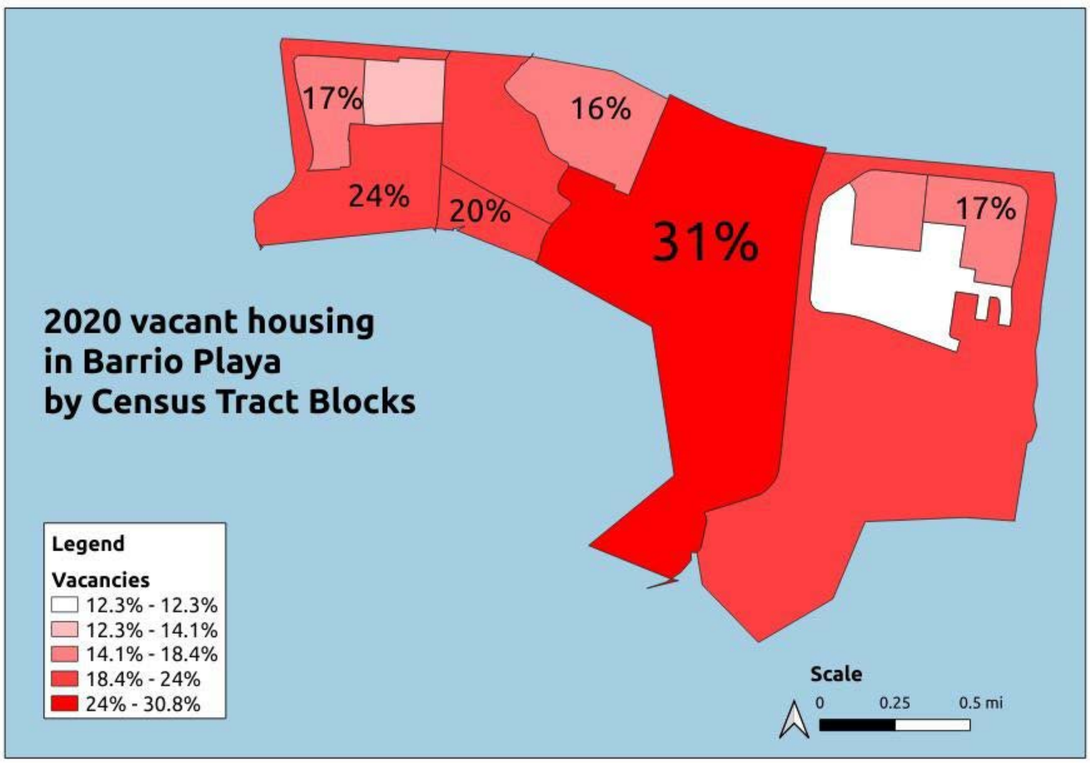

Figure 5. 2020 Vacant Housing Percentages in Playa de Ponce by Census Tracts

Source: Vacant Housing in Playa de Ponce, Un Nuevo Amanecer.

Despite these strengths, the community also faces challenges related to the reliability of its energy infrastructure. Participants during the workshops and questionnaire identified reducing electrical outages and improving the generation and distribution system as the primary community challenges.

Power outages have had a significant economic impact on residents and local businesses in Playa de Ponce, where energy costs represent a higher share of income compared to the archipelago-wide average. This leaves residents with less financial flexibility to handle the additional costs of outages, such as replacing spoiled food, purchasing backup power devices, or mitigating business losses.

Gaps in education about Puerto Rico's energy system and a lack of awareness of alternative energy solutions limit communities' ability to fully leverage available resources such as state-run programs by the Puerto Rico Electric Power Authority (PREPA), federal initiatives under FEMA post-Hurricane Maria, and local rebate programs aimed at increasing energy resilience. Strengthening education and awareness efforts could further support residents to adopt solutions that address the system's deficiencies and improve overall resilience.

After the March workshops, the planning team synthesized all the collected input from the community into a collective energy vision identified during the visioning process:

> *Establish community-led energy projects that strengthen energy security, enhance safety, and ensure reliable access to energy—all grounded in the needs and voices of Playa de Ponce residents. These efforts will be built through collaboration, local capacity building, and solutions that also support the community's long-term economic development.*

Furthermore, common themes, which were consistently mentioned by residents during the March workshops and later reaffirmed during the second round of workshops in June, were organized into three primary focus areas as shown in Table 2: 1) energy reliability; 2) safety and security; and 3) stakeholder participation, education, and capacity building.

Table 1. Summary of Playa de Ponce's Goals, Categorized by Focus Area

Focus Area	Goals
Energy Reliability	• Increased ability to prepare for, withstand, and recover from power outages during storms and heat waves. • Fast recovery for all areas of Playa de Ponce. • Functional water pumps during power outages. • Lower-cost and quieter backup energy options to replace noisy, expensive gasoline generators. • Accessible spaces for the community to go to during an emergency, focusing on serving those with medical vulnerabilities.
Safety and Security	• Safe electrical connections to prevent fires and electric shock. • Reliable street lighting (e.g., solar powered) to improve nighttime visibility, ensure safe mobility during emergencies, and enhance perceptions about neighborhood safety.
Stakeholder Participation, Education, and Capacity Building	• Transparent, community-led planning processes to foster trust and reflect residents' true needs. • Education on how energy systems work (e.g., how to operate and maintain at various scales). • Designated spaces for meetings and coordination to sustain community-led efforts.

3 Baseline Assessment

A baseline energy assessment involves gathering and analyzing data on current energy use, infrastructure, and challenges within the community. By understanding the existing conditions, the assessment helps identify strengths, weaknesses, and opportunities for improvement. In the case of Playa de Ponce, the baseline energy assessment not only provides a comprehensive understanding of the community's energy landscape but also serves as a critical tool for developing actionable strategies to address challenges. While this assessment helps inform strategies in all cases, for Playa de Ponce specifically, it was instrumental in identifying solutions aligned with the community's priorities of improving reliability, safety, and accessibility.

This energy baseline assessment was tailored to the community of Playa de Ponce using NLR's State and Local Planning for Energy (SLOPE) tool[3]. The SLOPE analysis included sections on local demographics, energy costs, energy generation potential, house ownership statistics in Playa de Ponce, and cooling day degrees within Ponce. The results of the analysis were then brought back to Playa de Ponce and discussed with local residents. This was a valuable exercise to gather insights from community members for a better understanding of the energy situation in Playa de Ponce.

3.1 Energy Costs, Income, and Ownership Patterns

In Playa de Ponce, most consumers are long-time Puerto Rican residents, many of whom have lived in the area for more than 40 years. More than half of the population (51.55%) is above 55 years of age. Most residents have a monthly income, ranging from $1,250 to $1,665, and about 42% of residents have a high school education (U.S. Census Bureau 2020).

Electricity services in Playa de Ponce (and overall, in Puerto Rico) cost an average of $0.24 per kilowatt-hour. This rate is significantly above the U.S. national average of around $0.17 per kilowatt-hour as of April 2025 (U.S. Energy Information Administration, 2025). As shown in Table 1, SLOPE analysis shows that in census tracts 716.02 and 721.01, residents spend an average of 9% to 10% of their yearly income on electricity. This is higher than the archipelago-wide average of 4% (LEAD Tool, 2023).

Annual electricity bills range from $1,200 to $1,700 depending on the census tract. These costs are especially difficult for families in Tract 721.01, where the average yearly income is $12,582. This census tract also features mixed housing patterns with a combination of owner-occupied and renter-occupied homes. Similarly, Tract 716.02, with predominantly renter-occupied single-family homes, may require policy interventions tailored to renters to address these high energy burdens effectively. The analysis identified the percentage of income spent on energy bills by census tract for the census tracts considered in this project. Figure 3 shows each census tract and the percentage of annual income spent on energy bills.

[3] Additional information about the SLOPE tool, including its data sources can be found https://maps.nrel.gov/slope/about

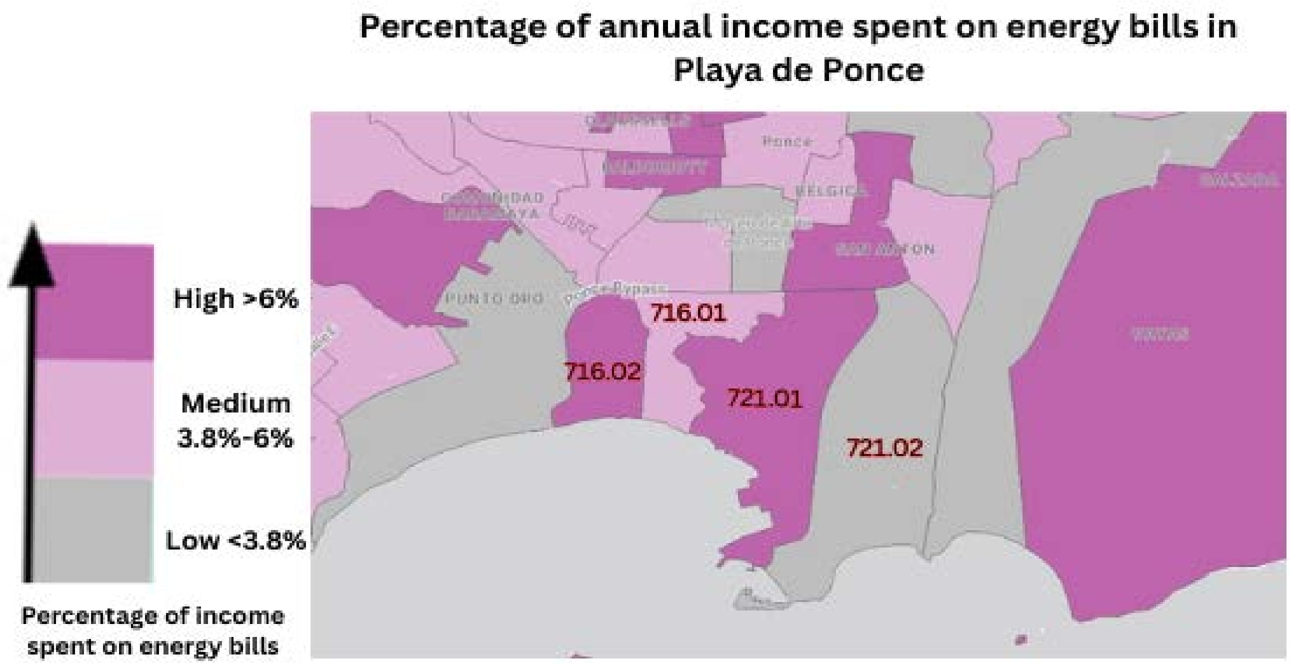

Figure 6. Map of Playa de Ponce census tracts with the percentage of income spent.

Map developed using the [SLOPE tool] by Megan Day, NLR

Table 2. Demographic, Economic, and Housing Characteristics of Census Tracts in Playa de Ponce

Census Tract	721130 716.02	721130 716.01	721130 721.01	721130 721.02
Average Price of Electricity	$ 0.24/kWh	$ 0.24/kWh	$ 0.24/kWh	$ 0.24/kWh
Average Annual Energy Cost Divided by Household Income	9%	5%	10%	3.7%
Energy Costs (Average Annual Energy Cost per Household)	$1,323	$1,699	$1,226	$1,722
Number of Homes	1,320	1,032	653	1,766
Population (Number of Residents)	3,210	2,229	1,306	4,707
Average Annual Household Income	$14,747	$36,342	$12,582	$38,590

Census Tract	721130 716.02	721130 716.01	721130 721.01	721130 721.02
Ownership Patterns	Mostly renter-occupied single-family homes	Majority owner-occupied residences	Mixed housing patterns (owner-occupied single-family homes, renter-occupied multifamily residences)	Mostly Owner-occupied single-family homes

Table developed using the SLOPE tool, U.S. Census Bureau and U.S. Energy Information Administration by Megan Day, NLR

3.2 Rooftop and Ground-Mount Solar Generation Potential

Solar energy technologies were evaluated as part of this assessment in response to community interests in improving energy affordability, reliability, and local energy resilience, as well as their relevance within Puerto Rico's broader energy planning context. To support these goals, the SLOPE analysis covered solar energy technologies and their energy generation potential in the area. One of the most significant results was the area's high rooftop solar generation potential. However, it's important to note that SLOPE does not take into consideration the structural condition or suitability of individual roofs, which are factors that could impact the actual feasibility of rooftop solar installations.

A comparison of rooftop and ground-mount solar generation potential across Playa de Ponce census tracts is summarized in Table 2. Overall, the results indicate that rooftop solar presents a substantially greater opportunity than ground-mount solar within the community, likely due to limited open space and smaller parcel sizes. Several census tracts demonstrate the potential for rooftop solar to meet a significant share of local electricity demand, with some areas capable of exceeding current demands levels. These findings suggest that rooftop solar could play a meaningful role in supporting community energy needs, while ground-mount solar may be constrained as a near-term strategy (SLOPE, 2020).

Table 3. Rooftop and Ground-Mount Solar Generation Potential and Estimated Share of Electricity Demand by Census Tract

Census Tract	Estimated Rooftop Solar Generation Potential (MWh/year)	% Energy Demand Potentially Met by Rooftop Solar	Estimated Ground-Mount Solar Generation Potential (MWh/year)
721.02	22,706	254%	234
721.01	10,048	75%	728
716.02	9,709	165%	442
716.01	8,803	125	354

Table developed using the SLOPE tool, U.S. Census Bureau and U.S. Energy Information Administration by Megan Day, NLR

3.3 Evaluating the UNA Building's Potential as a Resilience Hub Using REopt®

Could the Un Nuevo Amanecer Building Support the Community During 24- and 72-hour outages?

The REopt® tool is a techno-economic optimization tool developed by NLR that evaluates the economic viability of distributed energy resources. In this case, REopt was used to assess the economic feasibility and resilience of energy systems, helping to determine the optimal mix of generation and storage technologies needed to meet specific energy goals, such as surviving outages or supporting critical services during extended power disruptions. The tool is intended for planning and decision-making to guide stakeholders on feasible and cost-effective energy solutions. However, REopt does not replace detailed design or engineering processes – instead it offers strategic insights rather than final, implementable designs.

The team ran a high-level REopt analysis to measure the economic feasibility and resilience capability of a microgrid installed at UNA. This particular analysis was conducted after the June workshops in Playa de Ponce, at the request of UNA. Given that UNA already has an energy system in place—including a 6.84 kW DC solar PV roof system, a 11.4 kW and 22.8 kWh lithium-iron phosphate (LFP) battery energy storage system (BESS), a 9.2 kW diesel backup portable generator, and a smart inverter for off-grid functionality—UNA wanted to understand how much additional capacity would be required to withstand longer outage durations or support more people during extended disruptions. A second REopt analysis was considered for the Villa del Carmen community center. However, due to time and data constraints, the analysis could not be completed for the second community center. This analysis could be performed in the future as part of continued planning.

UNA expressed future interest in incorporating a microgrid that can sustain "black sky" or worse-case-scenario outages (e.g. several months without power) plus provide critical services to community members. This may include portable battery charging, food refrigeration, cell-phone charging, hot water, among others. This preliminary analysis solely focused on the *existing electric loads* and did not add additional loads to provide the community services listed above. As such, the analysis evaluates the UNA building's capacity to maintain its current operations during 24- and 72-hour outages, rather than its ability to act as a resilience hub during extended outages. This approach provides critical baseline insights but does not fully address the potential future role of UNA as a resilience hub.

Although UNA has been unable to utilize its existing system due to challenges in the interconnection process, this analysis informs future decision-making and planning. In Puerto Rico, interconnection is often slowed by long queues, administrative hurdles, and limited communication by utility authorities, which can delay deployment of distributed energy systems. By evaluating the performance of UNA's current installed system in maintaining basic operations during outages, UNA gains insight into how the existing infrastructure can be enhanced to meet future goals. Specifically, UNA aims to interconnect their system and potentially expand it to support more residents during long outages, making this analysis an important step for strategic planning and investment.

The analysis ran two scenarios, a 24-hour outage and a 72-hour outage, which represent typical short-term outages that UNA is interested in planning for. Both scenarios modeled five outages every year for a 25-year period. Both scenarios also included the existing energy technologies within the model. Therefore, REopt was able to calculate what additional, if any, energy generation and storage capacity the existing energy system requires to survive both outage scenarios. While these scenarios may not fully address the extended outages UNA anticipates in the future, the current analysis serves as a steppingstone to assess the building's baseline capability with its existing system. Future analyses could address longer outage durations by incorporating high-fidelity load calculations, additional emergency loads, and other community service requirements.

Table 4. Resilience Results for UNA

Resilience Results for UNA		
Metric	24-hour case	72-hour case
PV size (kW)	10.75	10.75
PV average annual production (kWh)	16,790	16,790
PV average annual export (kWh)	167	167
Annual export benefit ($)	13.00	13.00
Battery size (kW / kWh)	11.40 / 22.80	11.40 / 22.80
Generator size (kW)	9.2	9.2
Annual grid-purchased electricity (kWh)	390	390
Survivability probability at final outage hour (%)	99.88	99.68
Net Present Value ($)	5,965	5,965
Upfront Capital Cost without Incentives ($)	17,588	17,588

Table 4 displays the resilience results for both outage scenarios. An explanation of each metric's description is in Appendix G. The results suggest that UNA already has the necessary BESS and backup generator capacity to survive 24- and 72-hour outages. To be precise, UNA has over 99.6% probability of surviving both outage lengths at any point during the next 25 years with the addition of 3.91 kW of solar PV capacity. Additionally, the existing system with the added solar PV capacity has a positive net present value (NPV) which means it is a good investment.

This REopt analysis provides a valuable evaluation of UNA's system under specific outage scenarios and determines what additional generation and storage capacity would be required to improve resilience. It identifies that a relatively small solar PV addition (3.91 kW) allows the system to sustain short-term outages with a high probability (99.6%). This demonstrates the potential economic viability and resilience of the existing energy systems, forming a foundation for more detailed analyses that include expanded loads for community services during extended outages.

The analysis serves as an important first step by evaluating the existing system's performance under short-term outage conditions. For UNA to achieve its long-term vision of supporting the community during multi-month outages, future efforts should include high-fidelity electric load calculation and emergency load additions. If UNA wants to provide critical services during outages, then a more precise profile is required to provide higher accuracy to the results. Additionally, if additional backup is needed during outages, then the added emergency load additions would provide better insight on whether additional BESS and backup generator capacity is required to fulfill the energy needs of the emergency services.

Baseline Assessment Limitations

One challenge in conducting a detailed baseline assessment for Playa de Ponce was the limited availability of community-specific data[4]. Most of the existing information was only available at the broader Puerto Rico or municipal level, making it difficult to accurately reflect the unique characteristics of Playa de Ponce.

Tools like SLOPE provided some helpful insights such as energy costs, solar rooftop and ground-mount potential, and degree days, but lacked key data on actual energy consumption, other energy technologies, and community-specific demographics. As a result, supplemental information from within the community was required to fill some of these gaps, such as demographic information, which limited the depth and precision of our analysis.

[4] Additional information about the SLOPE tool, including its data sources can be found https://maps.nrel.gov/slope/about

4 Energy Strategies and Prioritization

This section outlines key energy strategies and priority projects identified through a combination of community input (gathered during two rounds of in-person workshops), site visits, existing data, insights from the energy baseline assessment, and discussions with local stakeholders and NLR technical experts. Each strategy is aligned with the community's energy vision and goals from the March workshops and organized under the three focus areas as follows:

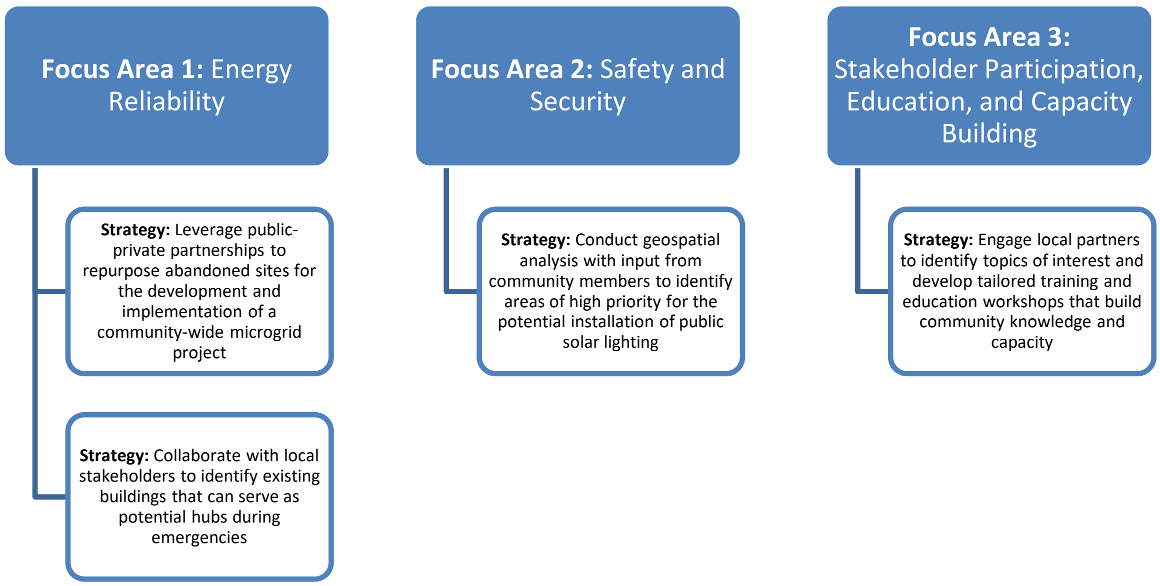

Figure 7. Strategies presented to the community during the June workshops, categorized by focus area

4.1 Prioritization Methodology

During the second community visit that took place June 24–26, 2025, a prioritization exercise was conducted at each of the three workshop locations across Playa de Ponce. A total of 48 residents participated, sharing input to rank community strategies based on urgency and implementation feasibility. Participants engaged with three proposed strategies as identified by the first workshops—public solar lighting, a resilience center, and a community microgrid—through hands-on activities and were asked to rank each project based on community importance and implementation feasibility. Detailed voting results are provided in Tables 4 and 5, with full vote counts available in Appendix D.

Overall, the exercises revealed a consistent community preference across workshops:

- Public solar lighting was ranked as the highest priority and the fastest-to-implement project in all locations, reflecting strong support for immediate, visible improvements to community safety and energy access.

- Resilience centers were generally ranked second, with participants noting existing community infrastructure (e.g., Un Nuevo Amanecer Center) that could support implementation.

- Community microgrids generally ranked third, reflecting recognition of their potential benefits but acknowledging higher complexity and resource requirements for deployment.

Subcommunity Insights

- Un Nuevo Amanecer (Census Tracts 716.02): Of the 15 participants, 11 voted. Solar lighting emerged as the top priority, followed by the microgrid and resilience center. Participants indicated that leveraging the existing center makes a resilience project more feasible than a microgrid in the short term.

- Unión de Trabajadores del Muelle (Census Tract 721.01): With three participants, solar lighting again ranked first, followed by the resilience center and microgrid. Implementation feasibility aligned with these rankings.

- Villa del Carmen (Census Tract 721.02): Among 30 participants (24 voting), the ranking mirrored the other workshops: solar lighting first, resilience center second, and microgrid third. Rankings for implementation speed were identical, indicating strong alignment on community priorities.

Table 5. Ranking Results from Strategy Prioritization Exercise by Workshop Location

Criterion 1: Urgency and Importance to the Community			
Workshop Location	UNA Workshop	Unión de Trabajadores del Muelle	Villa del Carmen
Strategy		Voting Rank	
Public Solar Lighting	1	1	1
Resilience Center	3	2	2
Community Microgrid	2	3	3

Table 6. Ranking Results from Strategy Prioritization Exercise by Workshop Location

Criterion 2: Implementation Speed			
Workshop Location	UNA Workshop	Unión de Trabajadores del Muelle	Villa del Carmen
Strategy		Voting Rank	
Public Solar Lighting	1	1	1
Resilience Center	2	2	2
Community Microgrid	3	3	3

Figure 8. Group photo of workshop facilitators with Villa del Carmen participants at the end

Photo from Juan Carlos Castro, Hispanic Federation

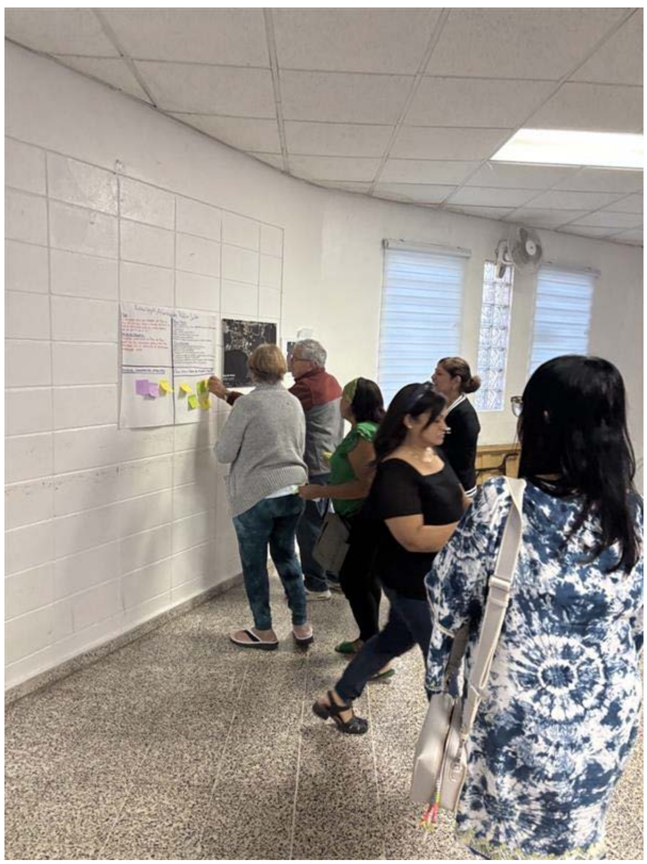

Figure 9. Villa del Carmen residents participating in the hands-on prioritization exercise at Workshop #3, placing sticky notes to identify the strategies most important and feasible to them.

Photo by Alexa Carrera, NLR

Lastly, as part of each workshop, participants were also asked to complete a structured worksheet designed to identify community interests and needs related to future training and capacity-building opportunities under Focus Area 3. The worksheet (see Appendix E) included a list of potential education topics based on previous interest expressed by the community. Participants were asked to rank these topics from 1 to 5 in order of importance to help the planning team understand which areas should be prioritized for future workshops and educational programming. The topics participants prioritized most for learning and capacity building varied by sector, but the overall top priority topics include 1. Funding and incentive programs, including how to navigate available resources, 2.) resilient infrastructure planning that enhances the community's ability to withstand, adapt to, and recover from energy disruptions, and 3.) community organizing and participatory decision-making. This activity sparked discussions around local knowledge gaps, areas of interest, and opportunities for skills development that align with the community's long-term energy goals.

4.2 Strategy Details

This section presents each potential strategy in more detail, including the technologies involved, anticipated benefits, potential risks, considerations, actionable steps, estimated timeline, and key partners involved. These summaries can serve as a roadmap to support the community's implementation goals.

4.2.1 Short-Term Project (0–1 year)

Strategy: Engage local partners to identify topics of interest and develop tailored training and education workshops that build community knowledge and capacity

Project: Energy education and capacity-building workshops

Focus Area: Stakeholder Participation, Education, and Capacity Building

Description: During the in-person workshops, the community expressed interest in gaining greater access to energy-related information and expanding participation in the planning of energy projects. To support this goal, UNA has taken steps to expand its outreach and community efforts. Following the second round of workshops, UNA initiated efforts to identify future participation in planning for energy-focused workshops via outreach to workshop attendees, while also leveraging existing UNA-led initiatives such as Proyecto VIDA Costera that focuses on habitat restoration and flood recovery efforts within the Playa de Ponce community.

This strategy focuses on increasing local awareness, knowledge, and engagement around energy systems in Playa de Ponce through community-based training and education workshops. These spaces would be designed to equip residents with practical tools and knowledge to take an active role in the planning, implementation, and maintenance of energy projects from a community-driven perspective.

Benefits:

- Builds energy literacy and workforce pipeline at the local level

- Allows residents the opportunity to be more involved in the decision-making process of projects that will take place in their community
- Supports long-term sustainability of local energy systems through community coordination and workforce development.

Risks and Considerations:

- Risk of limited engagement
- Tailor training materials and engagement methods across age groups and literacy levels
- Coordinate subject matter experts to deliver accurate and relevant content
- Proper community outreach efforts are needed to reach the wider community, beyond the most active participants
- Keep engagement consistent over time to build trust, reinforce learning, and maintain momentum
- Consider existing government priorities and guidelines for energy generation, as aligning with these could help identify potential funding opportunities, streamline approval timelines, and optimize implementation processes to effectively support the community's goals.

Actions:

1. Understand community training needs to better understand knowledge gaps.

    Milestone: Conduct a community training needs assessment to identify existing gaps.

2. Develop a training plan that considers frequency, format (i.e., in-person, online, hybrid) and intended audiences (i.e., youth, adults, technical learners).

    Milestone: Finalize and approve a training plan in collaboration with partners.

3. Partner with universities and nongovernmental organizations (NGOs).

    Milestone: Establish partnership agreements with universities and NGOs.

4. Identify existing community events where outreach efforts can take place.

    Milestone: Develop an outreach calendar that aligns with identified community events.

5. Pilot initial workshops and collect feedback.

Milestone: Complete the pilot series and document lessons learned.

6. Refine approach and launch an ongoing training calendar.

    Milestone: Launch and promote the full training calendar as a long-term, sustainable initiative.

7. Monitor participation and outcomes (e.g., number of certificates obtained, changes in employment).

    Milestone: Develop a progress and outcomes report based on participation and measurable results.

Estimated Timeline: 6–12 months, ongoing thereafter

Key Partners and Stakeholders: Some stakeholders include but are not limited to local residents and community leaders, nonprofits, universities, and local trainers.

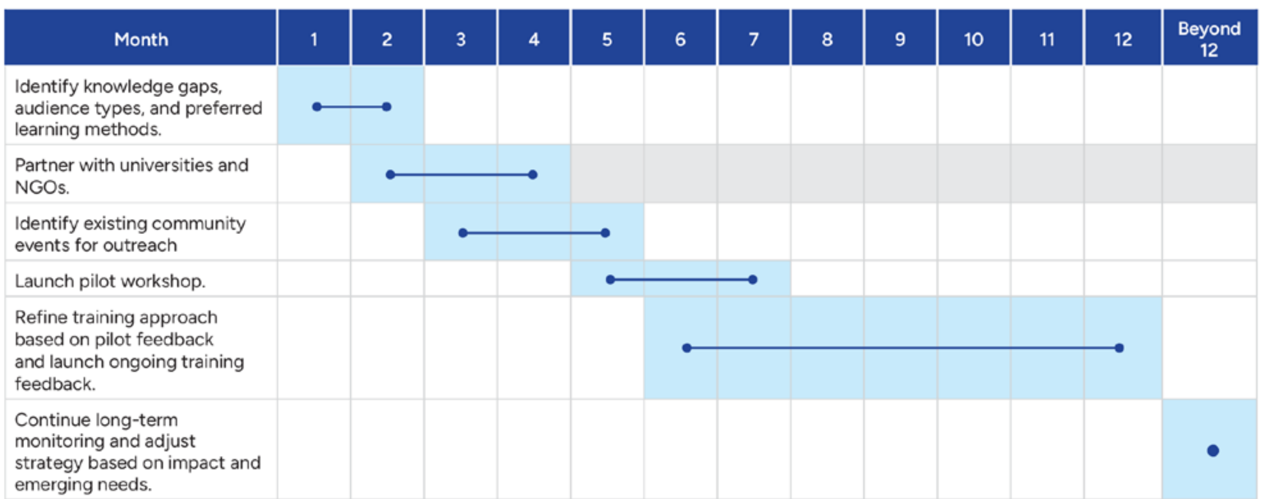

Figure 10. Actions and Timeline for Energy Education and Capacity-Building Workshops Project

4.2.2 Medium-Term Project (1–2 years)

Strategy: Conduct geospatial analysis with input from community members to identify areas of high priority for the potential installation of public solar lighting

Project: Public solar lighting installations in high-priority areas

Focus Area: Safety and Security

Description: One of the key concerns raised by Playa de Ponce residents was the lack of adequate street lighting, which contributes to a sense of insecurity during the evening hours and during blackouts. To address this, the community identified the implementation of public solar lighting in poorly lit or high-priority areas as a potential solution. This strategy consists of identifying priority areas where residents know there is no lighting or areas commonly affected by blackouts. Once these areas are identified, the community can develop a plan to implement public solar lighting systems in these priority areas. As part of the planning process, NLR developed an [interactive map](#) using 2020 data from utility company LUMA that highlights existing streetlights throughout Playa de Ponce. The map highlights several areas with limited or no lighting infrastructure, helping to identify potential priority zones for solar lighting installations.

Figure 11. Overview of public streetlight locations within Playa de Ponce

Map created by Maya Fein-Cole, NLR, using CARTO tool

Note: This map does not reflect the most current outdoor lighting conditions of the community. Qualitative data collected during the in-person community workshops revealed several discrepancies pointed out by residents—noting that the map underestimated the number of dark areas in the community. While still a useful starting point, the map should be supplemented with additional on-the-ground validation and community input to accurately target locations for future project siting.

Technology: Stand-alone solar-powered LED light poles with battery backup and motion sensors

Benefits:

- Increases pedestrian and community safety at night by illuminating public areas
- Provides lighting even during power outages, supporting visibility and mobility of residents.

Risks and Considerations:

- Theft and vandalism—*e*quipment may become a target for theft or damage if not adequately secured
- Requires securing financial resources, and a long-term maintenance plan

- Initial procurement and installation logistics may pose challenges
- Ensure systems are built to withstand coastal conditions, such as hurricanes, high humidity levels, and salt exposure
- Navigate the necessary regulatory and permitting processes with the appropriate legal authorities.

Actions:

1. Identify and map priority areas using resident feedback (i.e., streets near schools, hospitals, parks or elderly housing).

   Milestone: Finalize and validate priority zones for solar through community engagement.

2. Assess technical feasibility, such as sun exposure, pole placing, terrain, among other factors.

   Milestone: Complete feasibility assessment and finalize a list of viable sites.

3. Develop a procurement strategy in consultation with the community to select vendors that meet the community's expectations.

   Milestone: Select vendors and finalize contracts that reflect community input and priorities.

4. Coordinate installation and permitting with the appropriate authorities.

   Milestone: Obtain necessary permits and complete installation and testing of equipment.

5. Develop an operations and maintenance (O&M) plan and track performance and impact through community reporting mechanisms.

   Milestone: Establish O&M plan and share performance reports with community.

Estimated Timeline: 1–2 years

Key Partners and Stakeholders: Some stakeholders include but are not limited to private sector, urban planning and/or transportation agencies, electrical engineers, and LUMA.

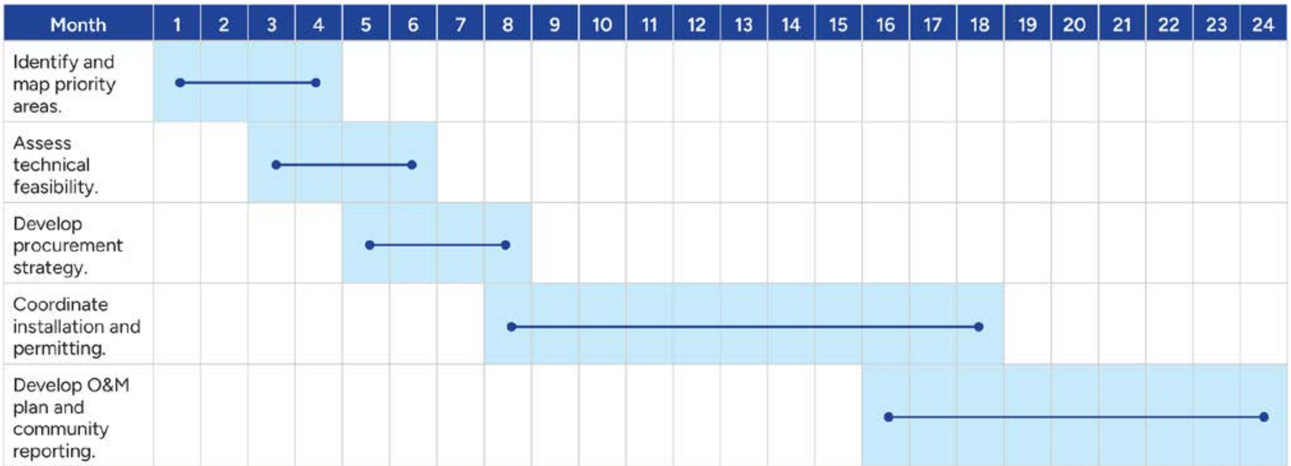

Figure 12. Actions and Timeline for Public Solar Lighting Project

4.2.3 Long-Term Projects (2–5 years)

Strategy: Collaborate with local stakeholders to identify existing buildings that can serve as potential hubs during emergencies

Project #1: Development of a resilience center

Focus Area: Energy Reliability

Description: This strategy focuses on identifying priority buildings with potential to develop resilience centers. Resilience centers are buildings equipped to provide residents with essential services during emergencies and are typically supported by a microgrid system, which enables critical loads to remain energized during power outages. These buildings are often guided by "black sky" operations, which outline their role during disaster scenarios, and "blue sky" operations, which define their everyday, nonemergency use. Particularly, residents expressed interest in pursuing this strategy given their role in protecting older adults and individuals with medical conditions. During blackouts these residents would have a safe place where they can keep medical equipment powered, stay cool, and receive necessary support. This kind of facility would reduce health risks and increase community preparedness during emergencies.

During the community workshops, residents identified several buildings that they consider to be central and accessible to the community with high potential to serve as hubs during emergencies—two of those buildings include the facilities where the in-person workshops were held, the Un Nuevo Amanecer building (Figure 13) and the Villa del Carmen Community Center (Figure 14). The UNA building has already been retrofitted with solar panels, a short-band radio communications hub, a community kitchen, and has community supported conceptual plans to further enhance the present site as a state-of-the-art community resilience hub. To inform future considerations, a REopt analysis was conducted in Section 3.3 of this report to evaluate the feasibility of the UNA building withstanding 24- and 72-hour power outages.

Residents of Villa del Carmen were especially interested in pursuing this strategy in the near future given that their community center is widely accessible and familiar to residents.

Figure 13. Un Nuevo Amanecer Community Center.

Photo from Un Nuevo Amanecer

Figure 14. Villa del Carmen Community Center.

Photo by Melanie Ramos

Technology: Rooftop solar photovoltaic (PV) systems and battery storage

Benefits:

- Provides designated space for community meetings and organizing future energy activities

- Offers a safe and powered location for older adults and residents with medical conditions during outages or emergencies, supporting essential electrical needs such as refrigeration for medications and cooling during extreme heat
- Ideal when the construction already exists and the community has already identified key spaces that are accessible

Risks and Considerations:

- Consider evaluating the building's energy load to ensure that backup systems (rooftop solar and battery storage) can adequately meet usage needs
- Structural retrofitting may be required to ensure the selected building can host rooftop solar and battery equipment
- It's important to assess the building's accessibility and capacity to accommodate residents during times of emergency
- Consider development of an emergency management plan in collaboration, which would require volunteering and ongoing community support.

Actions:

- Identify key community areas that are accessible, such as community centers, schools, and churches.

    Milestone: Finalize a prioritized list of resilience hub sites based on community feedback.

- Conduct resilience studies to evaluate feasibility of microgrid implementation and outage survival potential, including conducting additional community engagement to understand the most critical loads during power outages.

    Milestone: Complete site-specific feasibility assessments to finalize viable hub locations.

- Codesign with the community an emergency management plan that details the protocol that would need to be put in place (i.e., blue- and black-sky operations of the building).

    Milestone: Collaborate with the community to finalize and approve a detailed emergency management plan.

- Coordinate with local stakeholders to incorporate these hubs into broader disaster response plans.

    Milestone: Incorporate resilience hubs into local and regional emergency response frameworks.

- Install solar and battery backup systems that can meet critical loads during emergencies.

    Milestone: Complete installation and ensure operational readiness of solar and storage systems at designated sites.

Estimated Timeline: 2–5 years

Key Partners and Stakeholders: Some stakeholders include but are not limited to community residents and leaders, nonprofit organizations or foundations, emergency and resilience organizations (e.g., Red Cross, emergency response), local government (i.e., Municipality of Ponce), architects and engineers, and legal advisors.

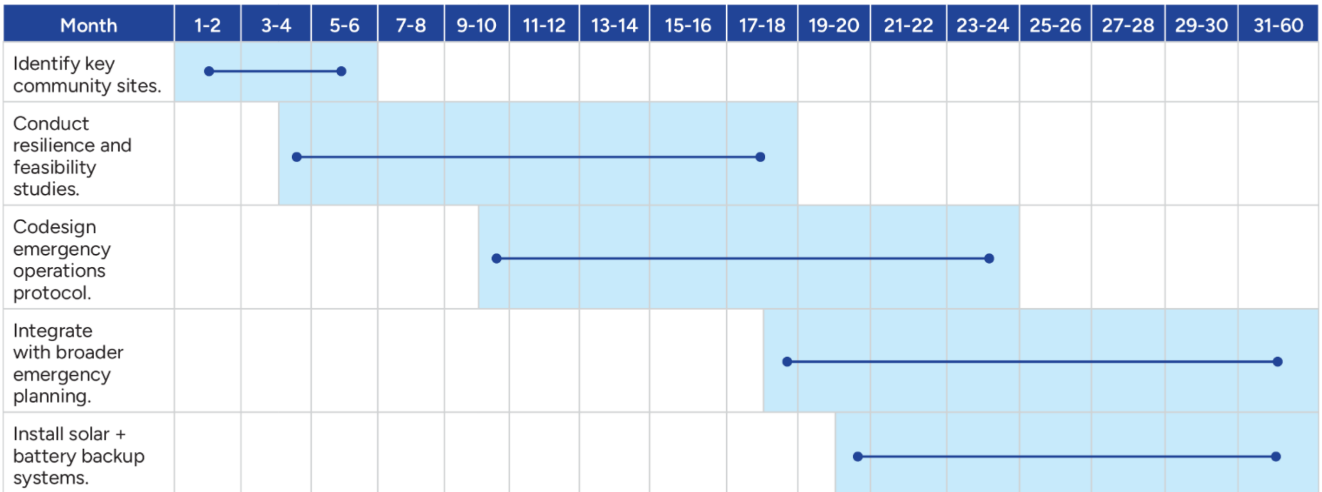

Figure 15. Actions and Timeline for Development of a Resilience Center Project

Strategy: Leverage public-private partnerships to repurpose abandoned sites for the development of a community-wide microgrid project

Project #2: Community microgrid on abandoned site

Focus Area: Energy Reliability

Description: This strategy focuses on repurposing unused sites near critical buildings and priority areas for developing local energy projects that could help improve the energy reliability in the area. It involves identifying vacant sites within Playa de Ponce and exploring legal pathways to transfer ownership to either the community or the municipality. Once the land is secured, the strategy includes assessing various microgrid ownership models to determine the best fit for local needs. This approach aims to turn abandoned spaces into valuable assets that support energy reliability within Playa de Ponce.

Technologies: Solar PV systems with battery energy storage with islanding capabilities

Benefits:

- Improves community resilience to power outages
- Generates long-term energy cost savings
- Repurposes abandoned sites for public good
- Supports critical services during emergencies.

Considerations:

- High up-front capital costs
- Legal and administrative complexities tied to land acquisition and permitting
- Requires long-term commitment from the community to implement a proper governance structure and a level of technical capacity.

Actions:

1. Conduct an inventory and mapping of abandoned sites in the community.

   Milestone: Abandoned sites inventory complete

2. Assess ownership status of selected sites in collaboration with the municipality of Ponce.

   Milestone: Priority sites with clear ownership identified

   - Note: Inquire if the sites have been officially declared as "*estorbo público*." If not, there is a formal process (Law 107-2020) to request initiation of that declaration process with the municipality.
   - Note: There are multiple legal pathways through which a community-based organization or nonprofit can obtain legal access to an abandoned site. However, these are context specific. Appendix D contains a table that outlines a partial list of legal routes for Playa de Ponce, but legal consultation is important. Stakeholders might explore the appropriate legal mechanisms for securing access in collaboration with the Municipality of Ponce and legal experts.

3. Conduct site assessments for potential microgrid implementation, including techno-economic feasibility studies that take into consideration geography, solar generation potential, and proximity to critical infrastructure.

   Milestone: Techno-economic feasibility report completed for at least one site

   - Note: If contamination is suspected, a potential pathway can include contracting a Phase 1 Environmental Site Assessment (ESA) through the U.S. Environmental Protection Agency's (EPAs) Brownfields Program.

4. Engage with utility LUMA early to initiate design, interconnection, and permitting process.

   Milestone: Interconnection application submitted

5. Define the project ownership model, such as defining a managing entity.

   Milestone: Ownership and governance model adopted

6. Build a financial plan through exploration of federal, local, and philanthropic funding sources.

Milestone: Financing strategy completed

7. Select engineering and construction partners in consultation with the community.

    Milestone: Finalize contracting and scope of work with community-informed selection criteria of subcontractors

8. Build and commission the microgrid system.

    Milestone: Microgrid system live and operational

9. Create a local O&M plan and workforce strategy that includes local job creation plans and governance structure.

    Milestone: O&M and workforce plan finalized and launched

<u>Estimated Timeline:</u> 5–10 years

Key Partners and Stakeholders: Some stakeholders include but are not limited to Municipality of Ponce, LUMA, EPA, land-use experts, solar developers, community residents, leaders, and local nonprofits or cooperatives.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	On-ward
Conduct inventory and mapping of abandoned sites, begin building relationships and collaborating with the Municipality of Ponce on ownership status, and begin legal consultation on access options.	●							
Finalize identification of priority sites with clear ownership, initiate estorbo público process if needed; begin site assessments to identify things like solar potential, proximity to infrastructure, and access issues; and, if needed, apply for Phase 1 of ESA through EPA Brownfields Program.		●						
Complete techno-economic feasibility studies, conduct community engagement and planning for project design, and engage with LUMA to initiate early interconnection and permitting conversations.			●					
Submit interconnection application to LUMA, define and adopt the project ownership and governance model, and begin financial planning.				●				
Finalize comprehensive financing strategy, select engineering and construction partners using community-informed criteria, and finalize design and scope of work.					●			
Begin construction of microgrid, continue community engagement and capacity building, and begin workforce planning and training for O&M.						●		
Commission microgrid system, finalize and launch O&M.							●	
Establish long-term governance and management plans.							●	●

Figure 16. Actions and Timeline for Microgrid on Abandoned Site Project

5 Implementation

Playa de Ponce is taking steps toward refining its energy future, one that prioritizes energy reliability, collaboration, and community ownership, all while maintaining the safety and security of its residents. In doing so, this community is not only responding to its most pressing energy challenges but also modeling a path for other communities in Puerto Rico.

Playa de Ponce envisions a future where decisions about energy are shaped by collective values, local knowledge, and community ownership. The energy vision, focus areas, and strategies detailed in this document are rooted in the needs and strengths of the people of Playa de Ponce.

Effective implementation of this SEP will depend not only on technical solutions but also on building the workforce and institutional capacity required to carry them out effectively. Execution of each strategy presented in this document might also include a combination of skilled labor, cross-sector coordination, and community-driven leadership. Strengthening local capacity through targeted workforce training, partnerships with educational institutions and technical experts, and alignment with the municipality and the utility will be essential. Lastly, another consideration is ensuring that implementation creates long-term job opportunities and pathways for local residents of Playa de Ponce.

References

ArcGIS Online. 2025. https://www.arcgis.com.

Belding, Scott, and Laura Beshilas. 2024. *Ensuring Resilient Operations of Solar-Plus-Storage Community Resilience Hubs*. Golden, CO: National Renewable Energy Laboratory. DOE/GO-102024-6251. https://www.nlr.gov/docs/fy24osti/89601.pdf.

CARTO. *Interactive Mapping Tool for Public Infrastructure Analysis (CARTO)*. Accessed May 1, 2025. https://carto.com/.

Departamento de Recursos Naturales y Ambientales de Puerto Rico (DRNA). *Programa Brownfields*. Accessed October 6, 2025. https://www.drna.pr.gov/programa-brownfields/.

Jeffers, Robert Fredric, et al. 2018. *Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico*. Albuquerque, NM: Sandia National Laboratories. https://www.osti.gov/servlets/purl/1530167/.

Junta de Planificación de Puerto Rico. 2025. *Resumen Económico de Puerto Rico: Informe Económico Mensual de la Junta de Planificación*, septiembre 2025, Vol. I, Núm. 9. San Juan: Junta de Planificación de Puerto Rico. https://jp.pr.gov/wp-content/uploads/2025/09/Resumen-Economico-de-Puerto-Rico-Mensual-Septiembre-2025-pdf-1.pdf.

Ley 107-2020: *Código Municipal de Puerto Rico*. August 13, 2020. https://docs.pr.gov/files/AAFAF/Administrative_Documents/Administrative_Documents/Laws%20_%20Regulations/2020/august/Act-107-2020-Municipal-Code-PR.pdf.

Low-Income Energy Affordability Data (LEAD) Tool. 2023. U.S. Department of Energy. Accessed May 1, 2025. https://www.energy.gov/scep/slsc/lead-tool.

LUMA Energy. 2020. *Streetlight Dataset: Outdoor Lighting Locations in Puerto Rico*. Dataset prepared for the Puerto Rico Grid Resilience and Transition to 100% Renewable Energy Study (PR100). Accessed May 1, 2025. Under nondisclosure agreement.

National Laboratory of the Rockies (NLR). *REopt*. Accessed October 6, 2025. https://www.nlr.gov/reopt.

Nguyen Cu, Khanh, and Allison Moe. 2022. *Energy Efficiency Assessment for a Microgrid in the Community of Castañer, Puerto Rico*. Golden, CO: National Laboratory of the Rockies. NREL/TP-5500-81877. https://www.nlr.gov/docs/fy22osti/81877.pdf.

Ortega Pastor, Angela, et al. 2024. *Assessing the Solar Photovoltaic Potential in Puerto Rican Brownfields and Reservoirs: Analysis and Modeling*. Golden, CO: National Laboratory of the Rockies. Accessed October 6, 2025. https://docs.nlr.gov/docs/fy24osti/89876.pdf.

SLOPE: State and Local Planning for Energy. 2023. "Average Residential Electricity Costs." National Laboratory of the Rockies. Accessed March 15, 2025. https://maps.nrel.gov/slope.

Un Nuevo Amancer. 2020. "Vacant Housing in Playa de Ponce." Accessed May 1, 2025. https://sites.google.com/davidsouthgate.com/poncegis/maps?authuser=1#h.2bwao3e08zrt.

U.S. Census Bureau. 2020. "Ponce Municipio, Puerto Rico." Accessed May 1, 2025. https://data.census.gov/profile/Ponce_Municipio,_Puerto_Rico?g=050XX00US72113.

U.S. Department of Energy. 2025. *Energy Technology Innovation Partnership Project*. Accessed December 22, 2025. https://www.energy.gov/cmei/energy-technology-innovation-partnership-project.

U.S. Department of Energy, Office of Indian Energy. 2025. "Strategic Energy Planning." Accessed October 6, 2025. https://www.energy.gov/indianenergy/tribal-energy-guide/strategic-energy-planning.

U.S. Energy Information Administration. 2025. "Puerto Rico Profile Data." Accessed May 1, 2025. https://www.eia.gov/state/data.php?sid=RQ.

U.S. Environmental Protection Agency. 2025. "Brownfields All Appropriate Inquiries." Accessed May 1, 2025. https://www.epa.gov/brownfields/brownfields-all-appropriate-inquiries.

Torres, Osiris. 2025. Personal communication. Municipality of Ponce, May 2025.

Appendix A. March Workshop Plan—Interactive Activities

The first March workshop took place at Un Nuevo Amanecer's building, the second workshop was hosted at the Pier Worker's Union, and the final workshop was at Villa del Carmen's Community Center. During each workshop, the NLR and Hispanic Federation teams presented an overview of the ETIPP program, a baseline energy assessment, and led an interactive activity designed to create space for residents to share their personal experiences with the current energy system. This included open group discussions guided by prompt questions, followed by a feedback questionnaire that was distributed digitally and completed by 113 workshop participants and residents from the area.

Workshop Dynamics Energy Technology Innovations Partnership Project: Playa de Ponce

Dates: March 18, 19, and 20, 2025

Facilitators: Alexa, Melanie, Angela, Juan, Jonathan

Activity #1: Community Strengths and Energy Challenges (during the welcome)

Objective: To identify specific community challenges related to energy. (e.g., high costs, lack of services, dependence on medical equipment, etc.)

Action:

When people arrive at the meeting, they will write the following on one side of a sheet of paper (sticky notes or any colored paper):

On one side of the paper: Mention the community/sector where they live, and at least one positive characteristic that identifies the community (word or drawing). E.g., Amalia Marín and we have many community activities.

On the other side of the paper, mention a challenge/problem related to energy (maximum two challenges), e.g., The power goes out frequently and I live with a bedridden person.

The sheets of paper will be collected and posted on a wall/poster board, preferably on a central table that has a drawing related to the community (map of the communities, a beach, letters spelling Ponce, etc.).

While the presentation is being given, the facilitators will read the challenges, and similar challenges will be grouped together to assign to the groups in the next part of the activity.

Activity #2

Part I: Presentation of challenges and solutions/goals that are within the community's reach (15 minutes)

Objective: To discuss the challenges that have been mentioned and propose possible solutions.

In charge: 1 facilitator per group to answer questions.

Action:

Divide the group (depending on the number of participants) into groups of 3-4 people, and the facilitators will assign 1 to 2 challenges to each subgroup. For each challenge, the group must discuss, propose, and reach a consensus on a solution or a project they are interested in working on or seeing implemented in the community (they can choose a maximum of 2 solutions). The group must choose one person to explain what was discussed. *A flip chart can be posted on the wall with the different focus areas (resilience, climate change, energy costs, renewable energy, technical training, community education, etc.).

Part II: Community Energy Vision (25 minutes) (15 minutes in subgroups and 10 minutes in plenary)

Objective: To consolidate ideas and establish a collective vision on alternative energy.

Actions:

In the previously divided groups, after working on challenges and solutions, each group should create a poster or chart with an image that represents their vision of the energy future (e.g., a sun, a landscape without smoke, solar panels, solar panels on vacant lots, etc.). While drawing or pasting the images, participants will write around the image the following: words that represent what is in the image, how alternative energy helps overcome the challenges, and words that represent their vision for the community (the image and the words should be together). Example question to facilitate:

How do we imagine our community in 10 years in terms of energy?

What type of energy sources do we need? Where would these sources be located? How is the community involved/what type of involvement?

Each group will present their information/discussion to the entire group, and key words that are mentioned or that are repeated most often in the presentations will be written on a flip chart.

The other participants can contribute and give their reactions.

Appendix B. Baseline Assessment Questionnaire Tool

Playa de Ponce is developing a community-wide strategic energy plan, and we want to hear from you. By answering this questionnaire, you will help us understand your community's energy challenges, goals, and priorities. We invite you to participate in this initiative to develop solutions that are tailored to the realities and needs of Playa de Ponce.

1. Which sector of the Playa de Ponce neighborhood do you reside in?
2. Have you participated in community initiatives related to electricity goals or issues?
    a. Yes
    b. No
    c. Not sure
3. What are the main concerns your community has when facing power outages? (Select all that apply.)
    a. Frequent power outages and lack of grid reliability
    b. Limited access to viable alternative power generation options (e.g., gasoline generators)
    c. Safety concerns during power outages
    d. Economic impact of power outages
    e. Environmental impact of electricity production
    f. Other (please specify):
4. What do you consider important energy goals for your community? Please select the 3 options that best align with your priorities and needs.
    a. Improve the reliability of the electrical system
    b. Reduce electricity consumption
    c. Reduce electricity service costs
    d. Promote education on energy sustainability
    e. Other (please specify):
5. Do you agree to the use of unused land within your community for an energy project that benefits the entire community?

a. Strongly agree
b. Agree
c. Disagree
d. Strongly disagree.

6. What actions do you expect to be taken to improve the reliability of electricity service in your area? Please select the 3 options that best align with your priorities and needs.
    a. Improve electricity generation and distribution systems
    b. Reduce the number and duration of power outages
    c. Develop better preparedness measures for natural disasters
    d. Use alternative energy technologies/resources
    e. Have clearer communication channels when power outages occur
    f. Nothing, the electricity service in my area is satisfactory
    g. Other (please specify):
7. What are your main questions related to alternative energy systems? (Select all that apply.)
    a. High installation costs
    b. Increase in electricity service costs
    c. Environmental impacts of new technologies
    d. Lack of reliability of new sources of electricity
    e. Maintenance costs of technological equipment
    f. Other (please specify):
8. What obstacles do you think your community faces in achieving its energy goals? (Select all that apply)
    a. Lack of funding
    b. Lack of community participation
    c. Lack of knowledge about energy alternatives

   d. Resistance to change

   e. Lack of institutional support

   f. High installation costs

   g. Other.

9. What resources do you think your community has that could facilitate achieving the community's energy goals?

10. What do you consider to be the main weaknesses of your community in achieving the desired energy goals?

Appendix C. In-Person Site Visits in Playa de Ponce

Figure 17. Site #1, abandoned site located in Playa de Ponce.

Photo by Melanie Ramos

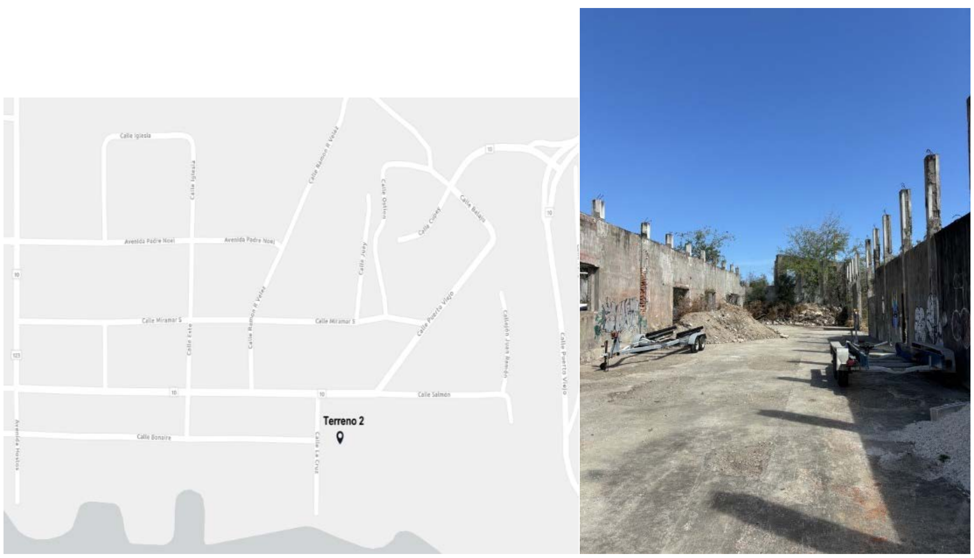

Figure 18. Site #2, abandoned site located near the police station.

Photo by Alexa Carrera

Figure 19. Site #3, abandoned site location near one of five water pumps within Playa de Ponce.

Photos by Alexa Carrera (left), Melanie Ramos (right)

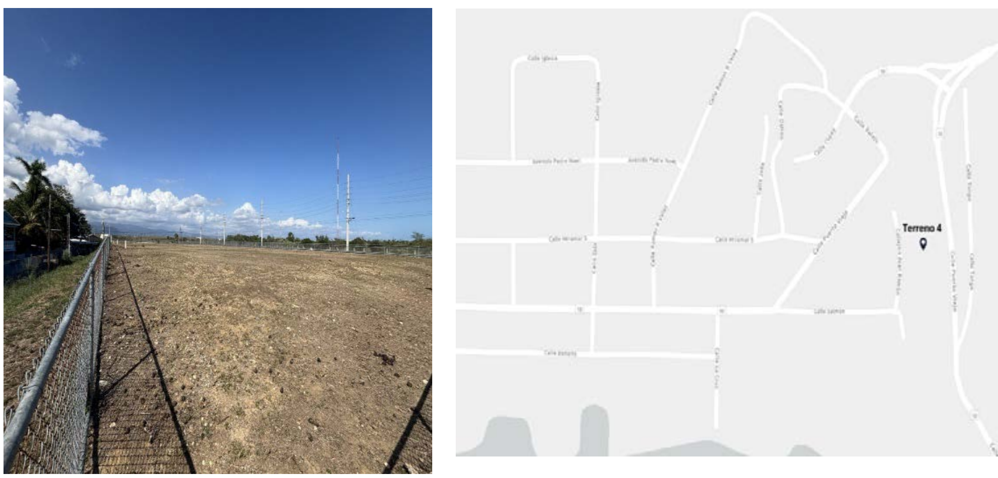

Figure 20. Site #4, abandoned site located near water infrastructure.

Photo by Melanie Ramos

Figure 21. Site #5 – abandoned site near Los Meros Ave in Playa de Ponce.

Photo by Melanie Ramos, NLR

Appendix D. Prioritization Exercise Results by Workshop Location

During the second community visit that took place June 24–26, 2025, a prioritization exercise was conducted at each of the three workshop locations, where a total of 48 Playa de Ponce residents attended and shared their input. During the June workshops, three presentation stations were set up, allowing participants to engage directly in each project and receive detailed explanations of project components, including key strengths and important considerations. The three strategies presented at each station included those under Focus Areas 1 and 2. Following the presentations, participants were invited to rank the projects from 1 to 3 (1 indicating the highest priority and 3 the lowest), based on two criteria:

- **Community need/most important:** This criterion was chosen as the first voting exercise with the community to ensure the strategies prioritized would address the most pressing challenges and concerns raised by residents. Factors that were taken into consideration include the frequency of power outages, vulnerability of specific populations (i.e., older adults, medically dependent residents), gaps in access to reliable or affordable energy, and the desire for increased safety. The criterion takes into consideration that future investments would directly benefit those most affected by the current energy system.
- **Implementation feasibility:** This criterion was selected to assess the likelihood that a given strategy could be realistically implemented with available resources, technical capacity, and within local constraints. Factors that were taken into consideration include existing infrastructure readiness, permitting requirements, capacity to operate and maintain systems, and level of coordination needed with external entities like the utility and the municipality. This criterion helped evaluate strategies that are both meaningful and actionable for the community.

It is important to note that results of the prioritization exercise varied depending on the sector of the community in which the workshop was held. In particular, responses differed between areas with higher income levels and those facing more economic vulnerability, which reflected differences in existing energy infrastructure, perceived risks, and immediate community needs.

D.1 Workshop 1: Un Nuevo Amanecer Center

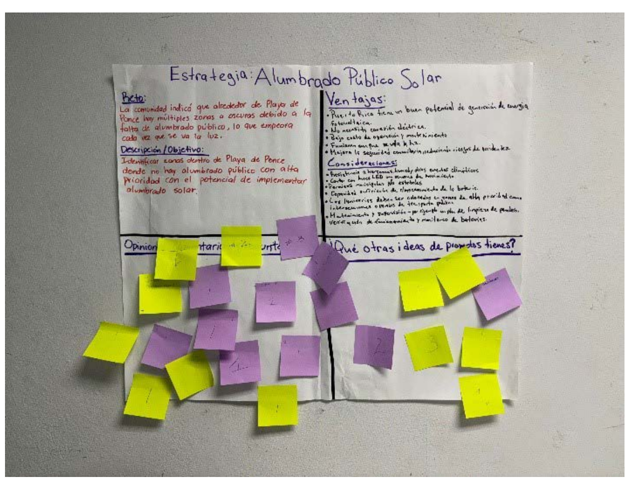

Figure 22. Strategy: Public Solar Lighting

Table D-1. Public Solar Lighting Strategy Priority Votes

Public Solar Lighting	
Strategy Priority	**Votes**
Very important-1	7
Important-2	3
Not as important-3	1

11 total votes

Table D-2. Public Solar Lighting Strategy Implementation Speed Votes

Public Solar Lighting	
Strategy implementation speed	**Votes**
Very fast-1	9
Fast-2	1
Not as fast-3	1

11 total votes

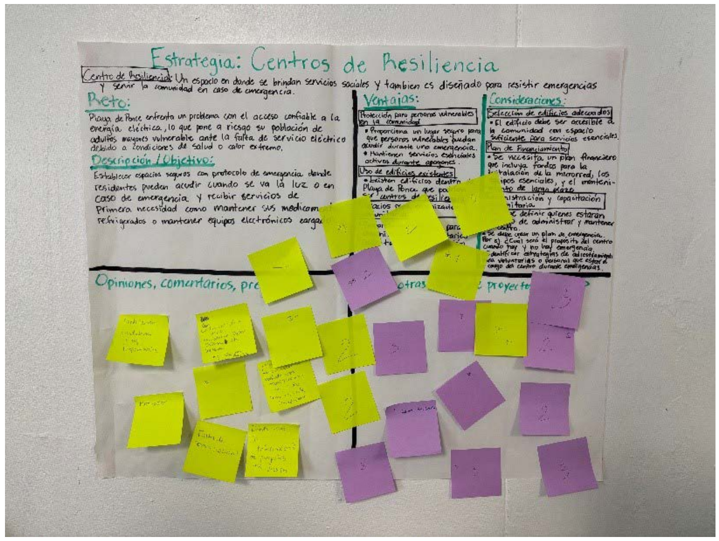

Figure 23. Strategy: Resilience Center

Table D-3. Resilience Center Strategy Priority Votes

Resilience Center	
Strategy Priority	**Votes**
Very important-1	1
Important-2	4
Not as important-3	6

11 total votes

Table D-4. Resilience Center Strategy Implementation Speed Votes

Resilience Center	
Strategy implementation speed	**Votes**
Very fast-1	2
Fast-2	5
Not as fast-3	3

10 total votes

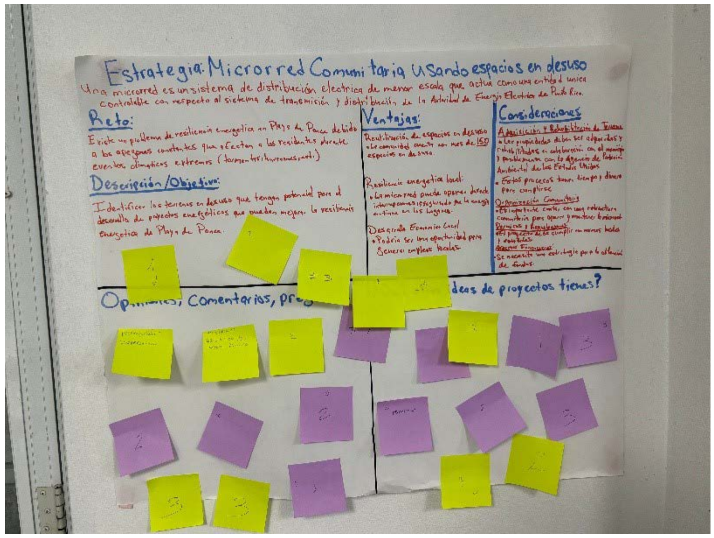

Figure 24. Strategy: Community Microgrid

Table D-5. Community Microgrid Strategy Priority Votes

Community Microgrid	
Strategy Priority	**Votes**
Very important-1	3
Important-2	5
Not as important-3	3

11 total votes

Table D-6. Community Microgrid Strategy Implementation Speed Votes

Community Microgrid	
Strategy implementation speed	**Votes**
Very fast-1	1
Fast-2	4
Not as fast-3	6

11 votes

D.2 Workshop 2: Unión de los Trabajadores del Muelle

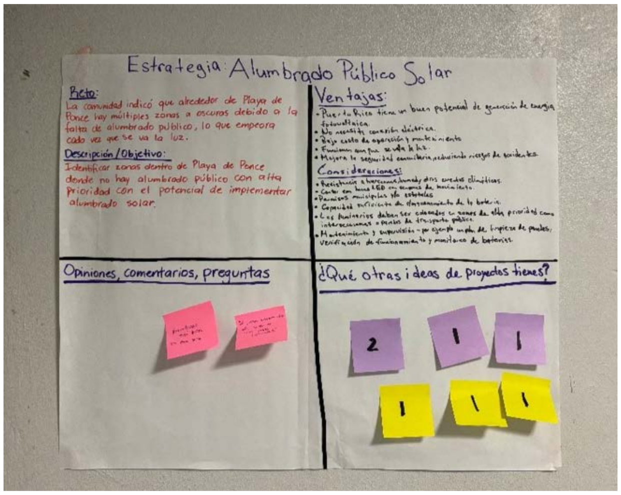

Figure 25. Strategy: Public Solar Lighting

Table D-7. Public Solar Lighting Strategy Priority Votes

Public Solar Lighting	
Strategy Priority	**Votes**
Very important-1	3
Important-2	0
Not as important-3	0

3 total votes

Table D-8. Public Solar Lighting Strategy Implementation Speed Votes

Public Solar Lighting	
Strategy implementation speed	**Votes**
Very fast-1	2
Fast-2	1
Not as fast-3	0

3 total votes

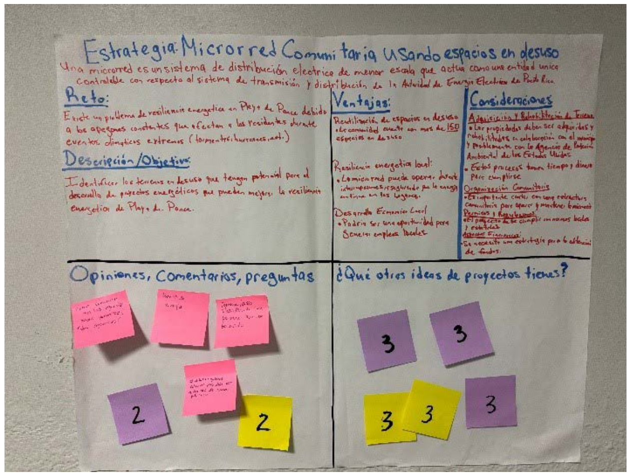

Figure 26. Strategy: Community Microgrid

Table D-9. Community Microgrid Strategy Priority Votes

Community Microgrid	
Strategy Priority	**Votes**
Very important-1	0
Important-2	1
Not as important-3	2

3 total votes

Table D-10. Community Microgrid Strategy Implementation Speed Votes

Community Microgrid	
Strategy implementation speed	**Votes**
Very fast-1	0
Fast-2	0
Not as fast-3	3

3 total votes

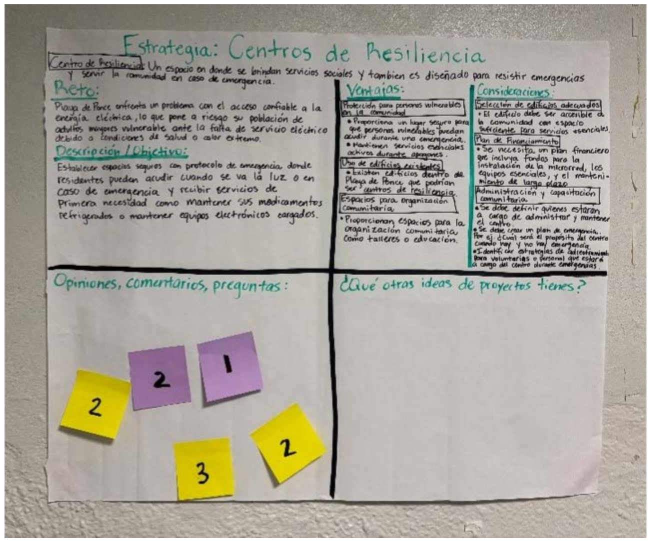

Figure 27. Strategy: Resilience Center

Table D-11. Resilience Center Strategy Priority Votes

Resilience Center	
Strategy Priority	**Votes**
Very important-1	0
Important-2	2
Not as important-3	1

3 total votes

Table D-12. Resilience Center Strategy Implementation Speed Votes

Resilience Center	
Strategy implementation speed	**Votes**
Very fast-1	1
Fast-2	2
Not as fast-3	0

3 total votes

D.3 Workshop 3: Villa del Carmen

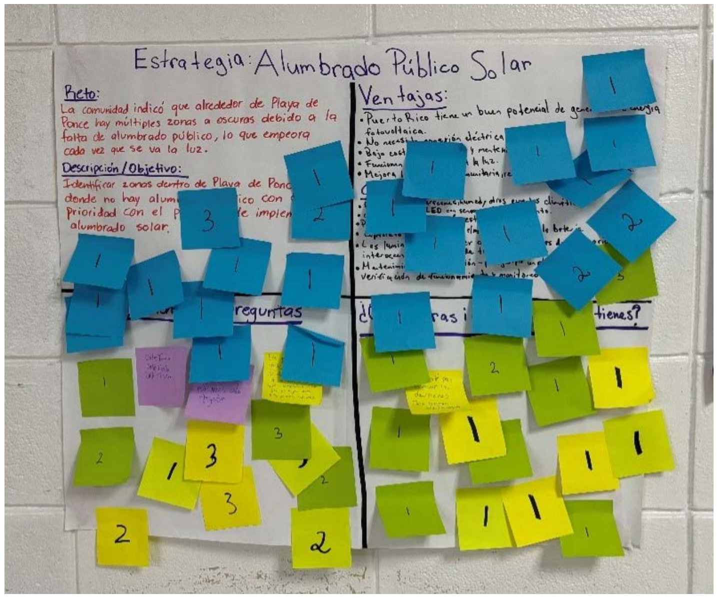

Figure 28. Strategy: Public Solar Lighting

Table D-13. Public Solar Lighting Strategy Priority Votes

Public Solar Lighting	
Strategy Priority	**Votes**
Very important-1	15
Important-2	5
Not as important-3	5

25 total votes

Table D-14. Public Solar Lighting Strategy Implementation Speed

Public Solar Lighting	
Strategy implementation speed	Votes
Very fast-1	20
Fast-2	3
Not as fast-3	1

24 total votes

Figure 29. Strategy: Community Microgrid

Table D-15. Community Microgrid Strategy Priority Votes

Community Microgrid	
Strategy Priority	**Votes**
Very important-1	5
Important-2	6
Not as important-3	13

24 total votes

Table D-16. Community Microgrid Strategy Implementation Speed Votes

Community Microgrid	
Strategy implementation speed	**Votes**
Very fast-1	1
Fast-2	3
Not as fast-3	20

24 total votes

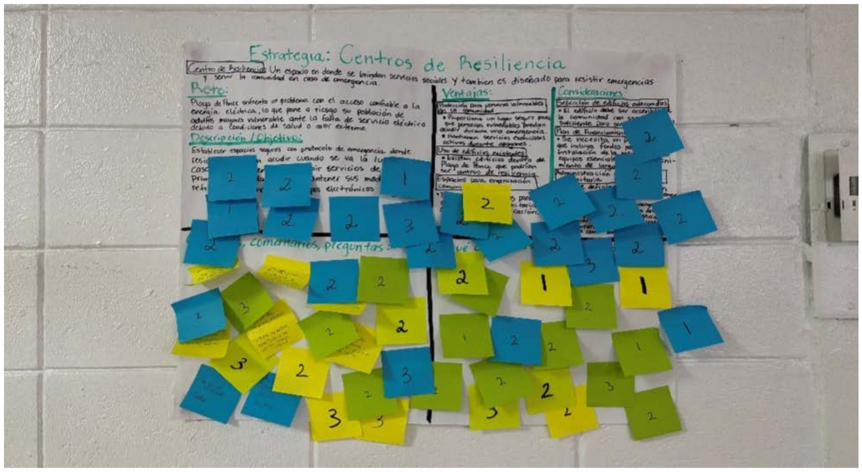

Figure 30. Strategy: Resilience Center

Table D-17. Resilience Center Strategy Priority Votes

Resilience Center	
Strategy Priority	**Votes**
Very important-1	5
Important-2	14
Not as important-3	6

25 total votes

Table D-18. Resilience Center Strategy Implementation Speed

Resilience Center	
Strategy implementation speed	**Votes**
Very fast-1	3
Fast-2	18
Not as fast-3	3

24 total votes

Appendix E. Energy Education and Training Priorities Worksheet

Prioritization of Educational Topics

Instructions:

For each educational topic, rate its importance to you on a scale of 1 to 5.

1 = Not important to me

5 = Very important to me

Table E-1. Educational Topics and Priority

Topic	Priority (mark one)
Who makes energy decisions? (Understanding how the laws work and who sets the prices)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
How to build and maintain a community energy system (Steps to implement a microgrid, and how to maintain it)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
What is a resilience hub? (What services it should have during an emergency and how to plan one)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
How to save on your electricity bill? (Tips for using less energy at home)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
How to organize as a community? (Ways to make community decisions and work in a group)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
What grants or funding are available for projects? (Learning about available programs and how to apply)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐
How can I get training to work on energy projects? (Courses or workshops to install energy projects, perform maintenance, or find employment)	1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

What other educational topic would you like to include?

Appendix F. Potential Pathways for Obtaining Ownership of an Abandoned Site in Playa de Ponce – Partial List of Legal Mechanisms

Note: There are multiple legal pathways through which a community-based organization or nonprofit can obtain legal access to an abandoned site. However, these are context specific. The following table outlines general routes, but legal consultation may be considered. Stakeholders may explore the appropriate legal mechanisms for securing access in collaboration with the Municipality of Ponce and legal experts.

Table F-1. Legal Mechanisms, Advantages, and Considerations

Mechanism	Advantages	Considerations
Declaration of “Estorbo Público”	Gateway opportunity to other mechanisms Allows the municipality to have control over the property	Obligatory legal process Takes time and legal resources
Vacant Inheritance (Act 181-2019)	Allows the acquisition of property without heirs Can be used by the municipality if it already declared as an *estorbo público*	Only applies if there are no legal heirs The state inherits the property if it’s not declared an *estorbo público* It is difficult to prove the absence of heirs
Compulsory Expropriation	Provides direct access to a property if approved Justifiable if there is an environmental risk in the property (Brownfield) Debt may be used as a form of payment	Complex and time-consuming judicial process Requires legislative approval
Housing and Urban Development Act (Act 118)	Can be used for urban rehabilitation Useful in projects with social or environmental goals	It depends on the state, not the municipality It does not guarantee community priority
Special Communities Program	Ideal for community projects Allows transfers to NGOs and trusts Access to federal funds (EPA, TBA)	Requires active community participation
Intergovernmental Agreements	Viable if no ownership is required Up to 30 years of use	No transfer of ownership (use only) Limited time Restrictions on modifications and transfers
Public-Private Projects/ PROMESA	Attractive for large developments	Requires legal structure and regulatory compliance

Mechanism	Advantages	Considerations
	Can attract investment and financial support	Less community oversight Long and bureaucratic processes
Execution of Judgment at Auction	Municipality can acquire properties with debts Legal method to take control	It depends on the existence of debt and legal proceedings It can be challenged by the owner

Source: Osiris Torres, Municipality of Ponce, personal communication, May 2025

Appendix G. REopt Analysis Assumptions, Parameters, and Additional Results

Table G-1. ReOpt Parameters and Values

Parameter	Value	Description/Source
Latitude/Longitude	17.9782, -66.6076	Location is set for the center of the Playa de Ponce. This location is used to estimate solar potential.
Electric cost escalation	2.5%	REopt default, https://www.nlr.gov/reopt/curriculum/user-guides
Net Metering export rate	$0.075 per kWh	Assumed to be equivalent to the wholesale rate, taken from LUMA.
Owner discount rate	6.38%	REopt default, https://www.nlr.gov/reopt/curriculum/user-guides
Owner tax rate	26.0%	REopt default, https://www.nlr.gov/reopt/curriculum/user-guides
PV installed cost per kW	Cost for solar per watt in PR is $3.00	Solar Reviews provided that value, however, it was multiplied by 50% in the model to provide a cost buffer, https://www.solarreviews.com/solar-panel-cost/puerto-rico/san-juan
Battery installed cost per kWh	$656.68 per kW $1,313.16 per kWh	Cost of current BESS that is installed at the time of the analysis, 3.8 kWh SimpliPhi 48V Lithium Battery PHI-3.8-48-60 | SunWatts
Battery replacement cost per kWh	$715	REopt default, https://www.nlr.gov/reopt/curriculum/user-guides
Battery end-of-life action	Augmentation	REopt default, https://www.nlr.gov/reopt/curriculum/user-guides
Generator fuel cost	Diesel, $3.18 per gallon	Cost of diesel at the time of the analysis, https://www.globalpetrolprices.com/Puerto-Rico/diesel_prices/
Generator installed cost per kW	$880	REopt default, https://www.nlr.gov/reopt/curriculum/user-guides
Critical Load	100%	Assuming UNA at minimum prefers to operate at 100% normal conditions during outages.

Table G-2. REopt Metric Definitions

PV size (kW)	The total PV size, including existing PV systems that were accounted for in the model.
PV average annual production (kWh)	The annual average energy production from the PV system including losses and system degradation over time.
PV average annual export (kWh)	Energy that is not being directly consumed at the moment of it being produced and therefore it is "sold" or exported to the grid.
Annual export benefit ($)	The credit or value for exporting to the grid, according to the utility's tariff structure.
Battery size (kW / kWh)	Batteries store energy (measured in kWh) but can only output, or *dispatch*, energy up to a certain power level. In other words, if I have a "4-hour" battery, that means that I can dispatch a quarter of the total energy stored ever hour. For example, 25 kW / 100 kWh.
Generator size (kW)	The size of the portable generator.
Annual grid-purchased electricity (kWh)	The average annual electric purchases from the utility.
Survivability probability at final outage hour (%)	The likelihood of surviving the full-outage length with no lack of energy or storage, in this case 24- and 72-hours respective to the scenario.
Net Present Value ($)	The difference between future costs and future revenues in today's dollars including the upfront capital costs. If the NPV is over $0, then it is considered a good project or investment. If the NPV is less than $0, it means you're losing money over the lifetime (or analysis period) of the project/investment.
Upfront Capital Cost without Incentives ($)	The upfront initial cost to get the project installed without including incentives… does not include operations and maintenance (O&M) or replacement costs.