Agrivoltaics Microgrid Energy and Resilience Project

Project Proposal Submission to the Puerto Rico Energy Bureau (PREB)

Electronically submitted by:
Agroenergética LLC
Moca, Puerto Rico

4/14/2026

Revision	Date	Author	Description
0	4/14/2026	Agroenergética LLC	Initial PREB submission

Honorable Commissioners
Puerto Rico Energy Bureau
World Plaza Building
268 Ave. Muñoz Rivera
Plaza Level, Suite 202
San Juan, Puerto Rico 00918

RE: Agrivoltaics Microgrid Energy and Resilience Project – Agroenergética LLC

Honorable Commissioners,

Agroenergética LLC respectfully submits for the consideration of the Puerto Rico Energy Bureau ("Bureau") the enclosed proposal for the development of an Agrivoltaics Microgrid Energy and Resilience Project in the municipality of Moca, Puerto Rico. The proposed initiative seeks to support Puerto Rico's electric system transformation through the deployment of distributed renewable generation, grid-forming battery energy storage, and advanced microgrid control systems designed to improve feeder-level reliability, enhance community resilience, and contribute to the modernization of the island's electric infrastructure.

The project has been conceived within the policy framework established by the Bureau to accelerate the integration of renewable energy, distributed energy resources, and resilient infrastructure across Puerto Rico. These policy objectives were reaffirmed through the Bureau's approval of the Puerto Rico Integrated Resource Plan (IRP). In particular, the Final Resolution and Order approving the Integrated Resource Plan (Case No. CEPR-AP-2018-0001) recognizes the strategic importance of distributed generation, battery energy storage systems, and microgrid infrastructure in improving system resilience and strengthening distribution system reliability across the island.

The proposed project directly supports these policy objectives by deploying a distributed microgrid resource designed to enhance operational flexibility and resilience at the feeder level within northwestern Puerto Rico. Rural communities in the municipalities of Moca, Aguadilla, Isabela, and surrounding areas have historically experienced recurring service interruptions and voltage instability associated with long distribution feeders, aging infrastructure, and exposure to severe weather events.

The proposed facility will consist of two Tesla Megapack 2XL Battery Energy Storage Systems totaling approximately 1.4 MW/5.6 MWh, integrated with a photovoltaic generation system composed of approximately 2.2 MWdc, together with a centralized Microgrid Energy Management System (EMS). The system will interconnect with the

local 4.16 kV distribution feeder through a 750 kVA interconnection transformer, with export levels actively managed through the EMS to remain within defined limits while providing grid support functionality.

Through its advanced control architecture, the microgrid will provide multiple ancillary services including voltage regulation, feeder stabilization, fast frequency response, renewable smoothing, controlled dispatch, and black-start capability. These capabilities allow the project to function as a controllable distributed energy resource that supports distribution system reliability and operational flexibility consistent with the objectives identified in the Integrated Resource Plan.

The project is designed to operate in compliance with Puerto Rico Energy Bureau Regulation 9028 – Regulation on Microgrid Development. The system architecture, including export controls, islanding capability, advanced EMS coordination, and protection schemes, has been structured to comply with this regulatory framework while ensuring safe integration with the existing distribution network.

Importantly, the project is intended to support the Bureau's oversight authority in guiding Puerto Rico's transition toward a more resilient and decentralized electric system. By demonstrating the implementation of a distributed microgrid operating within the Bureau's regulatory framework, the project seeks to serve as a replicable model for resilient distributed infrastructure capable of strengthening feeder-level reliability while advancing Puerto Rico's energy policy goals.

Beyond its energy infrastructure components, the project incorporates a significant agrivoltaics initiative on approximately 10 acres located at Hacienda Gosén in Moca, Puerto Rico. This initiative integrates renewable energy production with regenerative agriculture and conservation land management practices intended to improve food security, soil health, and long-term environmental sustainability.

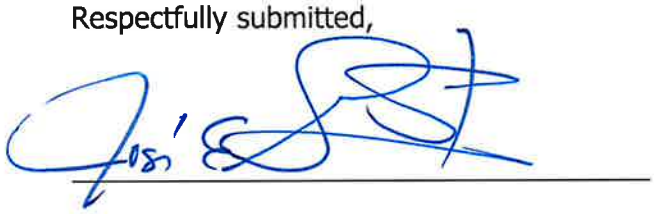
The project is expected to generate meaningful economic, environmental, and social benefits including job creation, emissions reductions, and improved energy reliability for surrounding communities. The project also aligns with the objectives of CDBG-DR ER2 resilience programs supporting infrastructure reliability and energy access for low- and moderate-income communities.

Agroenergética LLC has structured the development timeline over approximately forty-eight (48) months to allow permitting, environmental review, detailed engineering design, and construction.

Agroenergética LLC looks forward to working collaboratively with the Puerto Rico Energy Bureau, LUMA Energy, and other stakeholders to ensure that the project is implemented in full compliance with applicable regulatory requirements while supporting the modernization and resilience of Puerto Rico's electric system.

We respectfully welcome the opportunity to engage with the Bureau and provide any additional technical or regulatory information that may assist in its review.

Respectfully submitted,



José E. García Santiago, PE

Principal Agroenergética LLC

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Executive Summary

The Agrivoltaics Microgrid Energy and Resilience Project proposed by Agroenergética LLC is a multi-modal energy generation and storage facility designed to enhance grid reliability and community resilience in the municipality of Moca, Puerto Rico. The project is designed as a resilience-focused microgrid that supports feeder reliability in rural northwestern Puerto Rico while integrating renewable energy and agrivoltaics land use, a novel dual-use concept with increasing potential wherever land and/or electricity generation resources face similar constraints.

The project encompasses distributed photovoltaic (PV) generation, advanced battery energy storage systems (BESS), and microgrid control technologies capable of supporting feeder-level stability while providing renewable energy to the local distribution network (also known as an energy management system, or EMS). The system will integrate a 2.2 MW photovoltaic generation system with a 1.4 MW/5.6 MWh battery energy storage system. The microgrid will operate under controlled export conditions while providing grid services including voltage support, frequency response, renewable smoothing, and feeder stabilization.

The project supports Puerto Rico's Integrated Resource Plan (IRP) objectives and aligns with Puerto Rico Energy Bureau (PREB) Regulation 9028 governing microgrid development.

Through a centralized Energy Management System (EMS), the microgrid coordinates photovoltaic production and battery dispatch to maintain export limits while delivering grid services such as:

- voltage regulation
- fast frequency response
- renewable smoothing
- peak-period dispatch capability
- feeder stabilization

Beyond its energy infrastructure components, the project incorporates a 10-acre agrivoltaics initiative at Hacienda Gosén, combining renewable energy production with regenerative agriculture, soil restoration practices, and agricultural research.

The project supports Puerto Rico's policy objectives for:

- distributed renewable energy
- grid resilience
- energy diversification
- rural economic development

Technical System Overview

The Agrivoltaics Microgrid integrates photovoltaic generation, battery storage, and advanced controls to create a controllable distributed energy resource (DER) capable of providing both energy and ancillary grid services tied to a local feeder operated by the Transmission & Distribution (T&D) operator LUMA Energy (LUMA).

The key components include a 2.2 MWdc photovoltaic generation system, a 1.4 MW/5MWh BESS comprised of two (2) Tesla Megapack 2XL units, which are to be connected via a Microgrid EMS. The local grid-tie is expected to occur at a distribution feeder at 4160 V via a 750 kVA transformer. This export is to be controlled via the EMS for dispatch energy delivery between 2 pm and 10 pm local time.

The EMS will coordinate PV generation and battery dispatch to maintain export limits while stabilizing feeder voltage and frequency, in accordance with the following operational modes:

1. Interconnected Mode – Controlled Export
   EMS coordinates PV and BESS output while exporting energy to the feeder within limits.
2. Standby Mode – Pre-Islanding
   Battery storage is prioritized to maintain energy reserves ahead of forecast disturbances.
3. Feeder-Islanded Mode – Grid Forming
   The BESS establishes voltage and frequency reference during outages.
4. Grid Re-Synchronization
   EMS synchronizes the microgrid with the distribution network before reconnection.

More information is provided in Appendix documents, *Project Background and System Performance & User Requirements*.

Public Interest Benefits

Technical Benefits

In Puerto Rico, distribution feeders frequently experience operational challenges associated with long radial circuits, voltage drops during peak load conditions, and extended service restoration times following severe weather events. The proposed microgrid introduces a controllable distributed energy resource capable of supporting feeder stability through several operational mechanisms.

Specifically, the Agrivoltaics Microgrid is designed to provide operational support to the LUMA distribution feeder 7805-11, considered a semi-rural circuit. Feeder 7805-11 is located along PR-111 serving businesses as well as single-family and multi-family homes, with laterals that primarily serve family homes and smaller businesses. The technical benefits of tying in to this feeder are as follows:

Voltage Support

The battery energy storage system (BESS) and inverter-based photovoltaic generation are capable of providing dynamic reactive power support through advanced inverter controls. The EMS can regulate voltage levels on Feeder 7805-11 by adjusting inverter output, thereby mitigating voltage fluctuations caused by variable load conditions or distributed generation variability.

Frequency Response

The grid-forming capabilities of the battery storage system enable rapid frequency response to disturbances on the distribution network. The BESS can inject or absorb power within milliseconds, helping stabilize feeder frequency during transient events.

Solar Variability Smoothing

The EMS coordinates PV production with battery charging and discharging to smooth solar generation variability. This reduces short-term fluctuations that could otherwise propagate through the feeder and affect power quality.

Export Limitation and Feeder Protection

The microgrid is designed to operate under a **750 kVA export constraint**, ensuring that power exported to Feeder 7805-11 remains within safe operational limits established during the interconnection process. The EMS continuously monitors real-time power flows and automatically curtails photovoltaic generation or increases battery charging to maintain compliance with the export threshold.

Islanded Operation During Feeder Outages

If Feeder 7805-11 is isolated during a major outage, the microgrid can transition into grid-forming mode. In this configuration, the BESS establishes the voltage and frequency reference for the local electrical island, allowing the system to energize downstream loads until normal grid operations are restored.

Contribution to Distribution Resilience

By integrating photovoltaic generation, energy storage, and advanced control systems, the Agrivoltaics Microgrid provides a localized resilience asset capable of improving distribution system reliability. The project supports feeder stabilization objectives while aligning with Puerto Rico's broader strategy of deploying distributed energy resources to strengthen grid performance in vulnerable regions.

Regulatory Compliance Benefits

This project aligns with PREB Regulation 9028 and the Puerto Rico IRP CEPR-AP-2018-0001, as well as the Puerto Rico Energy Public Policy Act of 2019.

Economic Benefits

Available planning information for Feeder 7805-11 indicates that the feeder is already the subject of FEMA-funded resilience and hardening work under design, including, but not limited to, seven (7) PMUs, four (4) separate 1 MWh BESS installations, seven (7) reconductoring work scopes, numerous fuse replacements or upgrades, and at least one recloser. From an LCOE and public-benefit perspective, these planned feeder investments materially strengthen the case for the Agrivoltaics Microgrid, as it would would provide localized generation, storage, controllable dispatch, feeder support, and outage-restoration capability without requiring LUMA to independently develop and finance a new distributed generation facility for this portion of Feeder 7805-11. Resilience improvement under FEMA funds can remain focused on backbone hardening and distribution infrastructure improvements.

Because this project is a DER asset with both generation and grid-resilience capabilities, the project should not be evaluated solely as an energy-cost resource in comparison with conventional utility-scale solar.

In a public-benefit interpretation of the LCOE analysis, this avoided-utility-investment effect can be treated as a strategic economic offset, even if it is not yet quantified as a direct dollar-for-dollar reduction in the workbook. The Agrivoltaics Microgrid would leverage, rather than duplicate, FEMA-funded feeder improvements by adding localized generation and resilience functionality beyond the scope of conventional line hardening measures.

Service Expansion Opportunities

In addition to the primary microgrid configuration, the project may incorporate the future installation or coordination of distribution line reclosers located within an approximate radius of 3 miles from the point of interconnection on Feeder 7805-11. This option would enhance the practical resilience value of the microgrid by enabling the selective isolation of faulted feeder segments and the controlled energization of nearby service areas during major power disturbances or extended outages. For the public, this would mean an increase in the number of potentially served customers during major outages and an improvement of restoration capabilities.

Under this operating concept, utility-grade reclosers positioned on adjacent feeder sections could be configured, subject to utility approval and detailed protection coordination studies, to define a localized restoration zone around the microgrid interconnection point. Once upstream faults or broader feeder disturbances are isolated, the microgrid could operate in grid-forming mode and provide electrical service to customers located within the protected section bounded by the reclosers. This approach would allow the battery energy storage system and photovoltaic generation resources to serve not only as a feeder support asset, but also as a localized resilience node capable of sustaining critical community loads within a limited geographic radius.

Implementation of this functionality would require additional engineering analysis, including feeder sectionalization review, relay and recloser protection coordination, fault current assessment, critical load prioritization, synchronization logic, communications integration for safe islanding and reconnection, and operational integration and approval from LUMA. The final design would need to confirm that the isolated section can be safely energized within the microgrid's available real and reactive power capability, black-start strategy, and restoration sequence.

Levelized Cost of Energy Analysis Summary

Based on updated planning assumptions, the Agrivoltaics Microgrid may offset approximately $8 million to $10 million of potential distributed storage and resilience infrastructure investment that might otherwise be required to provide comparable feeder stabilization and localized resilience capability.

Based on previously stated public interest benefits, this LCOE analysis includes a public-benefit adjustment that recognizes avoided LUMA/FEMA resilience investment on Feeder 7805-11. The feeder planning excerpt identifies four separate 1 MWh BESS installations, seven PMUs, seven reconductoring scopes, multiple fuse upgrades, and a recloser under FEMA 406 design work. Given the Agrivoltaics project's 5.6 MWh energy storage capability and feeder support role, the analysis applies a conservative avoided-investment credit range of $8.0MM to $10.0MM against the full-cost hybrid LCOE numerator as a public-benefit adjustment.

This adjustment is not intended to replace the standard project-cost LCOE. Instead, it provides a policy-oriented view of the project's economic value when considering avoided public utility resilience spending that may no longer be required or may be redirected toward broader rural distribution infrastructure hardening on Feeder 7805-11.

Scenario	Avoided Investment Credit	Adjusted LCOE ($/MWh)	Reduction vs Baseline
Baseline Full-Cost Hybrid LCOE	$0	$280.3/MWh	-
Public-Benefit Adjusted (Low Case)	$8.0 MM	$127.7/MWh	54%
Public-Benefit Adjusted (Mid Case)	$9.0 MM	$108.6/MWh	61%
Public-Benefit Adjusted (High Case)	$10.0 MM	$89.5/MWh	68%

The revised public-benefit adjusted LCOE indicates that when avoided infrastructure investment is considered, the effective cost of delivered hybrid renewable energy falls into a range between approximately $89/MWh and $128/MWh. This adjusted range is significantly closer to the price levels observed in large utility-scale solar procurement contracts while still reflecting the additional value provided by dispatchable battery-

backed renewable energy. By providing localized storage capacity and dispatchable renewable generation, the project may reduce or defer the need for additional distributed storage installations within the same service territory.

When these system-level benefits are considered, the project demonstrates a strong economic case within the context of Puerto Rico's ongoing grid resilience and renewable energy transition.

This LCOE summary is supported by the accompanying spreadsheet workbook, which includes the following tabs: hybrid LCOE Calculation – lifecycle cost and energy modeling, battery Augmentation Model – degradation and augmentation schedule, 8760-lite Dispatch Model – export constraint and dispatch logic, and PREB Benchmark Comparison – market context analysis.

Proposed Pricing Structure

The Agrivoltaics project integrates photovoltaic generation and battery storage into a single bundled hybrid energy product, and therefore its pricing strategy must reflect the benefits of said product model as compared to existing solar-only power purchase agreements (PPAs). The following table illustrates a conceptual decomposition of the hybrid price relative to typical solar-only contract pricing.

Component	**Indicative Value ($/MWh)**
Solar Energy Equivalent (PV generation)	$80–$90
Battery Dispatch Value (energy shifting & storage)	$90–$120
Peak Delivery Premium (3 PM–9 PM availability)	$15–$25
Distribution Support / Grid Services	$5–$10
Total Hybrid Bundled Price	**$229/MWh ($0.229/kWh)**

Appendices

A. Proposal: Agrivoltaics for Energy & Food Security in Rural Northwestern Puerto Rico CDBG-DR
B. Grant Agreement for the Electrical power Rehability and resilience program
C. User Requirement Specifications Agrivoltaics MicroGrid
D. LCOE Analysis
E. Luma Interconnection Application OGPe SRI
F. Luma FEMA 334293 Mayaguez Group 4 Class 3 estimate sergent lundy