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GOVERNMENT OF PUERTO RICO
PUBLIC SERVICE REGULATORY BOARD
PUERTO RICO ENERGY BUREAU

IN RE: REVIEW OF THE PUERTO RICO ELECTRIC POWER AUTHORITY INTEGRATED RESOURCE PLAN	**CASE NO.:** NEPR-AP-2023-0004 **SUBJECT**: Motion Submitting First Interim Filing of the IRP in Compliance with the Resolution and Order of October 29, 2024, Request for Confidential Treatment, and Memorandum in Support of Confidentiality

MOTION SUBMITTING FIRST INTERIM FILING OF THE IRP IN COMPLIANCE WITH THE RESOLUTION AND ORDER OF OCTOBER 29, 2024, REQUEST FOR CONFIDENTIAL TREATMENT, AND MEMORANDUM IN SUPPORT OF CONFIDENTIALITY

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COME NOW LUMA Energy, LLC ("ManagementCo"), and **LUMA Energy ServCo, LLC** ("ServCo"), (jointly referred to as "LUMA"), and respectfully state and request the following:

I. Introduction

1. One of LUMA's core system planning responsibilities as operator of the Puerto Rico transmission and distribution system ("T&D System") pursuant to the *Puerto Rico Transmission and Distribution System Operation and Maintenance Agreement* dated June 22, 2020 ("T&D OMA"), is developing and proposing an Integrated Resource Plan ("IRP"). As such, the Puerto Rico Energy Bureau ("Energy Bureau") initiated this instant proceeding for the review of the proposed IRP to be filed by LUMA, as the agent of the Puerto Rico Electric Power Authority ("PREPA").

2. LUMA is committed to supporting and advancing the transformation of Puerto Rico's energy system into one that is more resilient, cleaner, and sustainable for everyone. As operator of the transmission and distribution system, LUMA is responsible for developing an IRP

that maps out the transformation of the island's energy resources over the next two decades. *See* PR Laws Ann. Tit. 22 § 1054v (2024); T&D OMA, Section 5. 6 (f), p. 67. LUMA's goal is to ensure that the IRP presents a diverse and analytically robust set of future scenarios and resource portfolios in order to map a sustainable and reliable energy future for Puerto Rico that is responsive to customer needs and Puerto Rico's energy public policy objectives.

3. After a series of procedural events, on October 29, 2024, the Energy Bureau issued a Resolution and Order approving a revised schedule for the 2025 IRP (the 2025 IRP) Filing ("October 29th Order"). Specifically, it directed LUMA to submit information at two interim milestone dates, the first on November 27, 2024, and the second on February 28, 2025, to share preliminary findings and demonstrate the progress of the 2025 IRP Filing. Moreover, it directed LUMA to file the 2025 IRP Report on May 16, 2025, in compliance with the *Regulation on Integrated Resource Plan for the Puerto Rico Electric Power Authority,* Regulation No. 9021, dated April 20, 2018 ("Regulation 9021").

4. In compliance with the October 29th Order, for the first interim milestone, LUMA submits as *Exhibit 1* to this Motion the First Interim 2025 IRP Filing with: (i) preliminary results of PLEXOS modeling to define the least cost resource portfolio for the 2025 IRP Revised Core Scenarios 1 through 4, including input assumptions; (ii) available information on the existing LUMA Transmission, Distribution and Advanced Grid Control facilities and equipment as described in Section 2.03(J)(1)(a)-(c) of Regulation 9021, consistent with the partial waiver granted by the Energy Bureau in its Resolution and Order dated April 15, 2024; and (iii) a summary and qualitative description of how LUMA expects planned transmission facilities will support its Preferred Resource Plan. LUMA also includes the work papers on the results, assumptions, and inputs of the 2025 IRP Revised Core Scenarios 1 through 4, as *Exhibit 2* to this Motion. The work

papers for the information on the existing LUMA Transmission, Distribution, and Advanced Grid Control facilities and equipment will be provided on or before December 10, 2024.

II. Procedural Background

5. On July 12, 2023, the Energy Bureau issued a Resolution and Order whereby it initiated the instant administrative proceeding for the review of the proposed IRP to be filed by LUMA as the agent for PREPA ("July 12th Order").

6. An initial Prefiling Technical Conference was held on August 8, 2023. During the initial Technical Conference, LUMA anticipated the possibility of modifying the IRP submission date to account for the delays in its technical consultant's contracting process.

7. On August 30, 2023, LUMA filed a *Motion Submitting Revised Version of Exhibit I of Final Contract for Technical Consultant and Related Documents, Request for Approval of Final Contract, and Request for Confidential Treatment* whereby, in what is pertinent, it submitted a revised Exhibit I in the terms discussed during the Technical Conference and requested that the Energy Bureau approve the revised version of Exhibit I of the technical consultant contract.

8. On September 7, 2023, the Energy Bureau issued a Resolution and Order approving the revised technical contract between LUMA and the technical contractor and scheduled a second IRP prefiling conference for October 31, 2023.

9. The second prefiling Technical Conference was held on October 31, 2023. During the same, LUMA delivered a presentation and answered the questions posed by the members of the Energy Bureau. LUMA also had the opportunity to introduce its technical consultant for the IRP filing (hereinafter, the "IRP Technical Consultant"). During the second prefiling Technical Conference, LUMA proposed the revised IRP filing date of June 28, 2024.

10. On November 14, 2023, LUMA filed a *Request for Modification of Timeline for 2024 IRP Filing*. LUMA included the revised timeline with a summary of the explanations supporting LUMA's request. LUMA respectfully set forth that, per its discussion with the IRP Technical Consultant and based on the technical consultant's vast experience, the normal scope of a regular IRP will typically require approximately nine (9) to twelve (12) months to complete. LUMA also explained that complexities in the planned scope of work for the IRP, which includes eight separate planning areas as opposed to the more common single planning area, integrated transmission modeling, and distributed energy resource modeling, as well as the transmission and distribution areas and additional sensitivities that will be considered, required extra time to develop and file the IRP.

11. On December 20, 2023, the Energy Bureau issued a Resolution and Order approving LUMA's request for an extension to file the IRP to June 28, 2024. Further, the Energy Bureau scheduled a third technical conference for January 30, 2024, for LUMA to present information on certain parts of the transmission sections of Regulation No. 9021.

12. On March 11, 2024, LUMA filed a *Motion Submitting Revised 2024 Integrated Resource Plan Scenarios and Characteristics*. Therein, LUMA submitted Revised Scenarios and Characteristics, the six (6) scenarios ("Core Scenarios") that will form a key part of its IRP modeling analysis, which will be filed as part of LUMA's IRP submission. It also included four (4) scenarios ("Supplemental Scenarios") that would be filed in a Supplemental Filing. LUMA also explained that the exercise of revising the scenarios caused a temporary halt in the modeling of the base case scenario 1.

13. On March 13, 2023, the Energy Bureau entered a Resolution and Order confirming that LUMA could continue modeling the six (6) Core Scenarios as requested in LUMA's *Motion*

Submitting Revised 2024 Integrated Resource Plan Scenarios and Characteristics ("March 13th Order"). The Energy Bureau also ordered LUMA to submit the applicable evaluation and analysis concerning the four (4) Supplemental Scenarios included in said Motion on or before August 1, 2024.

14. On June 7, 2024, LUMA requested a continuance of the IRP filing date of June 28, 2024. In said June 7th Motion LUMA requested until June 28, 2024, to submit an updated schedule of the IRP Filing, provided the base case resource plan has been completed.

15. On June 18, 2024, the Energy Bureau granted LUMA's request to suspend the filing date of June 28, 2024 ("June 18th Order"). It authorized LUMA to file the Supplemental scenarios no later than five weeks after the core scenarios are filed. Furthermore, the Energy Bureau ordered LUMA to file by no later than June 28, 2024, an expected date on which the IRP will be filed with all completed sections and work papers.

16. On June 28, 2024, LUMA submitted the Revised IRP Schedule Filing. LUMA requested that the date to file the IRP be extended to May 16, 2025 to reflect the modeling challenges experienced thus far and to account for the time necessary to complete and develop the IRP in compliance with Applicable Law, including conducting all assessments, stakeholder engagement and development of supporting materials necessary for a complete filing.

17. On August 20, 2024, the Energy Bureau ("August 20th Order"), the Energy Bureau declined to adopt LUMA's proposed revised IRP schedule. In the August 20th Order, the Energy Bureau instructed LUMA to file the Preferred Resource Plan and salient components of Regulation 9021 requirements by Friday, November 29, 2024. Further, the Energy Bureau ordered LUMA to file certain transmission and distribution-related requirements of Regulation 9021 by no later than February 28, 2025.

18. On September 11, 2024, LUMA filed a *Motion Requesting a Confidential Technical Conference*. Therein, LUMA requested the Energy Bureau to schedule an in-person Technical Conference to offer the Energy Bureau detailed insight into the status of the IRP and the complexities and challenges encountered while modeling the proposed scenarios. LUMA offered the week of September 17-20, 2024, given the impending deadlines established in the August 20th Order.

19. On September 16, 2024, the Energy Bureau issued a Resolution and Order scheduling the requested Confidential Technical Conference for September 18, 2024, at 10 a.m.

20. On September 18, 2024, the Confidential Technical Conference was held before the Energy Bureau. LUMA explained the constraints faced when modeling the base case and that not all issues arose simultaneously. Thus, LUMA and the Technical Consultant could not fix the issues simultaneously. Notwithstanding, LUMA explained that measures were implemented to resolve the issues and outlined its planned path to place LUMA in a position to complete a robust IRP by May 16, 2025. LUMA also identified certain factors that could affect its timeline while expressing confidence and commitment to work transparently to file a proposed IRP in May 2025.

21. On September 27, LUMA filed a *Motion Requesting Reconsideration of the Resolution and Order Dated August 20, 2024, and Modification of the IRP Filing Schedule*. Therein, LUMA requested the Energy Bureau to reconsider the August 20th Order. LUMA reiterated its proposal to provide the Energy Bureau information at two interim milestone dates, the first on November 27, 2024, and the second on February 28, 2025, to share preliminary findings and demonstrate the progress of the 2025 IRP Filing. In addition, LUMA expected that on May 16, 2025, it may file the 2025 IRP Report in compliance with Regulation 9021, as modified by any exception approved by the Energy Bureau.

22. In the October 29th Order, the Energy Bureau approved the aforementioned revised schedule for the 2025 IRP Filing, including the first interim filing subject of this Motion. Also, it instructed LUMA that the Base Case Scenario modeling shall include a new CCGT with the characteristics contemplated in the Resolution and Order issued by the Energy Bureau on August 3, 2022, in the proceeding *In Re: Preliminary Studies for New Combined Cycle Power Plant in Palo Seco*, Case NEPR-MI-2021-0003. Any variation to said characteristics shall be included in a sensitivity analysis.

III. Legal Framework of the 2025 IRP

23. PREPA and the Puerto Rico Public-Private Partnerships Authority entered into the T&D OMA with LUMA to (i) provide management, operation, maintenance, repair, restoration and replacement, and other related services for the transmission and distribution system ("T&D System"), in each case that are customary and appropriate for a utility transmission and distribution system service provider, and (ii) establish policies, programs, and procedures with respect thereto ((i) and (ii), collectively, the "O&M Services")[1]. *See* T&D OMA, Section 5.1, p. 62.

24. LUMA is tasked with (i) representing PREPA before the Energy Bureau with respect to any matter related to the performance of any of the O&M Services provided by LUMA

[1] The O&M Services are to be provided in accordance with the "Contract Standards," requiring compliance with Applicable Law, Prudent Utility Practice, and other standards, terms, conditions, and requirements specified in the T&D OMA (for purposes of this submission, "Contract and Policy Standards"). Contract and Policy Standards necessarily require acting consistently with policy mandates and directives in Act 57-2014, as amended, known as the "Puerto Rico Energy Transformation and RELIEF Act" ("Act 57-2014"), Act 120-2018, as amended, known as the Electric Power System Transformation Act ("Act 120- 2018") and Act 17-2019, known as the "Puerto Rico Energy Public Policy Act" ("Act 17-2019"), among others. This term includes "any foreign, national, federal, state, Commonwealth, municipal or local law, constitution, treaty, convention, statute, ordinance, code, rule, regulation, common law, case law or other similar requirement enacted, adopted, promulgated or applied by any [governmental body][…]" in each case applicable to the parties to the T&D OMA. *Id.*, Section 1.1, p. 3. "Prudent Utility Practice" is defined, in pertinent part, as "…at any particular time, the practices, methods, techniques, conduct and acts that, at the time they are employed, are generally recognized and accepted by companies operating in the United States electric transmission and distribution business as such practices, methods, techniques, conduct and acts appropriate to the operation, maintenance, repair and replacement of assets, facilities and properties of the type covered by the [T&D OMA] . . . ." *Id.*, p. 26.

under the T&D OMA; (ii) preparing all related filings and other submissions before the Energy Bureau; and (iii) represent PREPA before any Governmental Body and any other similar industry or regulatory institutions or organizations having regulatory jurisdiction. *See* T&D OMA, Section 5.6(a), p. 66.

25. Additionally, LUMA shall prepare a proposed IRP for review and approval by the Energy Bureau. *See* T&D OMA, Section 5.6(f), p. 67. "The proposed IRP shall be designed in accordance with Applicable Law and a manner to ensure that, if approved by the Energy Bureau and subject to the assumptions specified therein, LUMA can provide safe and adequate transmission and distribution service at the lowest reasonable rates consistent with budgetary and T&D System requirements, and with sound fiscal operating practices." *Id*.

26. As the main entity in charge of ensuring compliance with energy public policy and carrying out energy policy mandates, this Energy Bureau has the authority to review this submission pursuant to Act 57-2014 and Act 17-2019. Specifically, Act 57-2014 gives the Energy Bureau authority and regulatory oversight over electric services and companies such as PREPA and LUMA. *See* Sections 6.3 and 6.4 of Act 57-2014, PR Laws Ann. Tit. 22 §§ 1054b and 1054c (2024). Among other powers, the Energy Bureau may establish public policy standards concerning electric service companies, establish by regulations the public policy rules regarding electric power service companies, and adopt the rules, orders, and regulations needed to carry out its duties, issue orders, and impose fines to comply with the powers granted by law, as well as for the implementation of Act 57-2014. *Id*.

27. Furthermore, pursuant to Section 6.23 of Act 57-2014, the electric power company responsible for operating the electrical system shall submit to the Energy Bureau an IRP consistent with Section 1.9 of Act 17-2019. *See* Section 6.23(a) of Act 57-2014, PR Laws Ann. Tit. 22 §

1054v(a). The electric power company shall devise the IRP with the companies operating the power plants' input. *Id*. The Energy Bureau, addressing the comments of interested persons and organizations, shall review, approve, and, as applicable, modify said plans to ensure full compliance with the public policy on energy of Puerto Rico and the provisions of Act 57-2014. *See* Section 6.23(c) of Act 57-2014, PR Laws Ann. Tit. 22 § 1054v(c). Upon the approval of the IRP, the Energy Bureau shall supervise and oversee compliance therewith. *See* Section 6.23(d) of Act 57-2014, PR Laws Ann. Tit. 22 § 1054v(d).

28. Implementing its authority under Act 57-2014, the Energy Bureau issued Regulation 9021. "The purpose of . . . Regulation [9021] is to ensure that the IRP serves as an adequate and useful tool to guarantee the orderly and integrated development of Puerto Rico's electric power system, and to improve the system's reliability, resiliency, efficiency, and transparency, as well as the provision of electric power services at reasonable prices." *See* Section 1.03 of Regulation 9021. The IRP shall consider a planning period of twenty (20) years and shall remain in effect until the approval of a subsequent IRP. *See* Section 2.01 of Regulation 9021. Any proposal for a new IRP, or any proposed update, review, or amendment to an existing IRP must be submitted to the Energy Bureau for evaluation and approval. *Id*.

IV. Submission of the First Interim 2025 IRP Filing

29. As discussed previously, LUMA submits as *Exhibit 1* to this Motion the First Interim 2025 IRP Filing with preliminary results of PLEXOS modeling to define the least cost resource portfolio for the 2025 IRP Revised Core Scenarios 1 through 4 and their respective input assumptions. As explained in *Exhibit 1*, LUMA analyzed four potential scenarios to consider different uncertainties and complexities of future demands and resource availability. Each scenario describes combinations of plausible forecasts of load, fuel prices, capital costs, and risks that

influence the choice of resources serving future load. In the current filing, LUMA is presenting the assumptions and portfolios resulting from the modeling of the first four (4) of ten (10) scenarios (i.e., Scenario 1 to 4) of LUMA's 2025 IRP Revised Scenarios and Characteristics. *See* Exhibit 1, p. 23.

30. Scenario 1 is also referred to as the Base Case Scenario due to its use of the most likely assumptions. Once the assumptions for Scenario 1 were established in PLEXOS, an optimized expansion plan that includes resource additions and retirements was developed in the PLEXOS LT (long-term) module. Production costs were then developed for the optimized PLEXOS ST (short-term) module plan. *See* Exhibit 1, p. 27. Thereafter, Scenario 2, called the "System Stress Scenario," includes assumptions that would result in higher stress on the system versus the Base Case Scenario regarding the ability to serve load. *Id.*, p. 46. Scenario 3 is the "More Agricultural Land Use" Scenario and includes the same assumptions as Scenario 1, except more agricultural land is assumed to be available for solar and wind generation installation. *Id.*, p. 65. Lastly, Scenario 4 is called the "Optimistic Load Growth and Cost Scenario" and includes assumptions that result in higher load growth and lower resource capital costs for candidate resources from which PLEXOS can select. *Id.*, p. 81.

31. It should be noted that LUMA is submitting preliminary portfolios resulting from Scenarios 1 through 4 modeling results. These preliminary portfolios are currently under analysis and development and will change before filing by May 16, 2025, the 2025 IRP Report. *Id.*, p. 27.

32. LUMA also submits in the First Interim 2025 IRP Filing a summary of the existing LUMA Transmission, Distribution, and Advanced Grid Control facilities and equipment as described in Section 2.03(J)(1)(a)-(c) of Regulation 9021, consistent with the partial waiver granted by the Energy Bureau in its Resolution and Order dated April 15, 2024. In terms of

available information on the existing LUMA Transmission facilities and equipment, LUMA explains that it operates a transmission system with an extensive network of transmission lines at 230 kV and 115 kV voltage levels and sub-transmission lines at the 38 kV voltage level. The transmission system's main objective is to provide an efficient interconnection between the generation sites and the load centers throughout the island to supply the distribution substations and customer loads. The transmission system is composed of 424 miles of 230 kV lines that serve as the critical backbone of the Puerto Rico Transmission and Distribution infrastructure to transmit large volumes of power across the grid; 711 miles of 115 kV transmission lines that function as a supply to the 1,563 miles of the sub-transmission 38 kV system and as a direct source to distribution substations, consisting of 299 substation sites and 431 transformers. *See* Exhibit 1, p. 109.

33. As to the available information on the existing LUMA Distribution facilities and equipment, LUMA describes how Puerto Rico's electric distribution system includes distribution substations (transformers that step down the voltage from transmission levels to primary distribution voltage, plus associated switchgear, equipment and infrastructure), primary distribution lines that originate in the substation and supply a defined geographical area including serving customers directly (through customer-owned distribution transformers), and utility owned and operated distribution transformers that step down the primary voltage to a secondary voltage (for example, 13.2 kV to 240/120V) for use by end-use customer loads, and the secondary voltage circuits that run through neighborhoods and directly connect customers. It currently comprises 342 distribution substations that supply loads to 1,127 distribution circuits (also called feeders). These substations and feeders are energized at one of five primary voltage levels: 13.2 kV, 8.32 kV, 7.2 kV, 4.8 kV, or 4.16 kV. *See* Exhibit 1, p. 103.

34. Regarding the summary of the existing LUMA Advanced Grid Control facilities and equipment, LUMA informs that it is furthering its advanced grid technologies by deploying automated switchgear and fault sensors across distribution feeders to bolster reliability. *See* Exhibit 1, p. 121. Additionally, LUMA will implement automatic switching distribution feeder automation systems to enhance reliability further. *See* Exhibit 1, p. 121. LUMA is also deploying advanced sensor capabilities to improve the reliability and resilience of the energy system and support the integration of renewable generation sources. *See* Exhibit 1, p. 122.

35. Finally, LUMA also submits in the First Interim 2025 IRP Filing a summary and qualitative description of how LUMA expects planned transmission facilities will support its Preferred Resource Plan. *See* Exhibit 1, p. 126. LUMA explains that the transmission analysis of the Preferred Resource Portfolio will include a load flow analysis, using Siemens PSSe, that will assist in identifying areas that require transmission infrastructure modifications to enable the transmission network flows forecasted for the Preferred Resource Plan and the System Stress Scenario 2 conditions through 2034, i.e., the first 10-years of the 20-year IRP. The transmission analysis will identify system planning criteria violations, candidate infrastructure modifications to alleviate any violations, and a planning level estimate of the costs of any needed modifications to enable the Preferred Resource Plan. *See* Exhibit 1, p. 124.

V. Request for Confidential Treatment

36. LUMA respectfully submits that certain information included in the First Interim 2025 IRP Filing, *Exhibit 1* to this Motion, should be designated as confidential material protected from disclosure. Certain information included in the First Interim 2025 IRP Filing is protected from disclosure as trade secrets; *see, e.g.*, Act 80-2011, P.R. Laws Ann. tit. 10, §§ 4131-4144 (2023), contain confidential information associated with Critical Energy Infrastructure

Information ("CEII") as defined in federal regulations, 18 C.F.R. §388.113; 6 U.S.C. §§ 671-674, and pursuant to the Energy Bureau's Policy on Management of Confidential Information. *See* Energy Bureau's Policy on Management of Confidential Information, CEPR-MI-2016-0009, issued on August 31, 2016, as amended by Resolution dated September 20, 2016.

A. Applicable Laws and Regulations to Submit Information Confidentially Before the Energy Bureau

37. The bedrock provision on the management of confidential information filed before this Energy Bureau is Section 6.15 of Act 57-2014, known as the "Puerto Rico Energy Transformation and Relief Act." It provides, in pertinent part, that: "[i]f any person who is required to submit information to the Energy Commission believes that the information to be submitted has any confidentiality privilege, such person may request the Commission to treat such information as such . . . . " 22 LPRA § 1054n. If after appropriate evaluation the Energy Bureau determines that the information should be protected, "it shall grant such protection in a manner that least affects the public interest, transparency, and the rights of the parties involved in the administrative procedure in which the allegedly confidential document is submitted." *Id.* § 1054n(a).

38. The confidential information shall be provided "only to the lawyers and external consultants involved in the administrative process after the execution of a confidentiality agreement." *Id.* § 1054n(b). Finally, Act 57-2014 provides that this Energy Bureau "shall keep the documents submitted for its consideration out of public reach only in exceptional cases. In these cases, the information shall be duly safeguarded and delivered exclusively to the personnel of the [Energy Bureau] who need to know such information under nondisclosure agreements. However,

the [Energy Bureau] shall direct that a nonconfidential copy be furnished for public review." *Id.* § 1054n(c).

39. Relatedly, in connection with the duties of electric power service companies, Section 1.10(i) of Act 17-2019 states that electric power service companies shall provide the information requested by customers, except for confidential information under the Rules of Evidence of Puerto Rico.

40. Moreover, the Energy Bureau's Policy on Confidential Information details the procedures a party should follow to request that a document or portion thereof be afforded confidential treatment. In essence, the referenced Policy requires identifying confidential information and filing a memorandum of law explaining the legal basis and support for a request to file information confidentially. *See* CEPR-MI-2016-0009, Section A, as amended by the Resolution of September 20, 2016, CEPR-MI-2016-0009. The memorandum should also include a table that identifies the confidential information, a summary of the legal basis for the confidential designation, and why each claim or designation conforms to the applicable legal basis of confidentiality. *Id.* at ⁋ 3. The party who seeks confidential treatment of information filed with the Energy Bureau must also file both a "redacted" or "public version" and an "unredacted" or "confidential" version of the document that contains confidential information. *Id.* at ⁋ 6.

B. Grounds for Confidentiality

41. The Energy Bureau's Policy on Management of Confidential Information states the following with regard to access to validated Trade Secret Information and CEII:

1. Trade Secret Information

> Any document designated by the [Energy Bureau] as Validated Confidential Information because it is a trade secret under Act 80-2011 may only be accessed by the Producing Party and the [Energy

> Bureau], unless otherwise set forth by the [Energy Bureau] or any competent court.
>
> 2. Critical Energy Infrastructure Information ("CEII")
>
> The information designated by the [Energy Bureau] as Validated Confidential Information on the grounds of being CEII may be accessed by the parties' authorized representatives only after they have executed and delivered the Nondisclosure Agreement.
>
> Those authorized representatives who have signed the Non-Disclosure Agreement may only review the documents validated as CEII at the [Energy Bureau] or the Producing Party's offices. During the review, the authorized representatives may not copy or disseminate the reviewed information and may bring no recording device to the viewing room.

Id. at § D (on Access to Validated Confidential Information).

42. Under the Industrial and Trade Secret Protection Act of Puerto Rico, Act 80-2011, P.R. Laws Ann. tit. 10, §§ 4131-4144 (2023), industrial or trade secrets are deemed to be any information:

> (a) That has a present or a potential independent financial value or that provides a business advantage, **insofar as such information is not common knowledge or readily accessible** through proper means by **persons who could make a monetary profit from the use or disclosure of such information**, and
> (b) for which reasonable security measures have been taken, as circumstances dictate, to maintain its confidentiality.

Id. § 4131, Section 3, Act. 80-2011.[2] They include, but are not limited to, processes, methods and mechanisms, manufacturing processes, formulas, projects, or patterns to develop machinery, and lists of specialized clients that may afford an advantage to a competitor. *See* Statement of Motives,

[2] Relatedly, Rule 513 of the Rules of Evidence of Puerto Rico provides that the owner of a trade secret may invoke the privilege to refuse to disclose, and to prevent another person from disclosing trade secrets, provided that these actions do not tend to conceal fraudulent actions or lead to an injustice. 32 P.R. Laws Ann. Ap. VI, R. 513. If a court of law mandates disclosure of a trade secret, precautionary measures should be adopted to protect the interests of the owner of the trade secret. *Id.*

Act 80-2011; *see also* Puerto Rico Open Data Law, Act 122-2019, Article 4 (ix) (exempting from public disclosure trade secrets) and Article 4(x) (exempting from public disclosure commercial or financial information whose disclosure will cause competitive harm).

43. The Puerto Rico Supreme Court has explained that the trade secrets privilege protects free enterprise and extends to commercial information that is confidential in nature. *Ponce Adv. Med. v. Santiago Gonzalez,* 197 DPR 891, 901-02 (2017) (citation omitted).

44. The Energy Bureau should protect part of the Fixed Capacity Additions in generation, the Preliminary Portfolios of the different Scenarios, and the work papers on the results, assumptions, and inputs of the 2025 IRP Revised Core Scenarios 1 through 4 included in *Exhibits 1 and 2* because they pertain to processes and methods that may prove advantageous or useful to LUMA's competitors in the energy business and utilities in Puerto Rico. LUMA takes reasonable security measures, such as this one, to maintain the confidentiality of its data and information in draft form.

45. LUMA respectfully submits that part of the Fixed Capacity Additions in generation, the Preliminary Portfolios of the different Scenarios, and the work papers on the results, assumptions, and inputs of the 2025 IRP Revised Core Scenarios 1 through 4 presented as part of LUMA's response in *Exhibits 1 and 2* should be designated as commercially sensitive or trade secret information. This designation is a reasonable and necessary measure to protect the information and enable LUMA to compete fairly in the future.

46. It is respectfully submitted that the right of public access to information is promoted and protected by the public version. The protection of the specific information pertaining to the information will not hinder nor preclude the public in a material way from gaining access to relevant and necessary information. As such, the interest in the public viewing the information that

LUMA hereby requests be kept confidential is outweighed by the harm that LUMA would be exposed to should the information be made available to the public.

47. Further, a Puerto Rico Electric Transmission System map submitted in *Exhibit 1* contains portions of CEII that, under relevant federal law and regulations, are protected from public disclosure. LUMA stresses that the information with CEII warrants confidential treatment to protect critical infrastructure from threats that could undermine the system and negatively affect electric power services to the detriment of the interests of the public, customers, and citizens of Puerto Rico. In several proceedings, this Energy Bureau has considered and granted requests by PREPA to submit CEII under seal of confidentiality.[3] In at least two proceedings on Data Security,[4] and Physical Security,[5] this Energy Bureau, *motu proprio*, has conducted proceedings confidentially, thereby recognizing the need to protect CEII from public disclosure.

48. In this particular proceeding, LUMA has requested to protect CEII from public disclosure in the *Motion Submitting Responses to the Fifth Set of IRP Prefiling Period Requests of Information, Request for Confidential Treatment, and Memorandum in Support of Confidentiality* dated September 11, 2024, whereby LUMA stated the base case results; assumptions, parameters and costs; forecasts; transmission transfer capability; and workpapers should be granted confidential status.

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[3] *See e.g., In re Review of LUMA's System Operation Principles,* NEPR-MI-2021-0001 (Resolution and Order of May 3, 2021); *In re Review of the Puerto Rico Power Authority's System Remediation Plan*, NEPR-MI-2020-0019 (order of April 23, 2021); *In re Review of LUMA's Initial Budgets*, NEPR-MI-2021-0004 (order of April 21, 2021); *In re Implementation of Puerto Rico Electric Power Authority Integrated Resource Plan and Modified Action Plan,* NEPR MI 2020-0012 (Resolution of January 7, 2021, granting partial confidential designation of information submitted by PREPA as CEII); *In re Optimization Proceeding of Minigrid Transmission and Distribution Investments*, NEPR MI 2020-0016 (where PREPA filed documents under seal of confidentiality invoking, among others, that a filing included confidential information and CEII); *In re Review of the Puerto Rico Electric Power Authority Integrated Resource Plan*, CEPR-AP-2018-0001 (Resolution and Order of July 3, 2019 granting confidential designated and request made by PREPA that included trade secrets and CEII) *but see* Resolution and Order of February 12, 2021 reversing in part, grant of confidential designation).

[4] *In re Review of the Puerto Rico Electric Power Authority Data Security Plan,* NEPR-MI-2020-0017.

[5] *In re Review of the Puerto Rico Electric Power Authority Physical Security Plan,* NEPR-MI-2020-0018.

49. Additionally, this Energy Bureau has granted requests by LUMA to protect CEII in connection with LUMA's System Operation Principles. *See* Resolution and Order of May 3, 2021, table 2 on page 4, Case No. NEPR-MI-2021-0001 (granting protection to CEII included in LUMA's Responses to Requests for Information).

50. CEII or critical infrastructure information is generally exempted from public disclosure because it involves assets and information that pose public security, economic, health, and safety risks. Federal Regulations on CEII, particularly, 18 C.F.R. § 388.113, state that:

> Critical energy infrastructure information means specific engineering, vulnerability, or detailed design information about proposed or existing critical infrastructure that:
> (i) Relates details about the production, generation, transportation, transmission, or distribution of energy;
> (ii) Could be useful to a person in planning an attack on critical infrastructure;
> (iii) Is exempt from mandatory disclosure under the Freedom of Information Act, 5 U.S.C. 552; and
> (iv) Does not simply give the general location of the critical infrastructure.

Id.

51. Additionally, "[c]ritical electric infrastructure means a system or asset of the bulk-power system, whether physical or virtual, the incapacity or destruction of which would negatively affect national security, economic security, public health or safety, or any combination of such matters. *Id.* Finally, "[c]ritical infrastructure means existing and proposed systems and assets, whether physical or virtual, the incapacity or destruction of which would negatively affect security, economic security, public health or safety, or any combination of those matters." *Id.*

52. The Critical Infrastructure Information Act of 2002, 6 U.S.C. §§ 671-674 (2020), part of the Homeland Security Act of 2002, protects critical infrastructure information ("CII").[6]

[6] Regarding protection of voluntary disclosures of critical infrastructure information, 6 U.S.C. § 673, provides in

CII is defined as "information not customarily in the public domain and related to the security of critical infrastructure or protected systems [...]" 6 U.S.C. § 671 (3).[7]

53. The information contains data that qualify as CEII because they contain information on the engineering and design of critical infrastructure, as existing and proposed, relating to the

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pertinent part, that CII:

(A) shall be exempt from disclosure under the Freedom of Information Act;
(B) shall not be subject to any agency rules or judicial doctrine regarding ex parte communications with a decision-making official;
(C) shall not, without the written consent of the person or entity submitting such information, be used directly by such agency, any other Federal, State, or local authority, or any third party, in any civil action arising under Federal or State law if such information is submitted in good faith;
(D) shall not, without the written consent of the person or entity submitting such information, be used or disclosed by any officer or employee of the United States for purposes other than the purposes of this part, except—
(i) in furtherance of an investigation or the prosecution of a criminal act; or
(ii) when disclosure of the information would be--
(I) to either House of Congress, or to the extent of matter within its jurisdiction, any committee or subcommittee thereof, any joint committee thereof or subcommittee of any such joint committee; or
(II) to the Comptroller General, or any authorized representative of the Comptroller General, in the course of the performance of the duties of the Government Accountability Office
(E) shall not, be provided to a State or local government or government agency; of information or records;
(i) be made available pursuant to any State or local law requiring disclosure of information or records;
(ii)otherwise be disclosed or distributed to any party by said State or local government or government agency without the written consent of the person or entity submitting such information; or
(iii)be used other than for the purpose of protecting critical Infrastructure or protected systems, or in furtherance of an investigation or the prosecution of a criminal act.
(F) does not constitute a waiver of any applicable privilege or protection provided under law, such as trade secret protection.

[7] CII includes the following types of information:

(A)actual, potential, or threatened interference with, attack on, compromise of, or incapacitation of critical infrastructure or protected systems by either physical or computer-based attack or other similar conduct (including the misuse of or unauthorized access to all types of communications and data transmission systems) that violates Federal, State, or local law, harms interstate commerce of the United States, or threatens public health or safety;
(B)the ability of any critical infrastructure or protected system to resist such interference, compromise, or incapacitation, including any planned or past assessment, projection, or estimate of the vulnerability of critical infrastructure or a protected system, including security testing, risk evaluation thereto, risk management planning, or risk audit; or
(C)any planned or past operational problem or solution regarding critical infrastructure or protected systems, including repair, recovery, construction, insurance, or continuity, to the extent it is related to such interference, compromise, or incapacitation.

transmission of electricity, which is provided in sufficient detail that it could potentially be helpful to a person planning an attack on this or other energy infrastructure facilities interconnected with or served by this facility and equipment. The information identified as confidential in the information is not common knowledge and is not made publicly available. Therefore, it is respectfully submitted that, on balance, the public interest in protecting CEII weighs in favor of protecting the Puerto Rico Electric Transmission System map with CEII in *Exhibit 1* from disclosure, given the nature and scope of the details included in those portions.

54. Based on the above, LUMA respectfully submits that the Puerto Rico Electric Transmission System map with CEII in *Exhibit 1* should be designated as CEII. This designation is a reasonable and necessary measure to protect the specific location and other engineering, and design information of the energy facilities listed or discussed in the Puerto Rico Electric Transmission System map in *Exhibit 1*. Given the importance of ensuring the safe and efficient operation of the generation assets and the T&D System, LUMA respectfully submits that these materials constitute CEII that should be maintained confidentially to safeguard their integrity and protect them from external threats.

55. It is respectfully submitted that the right of public access to information is promoted and protected by the public version. The protection of the specific information will not hinder nor preclude the public in a material way from gaining access to relevant and necessary information. As such, the interest in the public viewing the information that LUMA hereby requests be kept confidential is outweighed by the harm that LUMA would be exposed to should the information be made available to the public.

VI. Identification of Confidential Information.

56. In compliance with the Energy Bureau's Policy on Confidential Information,

CEPR-MI-2016-0009, below is a table summarizing the hallmarks of this request for confidential treatment.

Document	Name	Pages in which Confidential Information is Found, if applicable	Summary of Legal Basis for Confidentiality Protection, if applicable	Date Filed
Exhibit 1	Part of Section 1.1.1 Fixed Capacity Additions	Page 22	Trade Secret Information under Section D(1) of the Energy Bureau's Policy on Confidential Information, CEPR-MI-2016-0009	November 25, 2024
	Table 4: Addition Summary (MW) for Preliminary Portfolio A Resulting from Scenario 1	Page 32	Trade Secret Information under Section D(1) of the Energy Bureau's Policy on Confidential Information, CEPR-MI-2016-0009	November 25, 2024
	Table 13: Preliminary Portfolio B Resulting from Scenario 2 Resource Addition Summary	Page 50	Trade Secret Information under Section D(1) of the Energy Bureau's Policy on Confidential Information,	November 25, 2024

Document	**Name**	**Pages in which Confidential Information is Found, if applicable**	**Summary of Legal Basis for Confidentiality Protection, if applicable**	**Date Filed**
			CEPR-MI-2016-0009	
	Table 22: Preliminary Portfolio C Resulting from Scenario 3 Resource Addition Summary Planning Horizon	Page 69	Trade Secret Information under Section D(1) of the Energy Bureau's Policy on Confidential Information, CEPR-MI-2016-0009	November 25, 2024
	Section of Table 31: Preliminary Portfolio D Resulting from Scenario 4 Resource Addition Summary	Pages 85-86	Trade Secret Information under Section D(1) of the Energy Bureau's Policy on Confidential Information, CEPR-MI-2016-0009	November 25, 2024
	Appendix A: Puerto Rico Electric Transmission System (Map)	Page 125	Critical Energy Infrastructure Information, 18 C.F.R. § 388.113; 6	November 25, 2024

Document	Name	Pages in which Confidential Information is Found, if applicable	Summary of Legal Basis for Confidentiality Protection, if applicable	Date Filed
			U.S.C. §§ 671-674.	
Exhibit 2	a. Results of Preliminary Portfolios A to D resulting from Scenarios 1 to 4 b. Assumptions, Parameters, and Costs c. Forecasts d. Transmission Transfer Capability	Entire file	Trade Secret Information under Section D(1) of the Energy Bureau's Policy on Confidential Information, CEPR-MI-2016-0009	November 25, 2024

WHEREFORE, LUMA respectfully requests the Energy Bureau to **take notice** of the foregoing, **accept** the First Interim 2025 IRP Filing, and **approve the request for confidential treatment** of certain information submitted with *Exhibits 1 and 2* to this Motion.

RESPECTFULLY SUBMITTED.

WE HEREBY CERTIFY that this Motion was filed using the electronic filing system of this Energy Bureau and that electronic copies of this Motion will be notified to the Puerto Rico Electric Power Authority: lionel.santa@prepa.pr.gov and through its attorneys of record González & Martínez, Mirelis Valle-Cancel, mvalle@gmlex.net; and Alexis G. Rivera Medina, arivera@gmlex.net; and Genera PR, LLC: brannen@genera-services.com; kbolanos@genera-pr.com; regulatory@genera-pr.com.

In San Juan, Puerto Rico, on November 25, 2024.

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Exhibit 1

First Interim 2025 IRP Filing

NEPR-AP-2023-0004

November 22, 2024

Executive Summary

LUMA is committed to transforming Puerto Rico's energy system into one that is more reliable, resilient, cleaner, and sustainable for all its 1.5 million customers. As part of our responsibilities as planner for the electrical system, LUMA is developing the current Integrated Resource Plan (2025 IRP) report and this filing serves as the First Interim filing in accordance with an order issued in this case by the Puerto Rico Energy Bureau (PREB or the Energy Bureau).

Since assuming operations over Puerto Rico's electric Transmission and Distribution System (T&D System), we have focused on critical priorities, consistent with the System Remediation Plan (SRP) and approved budgets, to make real and sustainable progress toward achieving a better electric service for our customers. In just three years, LUMA has improved grid resilience by installing more than 19,600 new storm-resilient poles[1], clearing vegetation from over 5,300 miles of powerlines[2] and installing more than 9,000 grid automation devices to reduce outage impacts[3]. It has also replaced more than 148,100 streetlights[4] to improve safety and connected over 118,000 customers to rooftop solar[5].

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[1] See Quarterly LUMA Reports: https://energia.pr.gov/en/dockets/?docket=nepr-mi-2021-0004 FY 2025: https://energia.pr.gov/wp-content/uploads/sites/7/2024/11/20241114-MI20210004-Motion-to-Submit-Quarterly-Report-for-the-First-Quarter-of-Fiscal-Year-2025.pdf FY 2024: https://energia.pr.gov/wp-content/uploads/sites/7/2024/08/20240813-MI20210004-Motion-to-Submit-of-Quarterly-Report-for-the-Fourth-Quarter-of-Fiscal-Year-2024.pdf FY 2023: https://energia.pr.gov/wp-content/uploads/sites/7/2023/08/20230814-Motion-to-Submit-Quarterly-Report-for-the-Fourth-Quarter-of-Fiscal-Year-2023-MI-2021-0004.pdf FY 2022: https://energia.pr.gov/wp-content/uploads/sites/7/2022/09/Motion-Submitting-Financial-Results-for-the-Fourth-Quarter-of-Fiscal-Year-2022-NEPR-MI-2021-0004.pdf

[2] See Quarterly Progress Reports for Vegetation Management Program: https://energia.pr.gov/en/dockets/?docket=nepr-mi-2019-0005 FY 2025: https://energia.pr.gov/wp-content/uploads/sites/7/2024/11/20241114-MI20190005-Exhibit-1_Q1-FY2025-Vegetation-Management-Progress-Report.xlsx FY 2024: https://energia.pr.gov/wp-content/uploads/sites/7/2024/08/20240821-MI20190005-Exhibit-1_-Motion-Submitting-Vegetation-Management-Progress-Report-for-the-4th-Quarter-of-FY-2024.xlsx FY 2023: https://energia.pr.gov/wp-content/uploads/sites/7/2023/08/20230814-Motion-Submitting-Vegetation-Clearing-Report-for-the-Fourth-Quarter-of-the-Fiscal-Year-2023.pdf

[3] See LUMA's key progress milestones press release of November 21, 2024 related to the Quarterly Legacy Performance Metrics Report filed with the Energy Bureau on November 20, 2024 at: https://lumapr.com/news/importante-avance-en-las-metricas-de-desempeno-de-luma-del-primer-trimestre/

[4] See November 13th, 2024, Motion at https://energia.pr.gov/wp-content/uploads/sites/7/2024/11/20241113-MI20200001-Motion-Subm-Quarterly-Report-on-Streetlight-July-to-Sept-2024.pdf

[5] See November 14th, 2024 Motion at https://energia.pr.gov/wp-content/uploads/sites/7/2024/11/20241114-MI20190016-Motion-Submitting-Interconnections-Progress-Report-for-July-through-September-2024-and-Supporting-Materials-1.pdf

See also Juan Saca's testimony at the hearing "*Examining Puerto Rico's Electrical Grid and the need for Reliable Energy*" held on Sept. 26, 2024 before the Subcommittee on Indian and Insular Affairs: https://naturalresources.house.gov/uploadedfiles/testimony_saca926iia.pdf and LUMA's letter to Hon. Harriet M. Hageman dated Oct. 17, 2024, in response to Questions For the Record (QFR) in relation to Juan Saca's testimony: https://www.congress.gov/118/meeting/house/117665/documents/HHRG-118-II24-20240926-SD012.pdf

First Interim 2025 IRP Filing

Three Year Progress	
Improvement Projects to rebuild and transform the electric system	**476** projects initiated; **153** projects where construction is completed or in progress
Pole Replacements to strengthen the system against storms	**19,600**+ utility poles and structures replaced
Vegetation Clearing to minimize downed poles and reduce power outages	**5,300**+ miles of powerlines cleared of vegetation
Grid Automation Devices to reduce the size and duration of outages	**9,000**+ devices installed; **195 million** customer interruption minutes prevented *(since July 2023*)
Substation Modernization to mitigate large-scale outages	**38 substation** reconstruction or repair projects started or completed
Community Streetlights to improve safety and energy efficiency	**148,100** streetlights installed
Renewable Energy to advance the clean energy transformation	**118,000**+ customers LUMA helped connect to rooftop solar representing more than **860** MW of clean energy
Energy Efficiency to help customers save energy and money	**51,000+** free energy efficiency kits distributed to customers resulting in **19,366** megawatt hours (MWh) of energy savings
Customer Support to help our customers in need	**$145M**+ in supported critical financial assistance
Workforce Training to safely maintain the system and respond to emergencies	**200,000**+ hours of health, safety and on-the job training completed

Puerto Rico's Integrated Resource Plan

The progress to improve the reliability and resiliency of the grid is related to one of LUMA's core planning responsibilities: the development and proposal of an Integrated Resource Plan (IRP). More specifically, the IRP is the long-term plan on how Puerto Rico will reliably and sustainably meet the energy needs of the island over the coming years and decades.

Since the beginning of 2022, LUMA has been working cooperatively and diligently to develop a realistic and pragmatic 2025 IRP that reflects industry standards, is built on accurate and comprehensive data and analyses, and reflects the energy needs and priorities of our customers as Puerto Rico moves toward a more reliable, more resilient, and cleaner energy system. Notably, in developing the 2025 IRP, we prioritized stakeholder engagement through the *Soluciones Energéticas para Transformar a Puerto Rico* (SETPR) initiative, a collaborative process designed to engage with a broad variety of customers and stakeholders and gain their input regarding Puerto Rico's energy future. Gathering and understanding diverse views and opinions on Puerto Rico's energy future is an important part of the IRP process and will help ensure that the final IRP report incorporates broad stakeholder input.

LUMA's 2025 IRP Role: Data-Driven Planner

Throughout the development of the 2025 IRP, LUMA has been committed to maintaining transparency and communication with the Puerto Rico Energy Bureau (Energy Bureau) and stakeholders. It is important to keep in mind that LUMA's role is to be the data-driven planner and author of the IRP, using technically robust analyses and modeling to recommend the optimal plan for Puerto Rico. LUMA does not own or operate generation resources, and we do not hold primary responsibility for the policy decisions that determine future energy resource projects. In our role as operator of Puerto Rico's T&D system, LUMA works to enable the safe and reliable interconnection of any approved energy resource additions and carries out multiple planning functions that examine the current and future shape of grid and the resources interconnected to the grid. Furthermore, LUMA's role as planner and operator for the grid and the interconnected resources (but not as investor or operator of generation) gives LUMA a unique perspective aligned with the outcomes that most benefit customers.

First Interim 2025 IRP Filing

As part of the 2025 IRP process, LUMA continues to work with key stakeholders, including the Energy Bureau, the Financial Oversight and Management Board (FOMB) and the Puerto Rico Authority for Public Private Partnerships (P3 Authority) to ensure that plans are comprehensive, practical and meet the needs of Puerto Rico. LUMA will also continue to collaborate with customers through the SETPR stakeholder engagement process to receive and incorporate meaningful feedback into the 2025 IRP analysis. LUMA looks forward to continuing to work with the Energy Bureau and stakeholders on development of the 2025 IRP so that the final report results in a plan for the continued transformation and recovery of the island's electric system for the benefit of LUMA's customers and the Commonwealth.

2025 IRP Timeline

IRP planning processes involve extensive data collection, iterative stakeholder outreach, and complex data analysis and scenario planning. The growth of inverter-based resources (including solar and wind generation) and the expanding role of resources controlled by customers (including demand management and distributed generation) require more probabilistic approaches and risk metrics to assess variable resources and flexibility. In Puerto Rico, the planning challenge is compounded by the immediate vulnerabilities of an energy system that is severely short of necessary resources to meet current demand and infrastructure that is out of configuration, with many elements beyond their expected life. The current situation makes it infeasible to operate under Prudent Utility Practice or according to electric utility industry standards a significant portion of the time. Although we've made progress in improving overall reliability, and making key repairs, like the Bayamon transformer and the vegetation management program, the system remains in a vulnerable state and requires significant repairs that LUMA is constantly working on to improve Puerto Rico energy system.

Most North American electric utilities with similar planning horizons to LUMA spend a minimum of 18 to 24 months to complete an IRP. These utilities typically have a more established planning function with greater access to reliable data in their jurisdictions, and less complex systems that are interconnected to neighboring utilities that can share critical electrical reserves. When LUMA began work on the 2025 IRP, it was anticipated that approximately twenty (20) months would be needed to complete the IRP report. Unfortunately, the procurement, selection and contracting process for the Technical Consultant took longer than expected, leaving only five (5) months until the original deadline (March 1, 2024), with the Technical Consultant starting work in September 2023. In October 2023, LUMA requested an extension of approximately four (4) additional months to have enough time to complete the modeling required to file the IRP by June 28, 2024. LUMA and the IRP Technical Consultant intended to finalize the 2025 IRP in the shortest possible time. As LUMA stated in the June 7th and June 28th, 2024, Motions, extraordinary contingencies and unexpected software issues outside of the IRP Technical Consultant and LUMA's control prevented completion within that timeframe.[6]

Despite the unique complexities and challenges facing Puerto Rico's energy system, LUMA is absolutely committed to getting the 2025 IRP right for our customers. Consequently, LUMA requested the Energy Bureau an additional ten (10) months extension to file the final 2025 IRP report. The 2025 IRP Schedule, approved by the Energy Bureau on October 29, 2024, requires two interim milestone filings - in November 2024 and February 2025 - before submittal of the final 2025 IRP report on May 16, 2025. The extended timeframe allows LUMA and the IRP Technical Consultant to develop scenarios, perform a complete transmission analysis,

[6] See June 7th, 2024 Motion at https://energia.pr.gov/wp-content/uploads/sites/7/2024/06/20240607-AP20230004-Continuance-of-the-Deadline.pdf and June 28th, 2024 Motion at https://energia.pr.gov/wp-content/uploads/sites/7/2024/07/20240628-AP20230004-Motion-in-Compliance-with-Resolution-and-Order-of-June-18-2024-and-Submitting-Second-Revised-IRP-Filing-Schedule.pdf

gather additional information, and conduct key SETPR meetings to present modeling results and preferred plans to stakeholders before the filing of the final report on May 16, 2025.

This First Interim 2025 IRP filing demonstrates that LUMA is making progress. This filing (and future filings of the 2025 IRP) reflects high utility industry standards, meets current regulatory requirements, and is built on the Energy Bureau and customer objective to reach Puerto Rico's clean energy goals at the most reasonable cost.

Puerto Rico's Energy System: A Legacy of Challenges

As has been well documented, Puerto Rico has suffered from decades of system-wide neglect under the previous operator. The effects of this underinvestment and mismanagement have been compounded by historic damage caused by natural disasters, specifically hurricanes and earthquakes. Since 1989, for example, the island's power grid has been severely impacted by six hurricanes, or more than one hurricane every six years. In September 2017, Hurricane Irma significantly damaged the power grid and led to more than one million residents losing power. Just weeks later, Hurricane Maria crippled the island's power grid and required years to restore power to all customers. This was the worst electrical blackout for any US state or territory. In 2022, Hurricane Fiona damaged 50 percent of the island's transmission lines and distribution feeders. While that disaster caused an island-wide blackout, improvements in emergency planning and response allowed LUMA to restore 90% of customers within 12 days—a timeframe comparable to similar restorations for other North American utilities.

Efforts to address the issues facing the electric system are significantly challenged by the unique nature of the grid in Puerto Rico, and the historic level of neglect by the previous operator for decades prior to LUMA, across all aspects of the electric system. In fact, before LUMA began operations, due to the previous operator's underinvestment and mismanagement, Puerto Rico's electric system was well below the minimally acceptable reliability standards for utilities, and many times worse than any peer utility, as defined by a benchmarking exercise conducted in accordance with IEEE 1366-2022. Unlike most other parts of the continental United States, Puerto Rico as an island is not connected to other electric grids. This means that Puerto Rico lacks access to electrical reserves from other regions that support efforts to improve system resiliency, posing an additional challenge when Puerto Rico faces disruptive events.

First Interim 2025 IRP Filing

In accordance with the Energy Bureau's Resolution and Order dated October 29, 2024 (October 29th R&O)[7], this filing serves as the First Interim filing of the 2025 IRP (First Interim 2025 IRP Filing). Per the October 29th R&O, LUMA will be making its Second Interim 2025 IRP Filing on February 28, 2025, and will submit the Final 2025 IRP Report on May 16, 2025. This

The information and results contained in this First Interim 2025 IRP Filing are preliminary and will change as further refinements are made and work progresses.

The First Interim 2025 IRP Filing represents a key milestone in the ongoing IRP and, consistent with the October 29th R&O, includes the following five (5) sections:

1. Overview of Preliminary Portfolios A to D resulting from Scenarios 1 through 4;

[7] See October 29, 2024, R&O at https://energia.pr.gov/wp-content/uploads/sites/7/2024/10/20241029-AP20230004-Resolution-and-Order.pdf

2. Preliminary Assumptions and Results;

3. Description of Existing Transmission, Distribution and Advanced Control Facilities and Equipment (As described in Section 2.03(J)(1)(a)-(c) of Regulation 9021- consistent with the partial waiver granted by the Energy Bureau in its Resolution and Order of April 15, 2024[8]);

4. Description of Existing Transmission, Distribution and Advanced Control Facilities and Equipment; and .

5. Transmission Facilities Support of Preferred Resource Plan

For this First Interim 2025 IRP Filing, LUMA is submitting the preliminary results of Scenarios 1 through 4, which consider different input assumptions for future demand, resource costs and other assumptions. A high-level summary of Scenarios 1 to 4 is shown in Table 1 below.

Table 1: Assumptions for 2025 IRP Scenarios and Characteristics 1 through 4

No.	Scenario Name	Load Growth	DER Growth / PV / BESS	PV Cost	Agriculture Land Use	Storage Cost	Resource Capital Cost	Fossil Fuel Cost	Energy Efficiency	DBESS Control (%)			
										2025	2030	2035	2040
1	Base Assumptions	Base	Base/ Base	Base	Less Land	Base	Base	Base	PR100-Base	5	10	10	10
2	System Stress Scenario	High	Low/ Low	High	Less Land	High	High	Base	PR100-Base	0	0	0	0
3	More Agriculture Land Use	Base	Base/ Base	Base	More Land	Base	Base	Base	PR100-Base	5	10	10	10
4	Optimistic Load Growth and costs	High	High/ High	Low	More Land	Low	Low	Low	PR100-Base	5	15	20	20

LUMA used the future conditions defined in Scenarios 1 as input assumption in its modeling software tool to define a least cost combination of energy resource additions and retirements, referred to as Preliminary Portfolio A. A Portfolio is defined as a resource plan, including resource additions and retirements, which result from the conditions of each Scenario. The process is then repeated for the remaining Scenarios 2 through 4 that in turn result in the Preliminary Portfolios B through D respectively. Each of the Preliminary Portfolios include the addition (or retirement) of a common set of assumed energy resources in the initial modeled years. These are new added or retired generation facilities and added utility-scale BESS that are currently approved by the Energy Bureau or P3 Authority. LUMA refers to these assumptions as "Fixed Decision" since they are not subject to change by LUMA or by the resource modeling software used by LUMA and the IRP Technical Consultant. These fixed decisions are listed in Section 1.1.1. In addition to these fixed decisions, each of the portfolios include continuing growth and a substantial contribution to the energy resources from customer owned distributed solar PV (DPV) The DPV contributions for Scenarios 1 and 3 approximate the values used in the mid case scenario of the PR100 Study (i.e., PR100 Scenarios 2LMNET).

A summary of the principal differences in the Preliminary Portfolio results is provided below. A more detailed summary of the Preliminary Portfolio results is provided in Section 1.

[8] See April 15, 2024, R&O at https://energia.pr.gov/wp-content/uploads/sites/7/2024/04/20240415-AP20230004-Resolution-and-Order-Partial-Waiver.pdf

Preliminary Portfolio A provides the least cost set of resources resulting from the conditions described in Scenario 1, which represents LUMA's view of the most likely assumptions for all inputs. In this Preliminary Portfolio, LNG-fueled units are added to meet the capacity requirements of retiring legacy generation. Several of the new LNG units, and some legacy units, are eventually converted to biodiesel to meet the increasing RPS requirements. It is notable that Preliminary Portfolio A does not add any additional utility scale solar PV resources beyond the fixed decision projects included in the Tranche 1 and 2 solar PV additions.

Preliminary Portfolio B provides the least cost set of resources resulting from the conditions described in Scenario 2, which represents the stress case scenario with an increased load forecast and reduced contributions from distributed solar PV. In this portfolio, as in Preliminary Portfolio 1, new LNG units are built and then converted to biodiesel along with some of the existing units. This portfolio also includes a substantial increase in the number of batteries built as compared to those built for Preliminary Portfolio A. In addition, no additional utility scale solar PV resources are added beyond the fixed decision projects included in the Tranche 1 and 2 solar PV additions.

Preliminary Portfolio C provides the least cost set of resources resulting from the conditions described in Scenario 3, which is identical to Scenario 1 except that Scenario 3 has additional land to build more utility-scale solar and wind resources at a lower average levelized cost of energy than the land available for Scenario 1. However, even with this additional, more productive land, no new solar or wind is built in Preliminary Portfolio C, and its energy resources are identical to those defined for Preliminary Portfolio A.

Preliminary Portfolio D provides the least cost set of resources resulting from the conditions described in Scenario 4, which has a higher load forecast but also has lower resource costs and more land available for renewable development. This combination of assumptions results in significantly more utility scale solar PV being built beyond the projects identified in Tranches 1 and 2. The portfolio also includes signification additions of batteries and new LNG units that are again partially converted to biodiesel fueled units to meet the growing RPS requirements. Again, further detail on each of these preliminary portfolios is provided in the following Sections.

Resumen Ejecutivo

LUMA está comprometida con la transformación del sistema energético de Puerto Rico en uno que sea más confiable, resiliente, limpio y sostenible para todos sus 1.5 millones de clientes. Como parte de sus responsabilidades como operador del sistema eléctrico, LUMA está desarrollando el informe actual del Plan Integrado de Recursos (PIR 2025). Esta radicación sirve como la Primera Presentación Interina de acuerdo con la orden emitida por el Negociado de Energía de Puerto Rico (Negociado de Energía).

Desde que LUMA asumió la responsabilidad como Operador del Sistema de Transmisión y Distribución Eléctrico de Puerto Rico (Sistema T&D), nos hemos enfocado en prioridades críticas, consistentes con el Plan de Remediación del Sistema (SRP) y los presupuestos aprobados, para lograr un progreso real y sostenible en el servicio eléctrico para nuestros clientes. En sólo tres años, LUMA ha mejorado la resiliencia de la red instalando más de 19,600 nuevos postes resistentes a tormentas, despejado la vegetación en más de 5,300 millas de líneas eléctricas e instalando más de 9,000 dispositivos de automatización de la red para reducir el impacto de las interrupciones eléctricas. Además, LUMA ha modernizado más de 148,100 luminarias para mejorar la seguridad y ha conectado a la red a más de 118,000 clientes que han instalado energía solar distribuida en sus techos.

Progreso de tres años	
Proyectos de Mejoras para reconstruir y transformar el sistema eléctrico	Iniciados **476** proyectos; **153** proyectos cuya construcción está terminada o en curso
Reemplazo de postes para fortalecer el sistema contra las tormentas	Reemplazamos **sobre 19,600** postes y estructuras
Despeje de vegetación para minimizar los postes caídos y reducir las interrupciones de servicio	Despejamos vegetación de **sobre 5,300** de millas de líneas eléctricas
Instalación de aparatos automatizados en la red para reducir la magnitud y la duración de las interrupciones	Instalamos **sobre 9,000** aparatos; Ha evitado sobre **195 millones** de minutos de interrupciones en el servicio de los clientes (desde julio de 2023)
Modernización de subestaciones para mitigar las interrupciones a gran escala	Comenzamos o completamos proyectos de reparación o reconstrucción en **38 subestaciones**
Alumbrado público para aumentar la seguridad y la eficiencia energética	Instalamos **148,100** luminarias
Energía renovable para impulsar la transformación de la energía limpia	Conectamos a **sobre 118,000** clientes con placas solares, lo que representa más de **860** MW de energía limpia
Eficiencia energética para ayudar a los clientes a ahorrar energía y dinero	Distribuimos sobre **51,000** kits de eficiencia energética libres de costo a los clientes, lo que representa **19,366** megavatios hora (MWh) de ahorro de energía
Apoyo al cliente para ayudar a quienes lo necesitan	Facilitamos **sobre $145 millones** en asistencia económica
Adiestramientos de nuestra fuerza laboral para darle mantenimiento al sistema eléctrico de manera segura y responder a las emergencias	Completamos **más de 200,000** horas de adiestramiento sobre salud, seguridad y capacitación personal

Plan Integrado de Recursos de Puerto Rico

El progreso para mejorar la confiabilidad y resiliencia de la red está relacionado con una de las principales responsabilidades de planificación de LUMA: el desarrollo y propuesta de un Plan Integrado de Recursos (PIR). Específicamente, el PIR es crucial para el desarrollo de un plan de recursos a largo plazo sobre como Puerto Rico podrá alcanzar de forma confiable y sostenible las necesidades energéticas de la Isla en los próximos años y décadas.

Desde comienzos del año 2022, LUMA ha trabajado de forma cooperativa y diligente para desarrollar un PIR realista y pragmático, que refleje los estándares de la industria, esté basado en datos y análisis precisos y exhaustivos, y refleje las necesidades y prioridades energéticas de nuestros clientes a medida que Puerto Rico avanza hacia un sistema energético más confiable, resiliente y limpio. En particular, al desarrollar el PIR 2025, LUMA ha priorizado la participación de diferentes partes interesadas a través de la iniciativa *Soluciones Energéticas para Transformar a Puerto Rico* (SETPR), un proceso de colaboración diseñado para participar con una amplia variedad de clientes y partes interesadas para obtener diferentes aportes con respecto al futuro energético de Puerto Rico. Recopilar y entender los diversos puntos de vista y opiniones sobre el futuro energético de Puerto Rico es una parte importante del proceso del PIR, lo cual ayudará a garantizar que el informe final del PIR incorpore las recomendaciones de las partes interesadas.

El papel de LUMA en el PIR de 2025: Planificación basada en datos

A lo largo del desarrollo del PIR de 2025, LUMA se ha comprometido a mantener transparencia en las comunicaciones con el Negociado de Energía y las partes interesadas. Es importante tener en cuenta que el papel de LUMA es ser el planificador y autor del PIR, basándose en datos, utilizando análisis y modelos técnicamente robustos para obtener un plan óptimo para Puerto Rico, actuando de asesor del Negociado de Energía y las partes interesadas. LUMA no posee ni opera recursos de generación, ni es responsable de decisiones acerca de las políticas que determinen el futuro energético de proyectos de generación de energía. En nuestro papel como operador del sistema de TD de Puerto Rico, LUMA trabaja para permitir la interconexión segura y confiable de cualquier adición de recursos energéticos aprobada, llevando a cabo múltiples funciones de planificación que examinan la forma actual y futura de la red y los recursos interconectados a ella. Además, el papel de LUMA como coordinador y planificador de la red y los recursos interconectados (pero no como inversor u operador de generación) le da una perspectiva única alineada con los resultados que más benefician a los clientes.

Como parte del desarrollo del PIR de 2025, LUMA continúa trabajando con las partes interesadas clave, incluyendo el Negociado de Energía, la Junta de Supervisión y Administración Financiera (FOMB) y la Autoridad para las Alianzas Publico Privadas de Puerto Rico (APPP) para garantizar que los planes sean integrales, prácticos y satisfagan las necesidades de Puerto Rico. LUMA también continuará colaborando con los clientes a través del proceso de participación de las partes interesadas de SETPR para recibir e incorporar comentarios significativos en el análisis del PIR de 2025. LUMA espera continuar trabajando con el Negociado de Energía y las partes interesadas en el desarrollo del PIR de 2025 para que el informe final resulte en un plan para transformación y recuperación del sistema eléctrico de la isla para el beneficio de los clientes de LUMA y el Estado Libre Asociado de Puerto Rico.

Cronología del PIR de 2025

Los procesos de planificación del PIR implican una amplia recopilación de datos, un contacto iterativo con las partes interesadas y un complejo análisis de datos y planificación de escenarios. En particular, el crecimiento de los recursos basados en inversores (incluyendo la generación solar y eólica) y el creciente papel de los recursos controlados por los clientes (incluida la gestión de la demanda de la generación distribuida) requieren enfoques más probabilísticos y métricas de riesgo para evaluar los recursos variables y la flexibilidad. En Puerto Rico, el reto de la planificación se ve agravado por las vulnerabilidades inmediatas de un sistema energético que carece gravemente de los recursos necesarios para satisfacer la demanda actual y una infraestructura que está fuera de configuración, con muchos elementos más allá de su vida útil prevista. La situación actual hace inviable operar bajo Prácticas Prudentes de Utilidad o de acuerdo con los estándares de la industria de servicios eléctricos una porción significativa del tiempo. A pesar de que se ha avanzado en la mejora de la fiabilidad y se han realizado reparaciones clave, tales como el transformador de Bayamón y el programa de gestión de la vegetación, el sistema sigue estando en un estado vulnerable y requiere reparaciones adicionales en las que LUMA trabaja constantemente para mejorar la red eléctrica y el servicio a nuestros clientes.

La mayoría de las empresas norteamericanas con horizontes de planificación similares a los de LUMA emplean un mínimo de 18 a 24 meses para completar un PIR. Estas empresas suelen tener una función de planificación más consolidada, con mayor acceso a datos fiables en sus jurisdicciones, y sistemas menos complejos que están interconectados con empresas vecinas que pueden compartir reservas eléctricas críticas. Cuando LUMA comenzó a trabajar en el PIR de 2025, se estimó que se necesitarían aproximadamente veinte (20) meses para completar el informe del PIR. Lamentablemente, el proceso de adquisición, selección y contratación del Consultor Técnico se prolongó más de lo previsto, quedando sólo cinco (5) meses hasta la fecha límite original (1 de marzo de 2024), desde que el Consultor Técnico comenzó a trabajar en septiembre de 2023. En octubre de 2023, LUMA solicitó una prórroga de aproximadamente cuatro (4) meses adicionales para tener tiempo suficiente para completar la simulación requerida para presentar el PIR antes del 28 de junio de 2024. LUMA y el Consultor Técnico del IRP aspiraban finalizar el PIR de 2025 en el menor tiempo posible. Como LUMA declaró en las Mociones radicadas el 7 de junio y del 28 de junio de 2024, contingencias extraordinarias y problemas inesperados de *software* fuera del control del Consultor Técnico del PIR y de LUMA impidieron la finalización dentro de ese plazo

A pesar de las complejidades y desafíos únicos que el sistema energético de Puerto Rico enfrenta, LUMA está absolutamente comprometida a lograr que el PIR de 2025 sea correcto para nuestros clientes. En consecuencia, LUMA solicitó al Negociado de Energía una prórroga adicional de diez (10) meses para presentar el Informe Final del PIR de 2025. El calendario del PIR de 2025, aprobado por el Negociado de Energía el 29 de octubre de 2024, requiere la presentación de dos etapas interinas, en noviembre de 2024 y en febrero de 2025, antes de la presentación del informe final el 16 de mayo de 2025. El plazo extendido permite que LUMA y el Consultor Técnico del PIR desarrollen escenarios, realicen un análisis de transmisión completo, reúnan información adicional y lleven a cabo reuniones SETPR clave para presentar los resultados de la simulación y los planes preferidos a las partes interesadas antes de la presentación del informe final el 16 de mayo de 2025.

Esta primera presentación interina demuestra que LUMA está progresando y garantiza que el PIR de 2025 refleje los estándares más altos de la industria, cumpla con los requisitos reglamentarios actuales y refleje las prioridades energéticas del Negociado de Energía y los clientes de LUMA para alcanzar los objetivos de energía limpia de Puerto Rico al costo más razonable.

El sistema energético de Puerto Rico: Un legado de retos

Como ha quedado bien documentado, Puerto Rico ha sufrido décadas de negligencia en todo el sistema bajo el anterior operador. Los efectos de esta falta de inversión y mala gestión se han visto agravados por los daños históricos causados por desastres naturales, en concreto huracanes y terremotos. Desde 1989, por ejemplo, la red eléctrica de la isla se ha visto gravemente afectada por seis huracanes, es decir, más de un huracán cada seis años. En septiembre de 2017, el huracán Irma dañó significativamente la red eléctrica y provocó que más de un millón de residentes se quedaran sin electricidad. Apenas unas semanas después, el huracán María paralizó la red eléctrica de la isla y se necesitó más de un año para restablecer el suministro a todos los clientes. Fue el peor apagón eléctrico de un estado o territorio estadounidense. En 2022, el huracán Fiona dañó el 50% de las líneas de transmisión y distribución de la isla. Aunque ese desastre causó un apagón en toda la isla, las mejoras en la planificación y respuesta ante emergencias permitieron a LUMA restablecer el suministro al 90% de los clientes en 12 días, un plazo comparable al de restauraciones similares de otras empresas de servicios públicos norteamericanas.

Los esfuerzos para abordar los problemas a los que se enfrenta el sistema eléctrico se ven considerablemente dificultados por la naturaleza única de la red en Puerto Rico y el nivel histórico de negligencia por parte del operador anterior durante décadas antes de LUMA, en todos los aspectos del sistema eléctrico. De hecho, antes de que LUMA comenzara a operar, debido a la falta de inversión y la mala gestión del operador anterior, el sistema eléctrico de Puerto Rico estaba muy por debajo de los estándares de fiabilidad mínimamente aceptables para las empresas de servicios públicos, y muchas veces peor que cualquier otra empresa de servicios públicos, según lo definido por un ejercicio de evaluación comparativa realizado de acuerdo con IEEE 1366-2022. A diferencia de la mayor parte de los Estados Unidos continentales, Puerto Rico como isla, no está conectado a otras redes eléctricas. Esto significa que Puerto Rico carece de acceso a las reservas eléctricas de otras regiones que apoyan los esfuerzos para mejorar la capacidad de recuperación del sistema, lo que plantea un reto adicional cuando Puerto Rico se enfrenta a eventos que perturben la red.

Primera Presentación Interina del PIR 2025

De acuerdo con la Resolución y Orden emitido por el Negociado de Energía el 29 de octubre de 2024 (R&O del 29 de octubre), esta presentación sirve como la Primera Presentación Interina del PIR 2025 (Primera Presentación Interina del PIR 2025). Según el R&O del 29 de octubre, LUMA someterá su Segunda Presentación Interina del PIR 2025 el 28 de febrero de 2025, y presentará su Reporte Final del PIR 2025 el 16 de mayo de 2025.

La información incluida en este Primera Presentación Interina del PIR 2025 es preliminar y cambiará según se realicen ajustes adicionales y el trabajo progrese.

Este Primera Presentación Interina del PIR 2025 representa un importante logro para el PIR en curso y, coincide con el R&O del 29 de octubre, este incluye las siguientes cinco (5) secciones:

1. Resumen general de los Portafolios A al D como resultado de los Escenarios 1 al 4; que describen los portafolios de recursos de menor costo para los escenarios 1 al 4;
2. Presunciones y Resultados preliminares;
3. Descripción de las instalaciones y equipos de transmisión existentes, distribución y control avanzado (Según descrito en la Sección 2.03(J)(1)(a)-(c) del Reglamento 9021, de conformidad con la exención parcial concedida por el Negociado de Energía en su Resolución y Orden del 15 de abril de 204);
4. Descripción de las facilidades y equipos de transmisión, distribución y control avanzado existentes; y
5. Apoyo de las facilidades de transmisión en conformidad con el Plan de Recursos Preferido.

Tabla 1: Presunciones de los Escenarios 1 al 4 del PIR 2025 y sus Características

Num.	Nombre del Escenario	Crecimiento de la Carga	Crecimiento DER / PV / BESS	Costos de PV	Uso Terreno Agrícola	Costos Almacenamiento	Costos Recursos de Capital	Costos Combustible Fósil	Eficiencia Energética	Control DBESS (%)			
										2025	2030	2035	2040
1	Presunción Base	Base	Base/ Base	Base	Menos Terreno Ag	Base	Base	Base	PR100-Base	5	10	10	10
2	Escenario de estrés en el sistema	Alto	Bajo/ Bajo	Alto	Menos Terreno Ag	Alto	Alto	Base	PR100-Base	0	0	0	0
3	Mas uso de terreno agrícola	Base	Base/ Base	Base	Mas Terreno Ag	Base	Base	Base	PR100-Base	5	10	10	10

4	Crecimiento de la carga y costes optimista	Alto	Alto/ Alto	Bajo	Mas Terreno Ag	Bajo	Bajo	Bajo	PR100-Base	5	15	20	20

LUMA utilizó las condiciones futuras definidas en cada uno de los Escenarios 1 al 4 para integrar presunciones iniciales en el software de simulación para definir la combinación de menor costo de recursos energéticos a ser añadidos y retirados, denominada Portafolio Preliminar A. Un Portafolio se define como un plan de recursos, incluyendo recursos añadidos o retirados, que resultan de las condiciones de cada Escenario. Este proceso se repite para los Escenarios 2 al 4 que, a su vez, dan lugar a los Portafolios Preliminares B al D respectivamente. Cada uno de los Portafolios Preliminares incluye un conjunto de presunciones comunes asociados a cambios en los recursos energéticos que han sido aprobados por el Negociado de Energía o la Autoridad P3; LUMA se refiere a estas presunciones como “Decisiones Fijas,” ya que no están sujetos a cambios realizados por LUMA o por el *software* de simulación utilizado por LUMA y el Consultor Técnico del PIR. Estas “Decisiones Fijas” se enumeran en la Sección 1.1.1. Además de estas “Decisiones Fijas”, cada uno de los Portafolios incluye un crecimiento continuo y una contribución sustancial a los recursos energéticos de energía solar fotovoltaica (PV) distribuida propiedad de los clientes. Las contribuciones de PV distribuida para los Escenarios 1 y 3 se aproximan a los valores utilizados en el escenario medio del Estudio de PR100 (PR100 Scenarios 2LMNET).

A continuación, se ofrece un resumen de las principales diferencias en los resultados del Portafolio Preliminar. En la Sección 1 se ofrece un resumen más detallado de los resultados preliminares de los Portafolios.

El Portafolio Preliminar A proporciona el conjunto de recursos de menor costo que resulta de las condiciones descritas en el Escenario 1, el cual representa la visión de LUMA de las presunciones más probables para todas las entradas (inputs). En este Portafolio Preliminar A, se añaden unidades alimentadas con Gas Natural Licuado (GNL) para cubrir las necesidades de capacidad de la generación heredada que se retira. Varias de las nuevas unidades de GNL, y algunas unidades heredadas, se convierten finalmente a biodiésel para cumplir con los crecientes requisitos del RPS. Cabe destacar que el Portafolio Preliminar A no añade ningún recurso solar fotovoltaico a escala de servicio público más allá de los proyectos de decisión fija incluidos en los Tramos 1 y 2 de energía solar fotovoltaica.

El Portafolio Preliminar B proporciona el conjunto de recursos de menor coste que resulta de las condiciones descritas en el Escenario 2, que representa el escenario de estrés con una previsión de carga aumentada y contribuciones reducidas de la energía solar fotovoltaica distribuida. En esta cartera, al igual que en el Portafolio Preliminar A, se construyen nuevas unidades de GNL y luego se convierten a biodiésel junto con algunas de las unidades existentes. Esta cartera también incluye un aumento sustancial del número de baterías construidas en comparación con las construidas para el Portafolio Preliminar A. Además, no se añaden recursos fotovoltaicos solares a escala de servicio público adicionales más allá de los proyectos de decisión fija incluidos en las adiciones fotovoltaicas solares de los Tramos 1 y 2.

El Portafolio Preliminar C proporciona el conjunto de recursos de menor costo que resulta de las condiciones descritas en el Escenario 3, que es idéntico al Escenario 1, excepto en que añaden terrenos adicionales para construir más recursos solares y eólicos a un costo inferior promedio de energía nivelado al de los terrenos disponibles para el Escenario 1. Sin embargo, incluso con este agregado, más productivo de terrenos, no se construye ningún nuevo recurso solar o eólico adicional en el Porfolio Preliminar C, y sus recursos energéticos son idénticos a los definidos para el Portafolio Preliminar A.

El Portafolio Preliminar D proporciona el conjunto de recursos de menor costo que resulta de las condiciones descritas en el Escenario 4, el cual tienen una previsión de carga más alto, pero también tiene costos de recursos más bajos y mayor terreno disponible para el desarrollo de renovables. Esta combinación de presunciones se traduce en la construcción de una cantidad significativamente mayor de energía solar fotovoltaica a gran escala, en adición a los proyectos identificados en los *Tranches* 1 y 2. El Portafolio también incluye adiciones significativas de baterías y nuevas unidades de GNL que, nuevamente, se convierten parcialmente en unidades alimentadas con biodiésel para cumplir con el aumento requerido para el *RPS*.

En las secciones siguientes se ofrecen mayores detalles sobre cada uno de estos Portafolios Preliminares.

Contents

Tables

List of Acronyms

Acronym	Definition
ANSI	American National Standards Institute
ABFE	Advisory Base Flood Elevation - FEMA
ADMS	Advanced Distribution Management System
ASAP	Accelerated Storage Addition Program
BESS	Battery Energy Storage System
CBES	Customer Battery Energy Sharing
CC	Combined Cycle
CDD	Cooling Degree Days
CHP	Combine Heat and Power
CO2	Carbon Dioxide
CS	Costa Sur
CT	Combustion Turbine
DBESS	Distributed Battery Energy Storage
DPV	Distributed Photovoltaic
DER	Distributed Energy Resources
DR	Demand Response
EE	Energy Efficiency
EMS	Energy Management System
FCI	Fault Circuit Indicators
FOMB	Financial Oversight and Management Board for Puerto Rico
FO&M	Fixed Operation and Maintenance
GWh	Gigawatt hour
IEEE	Institute of Electrical and Electronics Engineers
IHCM	Incremental Hosting Capacity Maps
IRP	Integrated Resource Plan
kV	Kilovolt

Acronym	Definition
kW	Kilowatt
kWh	Kilowatt-hour
LCOE	Levelized Cost of Electricity
LNG	Liquefied Natural Gas
LOLE	Loss of Load Expectation
LOLP	Loss of Load Probability
LT	Long-Term
LTC	Load Tap Changer
MVA	Megavolt-amperes
MW	Megawatt
NEM	Net Energy Metering
NERC	North American Electric Reliability Corporation
O&M	Operation and Maintenance
PMU	Phasor Measurement Unit
PR100	The Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy Study of the US Department of Energy
PREPA	Puerto Rico Electric Power Authority
PSSe	Power System Simulation for Engineering
PV	Solar Photovoltaic
PVRR	Present Value Revenue Requirement
RPS	Renewable Portfolio Standard
SCADA	Supervisory Control and Data Acquisition
SETPR	Soluciones Energéticas para Transformar a Puerto Rico
SJ	San Juan
SRP	System Remediation Plan
ST	Short-Term
TC	Transmission Centers
TPA	Transmission Planning Area

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Acronym	Definition
T&D	Transmission and Distribution
VO&M	Variable Operation and Maintenance

1.0 Overview of Preliminary Portfolios A to D resulting from Scenarios 1 through 4

1.1 2025 IRP Fixed Decisions

A significant amount of work has been undertaken with respect to Puerto Rico's energy system over the past several years. This work has resulted in numerous generation resource projects that have received government approval or are currently in advanced stages of development. Additionally, Puerto Rico must comply with legally mandated retirements of certain existing generation units. LUMA collectively refers to this work in the 2025 IRP as "Fixed Decisions." LUMA has included the Fixed Decisions listed below as unchangeable aspects of its modeling in this First Interim 2025 IRP Filing that are applied to all the Scenarios:

1.1.1 Fixed Capacity Additions

- Tranche 1: 578.8 MW (PV) + 350 MW (BESS) between 2025 and 2026
- Tranche 2: 66 MW (PV) + 60 MW (BESS) in 2026
- ASAP batteries: 360 MW (BESS) in 2026[9]
- Genera Peaking Units: 336 MW (LNG RICE and CT) in 2027
- Genera Batteries: 430 MW (BESS) in 2026
- PREPA Hydroelectric 67 MW in 2026
- [redacted]

1.1.2 Fixed Capacity Retirements

- GT 1, 2, 11, 19, 20, 21 and 22 Peaking Units: 147 MW (Diesel) in 2027
- AES 1 and AES 2: 454 MW (Coal) in 2028

1.2 Summary of Preliminary Portfolios A to D Resulting from Scenarios 1 to 4

In developing the 2025 IRP, LUMA worked with stakeholders and the Energy Bureau to develop and analyze ten (10) potential future planning scenarios (Scenarios). Each scenario includes a combination of plausible conditions such as: load growth, fuel prices, land use, capital costs, and risks that influence the choice of resources serving the forecasted load. For this First Interim 2025 IRP Filing, LUMA is submitting the preliminary results of Scenarios 1 through 4, which consider different input assumptions for future demand, resource costs and other assumptions. A high-level summary of Scenarios 1 to 4 is shown in Table below.

[9] See IN RE: LUMA's Accelerated Storage Addition Program NEPR-MI-2024-0002 at https://energia.pr.gov/en/dockets/?docket=nepr-mi-2024-0002. BESS Capacity was calculated based on approved Standard Offer (SO) Phase 1 Agreements.

Table 1: Assumptions for 2025 IRP Scenarios and Characteristics 1 through 4

Scenario	Scenario Name	Load Growth	DER Growth / PV / BESS	PV Cost	Agriculture Land Use	Storage Cost	Resource Capital Cost	Fossil Fuel Cost	Energy Efficiency	DBESS Control (%)			
										2025	2030	2035	2040
1	Base Assumptions	Base	Base/ Base	Base	Less Land	Base	Base	Base	PR100-Base	5	10	10	10
2	System Stress Scenario	High	Low/ Low	High	Less Land	High	High	Base	PR100-Base	0	0	0	0
3	More Agriculture Land Use	Base	Base/ Base	Base	More Land	Base	Base	Base	PR100-Base	5	10	10	10
4	Optimistic Load Growth and costs	High	High/ High	Low	More Land	Low	Low	Low	PR100-Base	5	15	20	20

LUMA ran Scenarios 1 through 4 in its modeling software tool and the output or result of each scenario is called a Portfolio[10]. In this First Interim 2025 IRP Filing, LUMA refers to the output resulting from the modeling software of Scenarios 1 through 4 as the four (4) Preliminary Portfolios A through D, see Table 2 of Preliminary Portfolios Resulting from the Scenarios below.

Table 2: Preliminary Portfolios Resulting from Scenarios

Scenarios	Preliminary Portfolios
Scenario 1	Preliminary Portfolio A
Scenario 2	Preliminary Portfolio B
Scenario 3	Preliminary Portfolio C
Scenario 4	Preliminary Portfolio D

1.2.1 Preliminary Portfolio A Resulting from Scenario 1 (Base Case: Least Cost Portfolio with Less Land Use)

The Preliminary Portfolio A is the least cost resource plan that results from the conditions in Scenario 1, or Base Case Scenario (Least Cost, Less Land Use). Scenario 1 considers the most likely forecast of load, costs, and other key assumptions. It also assumes that less agricultural land is available for renewable development compared to other Scenarios. The definitions of the “less land’ used in Scenario 1 and 3, and “more land” used in Scenarios 2 and 4 are based on the work completed as part of the Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy Study of the United States Department of Energy (PR100). In addition to the Fixed Decisions, the list below summarizes the major generation and transmission additions, generator modifications of Preliminary Portfolio A:

- Additions:
    - 4hr BESS- 40 MW in 2027
    - LNG CT - 226 MW added in 2030 and converted to biodiesel in 2039
    - LNG CC - 551 MW added in 2032 and converted to biodiesel in 2044
    - Two LNG CTs – 452 MW added in 2036
- Biodiesel Conversions:
    - New 453 MW LNG CC added as a fixed decision in 2028 is converted to biodiesel in 2030

[10] A Portfolio is defined as the least cost resource plan, including resource additions and retirements, which result from the conditions of each Scenario.

- Genera peaking units added as a fixed decision in 2027 are converted to biodiesel between 2036 and 2038 (34 MW)
- San Juan 6 CC converted to biodiesel on 2040 (210MW)

- Retirements:
  - All 1130 MW of Heavy Fuel Oil units retired by 2032
  - Additional 540 MW of Diesel units retired by 2038
- Transmission line additions:
  - Caguas- Carolina 115kV added in 2030
  - Caguas- San Juan 115kV added in 2030

1.2.2 Preliminary Portfolio B Resulting from Scenario 2 (Stress Case Scenario: High Load Growth, High Cost)

The Preliminary Portfolio B is the least cost resource plan that results from the conditions in Scenario 2 which was defined as the least cost portfolio to meet the condition of Scenario 2, or the Stress Case Scenario (High Load Growth, High Cost). Scenario 2 includes a high load forecast and higher costs for renewable and conventional resources, and lower growth of distributed solar PV as a result of higher costs. In addition to the Fixed Decisions, the list below summarizes the major additions and retirements in Portfolio B:

- Additions:
  - 4hr BESS- 740 MW (2027)
  - 6HR BESS- 120 MW (2027)
  - LNG CC - 551 MW added in 2032
  - Two LNG CTs – 452 MW added in 2034
  - LNG CT - 226 MW added in 2038
- Biodiesel Conversions:
  - New 453 MW LNG CC added as a fixed decision in 2028 is converted to biodiesel in 2030
  - Genera peaking units added as a fixed decision in 2027 are converted to biodiesel between 2040 and 2041 (93 MW)
  - San Juan 6 CC converted to biodiesel on 2036 (210MW) and San Juan 5 CC on 2042 (210MW)
- Retirements:
  - All 1130 MW of Heavy Fuel oil units by 2034
  - Additional 540 MW of Diesel units retired by 2042
- Transmission line additions:
  - Ponce OE- Ponce ES 230kV added in 2030

1.2.3 Preliminary Portfolio C Resulting from Scenario 3 (Least Cost Scenario with More Agricultural Land Use)

The Preliminary Portfolio C is the least cost resource plan that results from the conditions in Scenario 3, or the More Agricultural Land Scenario. Scenario 3 was identical to Scenario 1 except that it assumed more agricultural land, with greater production capability available for development. However, the availability of more land had no impact on the additions and retirements, and the resource plan for Portfolio C is identical to that of Portfolio A.

1.2.4 Preliminary Portfolio D Resulting from Scenario 4 (Optimistic Load Growth and Low Costs Scenario)

The Preliminary Portfolio D is the least cost resource plan that results from the conditions in Scenario 4, or the Optimistic Load Growth and Costs Scenario (Optimistic Load Growth, Low Cost). Scenario 4 assumes a higher load forecast in addition to lower costs for renewable and traditional resources and more land available for renewable development. Likely due to the assumption of lower renewable energy costs, this is the only preliminary portfolio of the first four (4) presented in this First Interim 2025 IRP filing that includes any additional solar PV builds beyond the fixed solar additions in Tranche 1 and Tranche 2. In addition, to the Fixed Decisions, the list below summarizes the major additions and retirements in Portfolio D. Major conclusions include:

- Additions:
  - 4hr BESS- 740 MW in 2027 and 100 MW in 2028
  - 6HR BESS- 180 MW in 2027
  - LNG CTs - 18 MW in 2030, 226 MW in 2034, 226 MW in 2035 and 18 MW in 2039
  - LNG CC - 551MW in 2032
  - Solar PV- 525 MW in 2030, 225 MW in 2031, 225 MW in 2032 and 300 MW in 2033
- Biodiesel Conversions:
  - Genera peaking units added as a fixed decision in 2027 are converted to biodiesel between 2031 and 2033 (93 MW)
  - New 453 MW LNG CC added as a fixed decision in 2028 is converted to biodiesel in 2035
- Retirements:
  - All 1130 MW of Heavy Fuel Oil units retired by 2032
  - Additional 540 MW of Diesel units retired by 2042
- No Transmission line additions

1.3 Updated High Load Forecast

LUMA has periodically reviewed and updated the data and assumptions for the 2025 IRP Scenarios. During the last few months as actual system peak load data from the last two summers were compared to the 2025 IRP forecasts, LUMA noticed actual system peak loads were well above the base load forecast and close to the high load forecast. LUMA believes the recent two years of very high actual system peak loads are due to the higher than forecast temperatures that Puerto Rico experienced during the last two summers and changes in population behavior since Covid-19.

Aided by Guidehouse, LUMA analyzed the recent load data and assessed the need to revise the forecasts that are currently used in the 2025 IRP. It was determined that revised forecasts using the most recent sales and weather data would have a material impact on the high forecast but was estimated to have only a very small impact on base forecast. Once this determination was made, LUMA contracted with Guidehouse to provide a revised high forecast for the 2025 IRP, which has been completed but is still under review and was not available for the results presented in this filing. LUMA plans to rerun Scenarios 2 and 4 with the updated high load forecast and submit the updated Portfolio in the February 28, 2025, filing.

LUMA has also made the determination that given the increasing volatility of system peak loads, it will be more prudent to model the transmission system's ability to support the preferred portfolio operating under the high load forecast scenario, rather than the base scenario. The results of the transmission modeling of the preferred portfolio will be included in the May 16, 2025, filing.

2.0 Preliminary Assumptions and Results

As indicated above, all the information provided herein regarding Scenarios 1 through 4 and their respective Preliminary Portfolios A through D is subject to change. LUMA plans to rerun Scenarios 1 through 4 in the coming weeks with revised assumptions:

1) LUMA will rerun Scenarios 2 and 4 to include the revised high load forecast;
2) LUMA will rerun Scenarios 1 through 4 without the Genera 3x50 MW LNG Peaking Units;
3) LUMA plans to rerun Scenarios 1 through 4 with changes to the methods used to address the maintenance and forced outages for load modifiers;
4) LUMA may choose to make any other revisions to Scenarios 1 through 4 that it deems appropriate in order to provide more accurate or practical results.

Even though the information provided herein will change, LUMA consider the Preliminary Portfolios A through D an important milestone in the development of the 2025 IRP. With the continued support of the IRP Technical Consultant and the modeling software developer, the team was able to make the necessary updates, configurations and fixes to model the scenarios while complying with all legal and administrative mandates. The modeling software issues encountered early in the development process caused major delays in the 2025 IRP. However, the workarounds and solutions applied to the modeling software to generate the preliminary results in this filing have led to the development of a more deliberate and well considered process that is delivering logical results. LUMA and the IRP Technical Consultant will continue to apply these workarounds and fixes to the remaining modeling to deliver on May 16, 2025, a robust and realistic 2025 IRP that will benefit Puerto Rico.

3.0 Resource Planning Assumptions and Preliminary Results

3.1 Preliminary Portfolio A Resulting from Scenario 1 (Base Case) Portfolio Resource Plan Overview

This section provides the preliminary portfolios resulting from the modeling results of Scenarios 1 through 4 for the 2025 IRP. These preliminary portfolios are currently under analysis and development and are subject to change before the 2025 IRP filing on May 16, 2025. LUMA has defined an IRP development process that complies with the specific requirements of Regulation 9021, applicable laws and government policies of Puerto Rico. Regulation 9021 requires that the IRP shall consider multiple scenarios that encompass the reasonable range of possible outcomes for uncertain forecasts. Following this mandate, LUMA is developing a recommended preferred resource plan based on, among other requirements, an analysis of a range of Scenarios that each describe combinations of plausible forecasts of load, fuel prices, capital costs and risks that influence the choice of resources serving future load[11]. For this filing, LUMA is presenting the assumptions and portfolios resulting from the modeling of the first four (4) of ten (10) scenarios (i.e., Scenario 1 to 4) of LUMA's 2025 IRP Revised Scenarios and Characteristics. A high-level summary of Scenarios 1 to 4 is shown in Table above.

In addition to the assumptions outlined in the scenarios, LUMA has established a list of additional planning criteria that are applied to all scenarios, including, among others:

- Attain the Renewable Portfolio Standard requirements of Act 82-2010, as amended, per Section 2.03(H)(2)(a)(ix) of Regulation 9021;
- Improve Loss of Load Expectation (LOLE) to attain an industry standard performance for Puerto Rico of 0.1 days/year within the 2025 to 2044 IRP planning horizon if possible;
- Minimize expected unserved energy[12];
- Improve the geographic and technological diversity of energy resources;
- Retire the existing heavy fuel-fired units as soon as practical;
- Include all known changes to the resource portfolio including both approved retirements (i.e., AES retirement by the end of 2027) and approved additions, these are referred to as Fixed Decisions;
- Only projects with Fixed Decisions and utility scale batteries can be installed prior to 2030. The earliest year utility scale batteries can be installed is 2027.

Scenario 1 is also referred to as the Base Case due to its use of the most likely assumptions. The Scenario 1 assumptions for each category listed in Table are assumptions representing the most likely outlook.

Once the assumptions for Scenario 1 were established in PLEXOS, an optimized expansion plan that includes resource additions and retirements was developed in the PLEXOS long-term (LT) module. Production costs were then developed for the optimized plan in the PLEXOS short-term (ST) module. In this section, the results

[11] See Regulation 9021 Section 2.03(G)(c) and Section 2.03(H)(2).

[12] Expected Unserved Energy: The summation of the expected number of megawatt (MW) hours of load that will not be served in a specific time interval because of demand exceeding the available generation capacity. This energy-centric measure considers the frequency, magnitude and duration for all hours of the period. See page 44 of Resource Adequacy Study at https://energia.pr.gov/wp-content/uploads/sites/7/2023/12/20231220-AP20230004-Motion-Submitting-Final-Version-of-Resource-Adequacy-Analysis-Report.pdf

of the Scenario 1 simulation in PLEXOS are presented. Results reported include outputs for multiple categories including year-by-year values for the following:

- System capacity balance,
- Capacity additions and retirements,
- Fuel diversity and energy production by source,
- Renewable Portfolio Standard (RPS) compliance,
- Emissions of CO2,
- Expected unserved energy, and
- System costs measured in terms of the Present Value Revenue Requirements (PVRR).

3.1.1 Preliminary Portfolio A Resulting from Scenario 1 - System Capacity Balance, Capacity Additions and Retirements

The resource additions and retirements for Preliminary Portfolio A, is the least cost resource plan that results from the conditions in Scenario 1. Also presented is a capacity balance, which compares the total installed resources and the total firm resources against the projected peak load for each year in the planning horizon.

Figure 1 is a graphical representation of the Preliminary Portfolio A capacity balance for the 2025 to 2044 planning period. Data for 2024 is also provided for reference. The figure includes the yearly resource additions and retirements during the planning period and includes total installed resources as well as the total firm resources. Total installed resources include conventional generation, renewable generation, Battery Energy Storage System (BESS), distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. In the figure, the total firm capacity is lower than the total installed resources given the intermittent nature of renewable energy resources (solar, wind and hydro) that cannot be counted on to provide the full installed capacity on a firm basis at the time of system peak. BESS resources are also given partial capacity credit in the graph, as are some existing conventional units with very high outage rates.

As reflected in Figure 1, the system peak demand is projected to generally trend downward from 2025 to 2044. Conversely, the total installed resources and firm resources are projected to remain relatively level from 2026 through the remaining planning period. Additional details behind the trends shown in Figure 1 are provided in Table 3.

Figure 1: Preliminary Portfolio A Resulting from Scenario 1 Capacity Balance

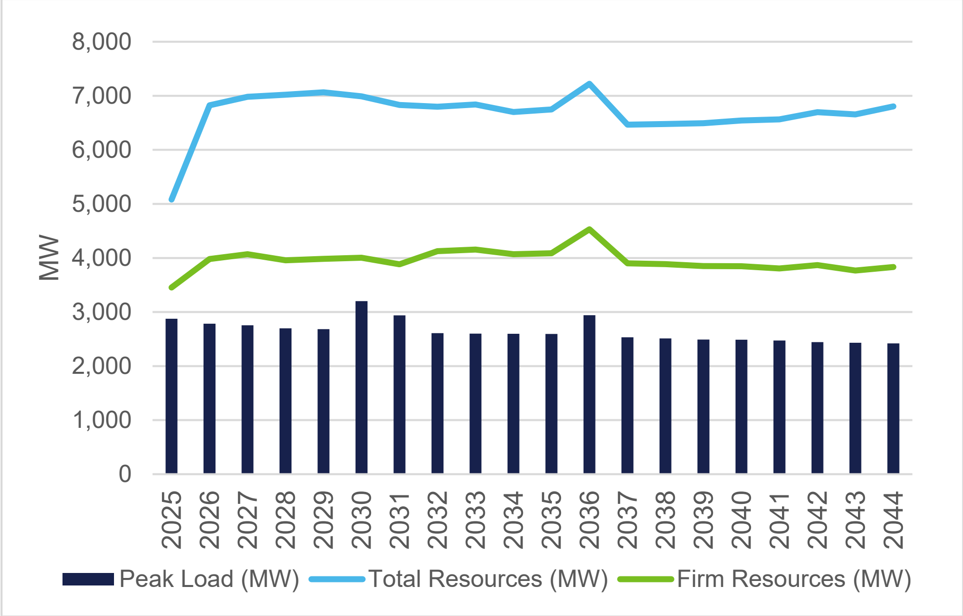

Table 3 presents the Preliminary Portfolio A, year-by-year resource balances from 2025 to 2044. For each year shown, the total install resource figure reflects the total MW of installed resources regardless of type. These resources include conventional generation, renewable generation, BESS, distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. Also shown in this table are the firm resources available each year. Firm resources are less than the total installed resources due to reduced capacity values for intermittent renewable generation (wind, solar, and hydro) and energy storage resources, as well as for some existing and unreliable generating units having high outage rates.

The capacity balances in the table indicate that during the planning horizon, there is a positive balance between firm resources installed and peak load. Total firm resources begin at 3,453 MW in 2025 and end at 3,831 MW in 2044. When firm resources are compared to the projected peak demand, the capacity balance (and reserve margin) grows from 579 MW (20.13 percent) in 2025 to 1,413 MW (58.41 percent) in 2044. It should be noted that for all Scenarios, LUMA uses LOLE, rather than reserve margin, as the primary indicator of the system resource adequacy for the 2025 IRP. The resulting resource plan enables an increasingly reliable system, measured in terms of reduced levels of expected unserved energy, as discussed further in Section 3.1.5.

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Table 3: Capacity Balances for Preliminary Portfolio A Resulting from Scenario 1

Measure	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Peak MW Demand	2875	2784	2756	2698	2684	3202	2939	2608	2599	2596	2593	2940	2532	2512	2491	2489	2472	2443	2430	2419
Total Resources, MW	5081	6824	6983	7020	7065	6991	6830	6798	6839	6700	6747	7222	6465	6479	6492	6542	6565	6697	6654	6804
Firm Resources, MW	3453	3980	4070	3956	3982	4004	3882	4127	4155	4070	4089	4531	3902	3887	3852	3847	3807	3869	3767	3831
Firm Resources Above Peak Demand, MW (Capacity Reserves)	579	1195	1314	1258	1299	802	944	1519	1556	1474	1496	1590	1370	1375	1361	1358	1335	1426	1337	1413
Firm Capacity % Above Peak (Reserve Margin)	20.13	42.93	47.70	46.64	48.40	25.04	32.11	58.23	59.86	56.77	57.67	54.09	54.10	54.74	54.62	54.57	54.01	58.36	55.00	58.41

Table 4 and Table 5 present information about the MW of generator and battery resource additions and retirements that occur under Preliminary Portfolio A. Combined, the information in the tables shows significant activity with numerous additions (6,969 MW when including the conversion of conventional generation to burn biodiesel) and retirements (5,033 MW) over the planning period. This activity is primarily driven by the ramping up of renewable energy resources to meet the RPS targets and the targeted reduction of Expected Unserved Energy levels. Two (2) 115 kV transmission lines were added in Scenario 1 as a component of the optimal expansion plan. The two (2) transmission lines are added in the year 2030. The lines added are a Caguas-Carolina 115 kV line and a Caguas-San Juan 115 kV line.

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Table 4: Addition Summary (MW) for Preliminary Portfolio A Resulting from Scenario 1

[redacted]

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Table 5: Preliminary Portfolio A Resulting from Scenario 1 Resource Retirements (MW)

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
Coal	-	-	-	(454)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**(454)**
Diesel	-	-	(147)	-	-	-	-	(100)	-	(195)	-	-	(170)	(75)	-	-	-	-	-	-	**(687)**
Fuel Oil	-	-	-	-	-	(350)	(230)	(550)	-	-	-	-	-	-	-	-	-	-	-	-	**(1,130)**
Landfill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(2)	(2)	-	-	**(5)**
LNG – Costa Sur	-	-	-	-	-	-	-	-	-	-	-	-	(600)	-	-	-	-	-	-	-	**(600)**
LNG – San Juan	-	-	-	-	-	(454)	-	-	-	-	-	-	-	-	(301)	(285)	(100)	-	-	(551	**(1,691)**
LNG - Trucked	-	-	-	-	-	-	-	-	-	-	-	(17)	(17)	(9)	(25)	-	(25)	(40)	(226)	-	**(359)**
Utility Scale Solar	-	-	-	-	-	-	-	(2)	(20)	-	-	(30)	(55)	-	-	-	-	-	-	-	**(107)**
Total	-	-	**(147)**	**(454)**	**-**	**(804)**	**(230)**	**(652)**	**(20)**	**(195)**	**-**	**(47)**	**(842)**	**(84)**	**(326)**	**(285)**	**(127)**	**(42)**	**(226)**	**(551)**	**(5,033)**

3.1.2 Preliminary Portfolio A Resulting from Scenario 1 Energy Production by Resource and Fuel

The Preliminary Portfolio A resource capacity additions will result in a significant change in the energy production by resource and fuel type. Figure 2 provides year-by-year source of energy information and Figure 3 shows the source of energy for selected years from 2025 to 2044. As shown in the two figures, biodiesel will account for an increasing portion of energy production, while energy from BESS will also increase. Conversely, energy generated from coal is phased out by the end of 2028 and energy generation by fuel oil (phased out by 2032) and diesel (phased out by 2042) are also shown to end early in the planning horizon.

Figure 2: Preliminary Portfolio A Resulting from Scenario 1 Energy Production by Source

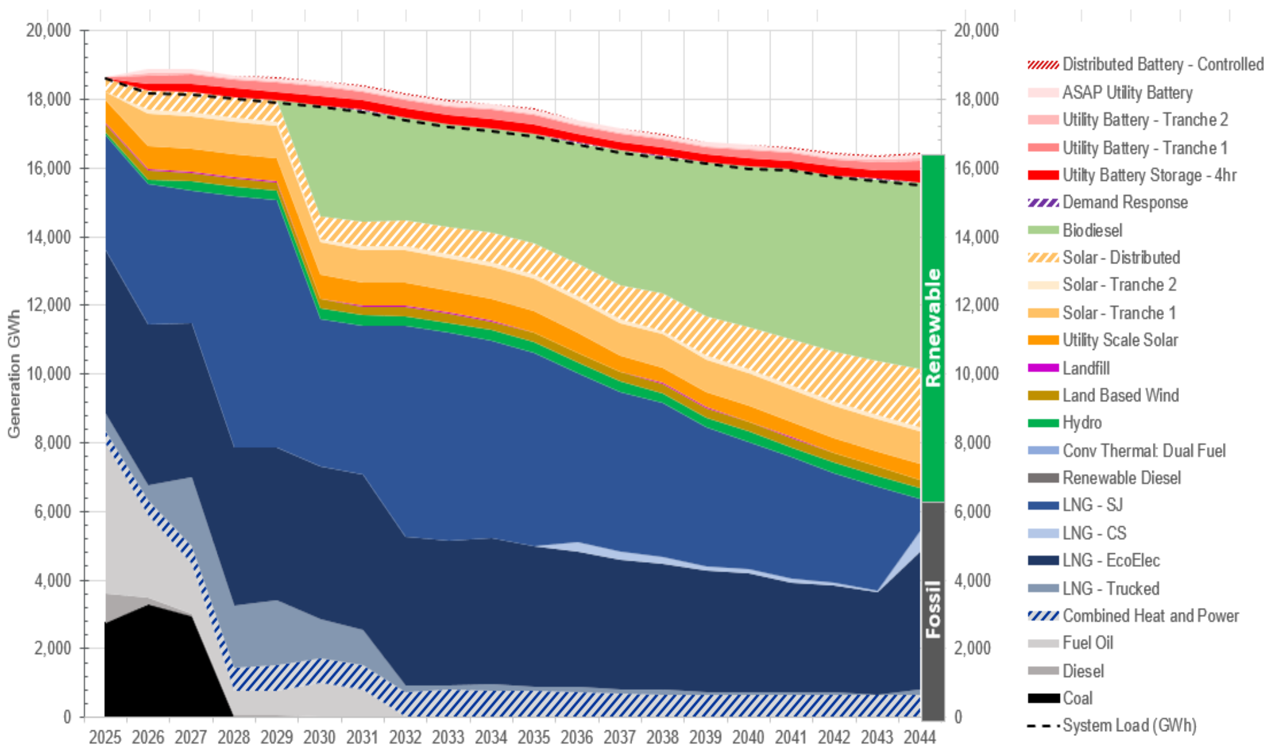

Figure 3: Preliminary Portfolio A Resulting from Scenario 1 Energy Production by Source for Selected Years

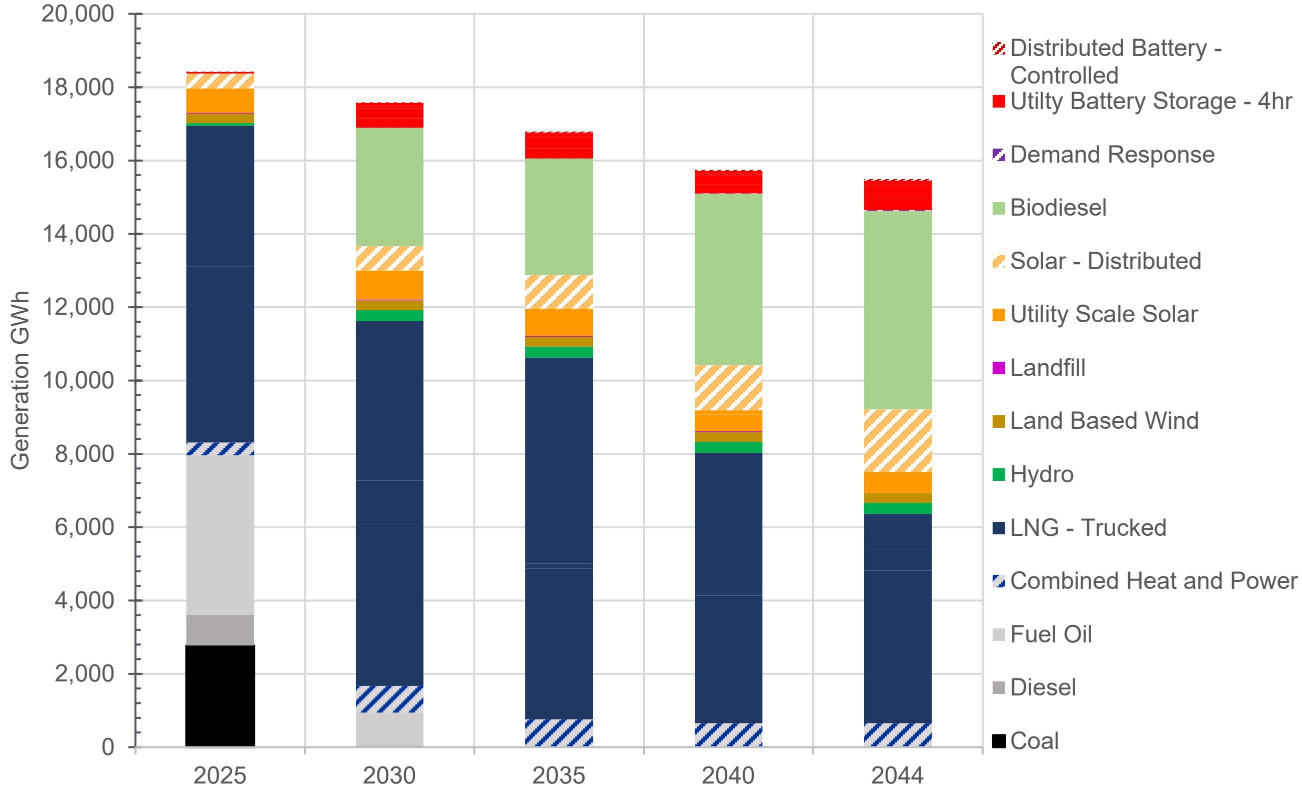

Table 6 provides additional details on the source of energy production by fuel type and resource. Again, there is notable growth in the generation of energy by biodiesel, which is contributing to progress toward the RPS target. The table also shows the contribution of various renewable generation sources to the overall energy production mix.

Table 6: Preliminary Portfolio A Resulting from Scenario 1 Energy Production by Fuel or Resource (GWh)

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Coal	2,773	3,291	2,951	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diesel	840	216	75	68	73	41	17	13	7	3	2	1	1	1	1	0	0	0	1	1
Fuel Oil	4,347	2,390	1,472	696	759	899	785	-	-	-	-	-	-	-	-	-	-	-	-	-
LNG - EcoElec[13]	4,801	4,671	4,481	4,594	4,455	4,441	4,545	4,343	4,183	4,247	4,112	3,933	3,779	3,673	3,544	3,482	3,205	3,116	3,011	4,004
LNG-SJ[14]	3,339	4,107	3,874	7,351	7,208	4,348	4,342	6,108	6,064	5,751	5,620	4,946	4,660	4,484	4,057	3,706	3,538	3,188	3,017	958
Hydro	71	116	243	244	243	301	301	301	300	300	300	301	300	300	300	301	300	300	300	301
Utility Scale Solar	660	677	677	680	676	677	677	675	633	633	633	576	458	458	458	459	458	458	459	460
Land Based Wind	264	270	270	271	269	269	269	270	269	269	270	271	269	270	270	271	268	270	269	271
Landfill	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	11	-	-	-
LNG - Trucked	500	448	1,995	1,821	1,835	1,160	1,023	167	140	182	133	164	113	125	73	67	72	78	8	157
Biodiesel	-	-	-	-	-	3,231	3,242	2,998	2,990	3,028	3,175	3,507	3,923	4,002	4,464	4,667	4,956	5,121	5,274	5,406
Solar - Tranche 1	234	945	946	948	946	945	945	947	946	947	945	948	946	946	946	948	946	946	945	948
Solar - Tranche 2	-	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Combined Heat and Power	347	428	510	667	751	730	699	742	803	788	757	727	699	677	661	653	654	654	652	653
Dist. Solar	411	547	580	604	630	664	707	756	808	865	919	964	1,014	1,074	1,150	1,237	1,332	1,443	1,571	1,707
Demand Response	0	0	0	0	0	2	3	4	5	4	2	7	7	10	12	13	16	21	25	27

[13] EcoEléctrica Natural Gas Power Plant

[14] LNG Units located in San Juan power station

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BESS (all)	52	642	682	628	653	694	713	689	706	720	733	666	641	644	603	645	590	653	683	846

First Interim 2025 IRP Filing

3.1.3 Preliminary Portfolio A Resulting from Scenario 1 RPS Compliance

Puerto Rico has aggressive RPS targets for the production of renewable energy resources. The mandate is to achieve an RPS target of 40 percent by 2025, 60 percent by 2040, and 100 percent by 2050. Given that the actual RPS level in 2024 was below 10 percent, it is not realistic to meet the 2025 RPS target. The goal of this 2025 IRP is to meet the 2040 target and to ramp up to this level aggressively, while reflecting realistic timeframes for implementing new options that will help meet the RPS targets.

shows the RPS results for Scenario 1. In the figure, the green line shows the year-by-year RPS percentage achieved for the generation portfolio resulting from Scenario 1. The results achieved are compared to a theoretical ramp rate in the grey dotted line that allows the overall system to quickly ramp up from the low actual levels of renewable generation achieved in 2024 to meet the targeted 60 percent mark by 2040. In the Preliminary Portfolio A, the RPS levels represented by the grey line were adopted as a "soft" target and results were reviewed to determine if the "soft" target was met or exceeded during the planning period.

As shown in the Preliminary Portfolio A expansion plan exceeds the soft RPS targeted ramp rate during the years leading up to 2040 and also exceeds the 60 percent mandate in 2040. Thereafter, the RPS percentage continues to increase through 2044 and leaves the system in position to meet the 2050 objective of attaining a 100 percent RPS level. Achieving these aggressive RPS targets helps explain the many resource additions to the system that are reflected in the resource additions and retirements tables.

Figure 4: Preliminary Portfolio A Resulting from Scenario 1 RPS Percentage Achieved vs. Goals

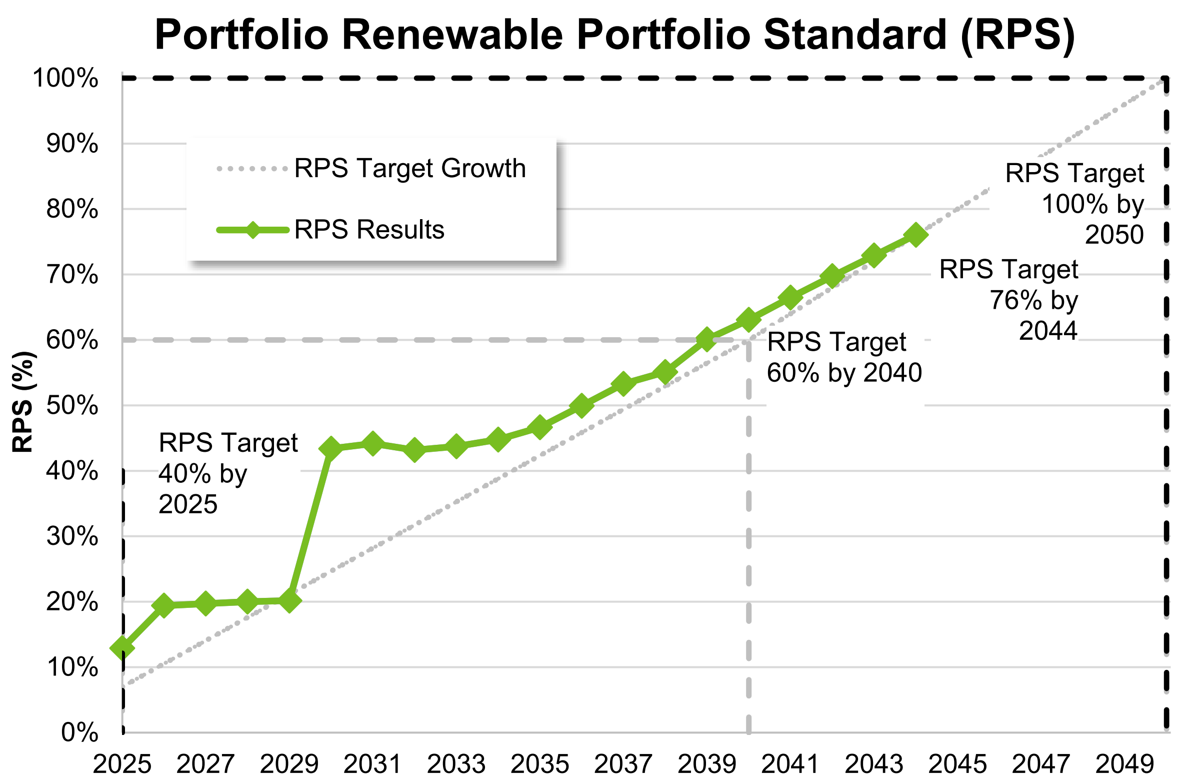

Table 7: Preliminary Portfolio A Resulting from Scenario 1 RPS Percent Achieved vs. Targets

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
RPS Soft Target, %	7	11	14	18	21	25	28	32	35	39	42	46	49	53	56	60	64	68	72	76
RPS Results, %	13	19	20	20	20	43	44	43	44	45	47	50	53	55	60	63	66	70	73	76
Difference	6	9	6	2	(1)	19	16	12	8	6	4	4	4	2	4	3	2	2	1	0
RPS Target, GWh	1071	1557	2056	2551	3043	3500	3955	4375	4792	5210	5611	5962	6310	6649	6975	7301	7700	8006	8323	8633
RPS Results, GWh	1974	2869	2882	2900	2904	6153	6186	5970	5944	6013	6185	6491	6807	6921	7421	7675	7998	8211	8427	8641
Difference, GWh	903	1312	827	349	-138	2653	2231	1595	1151	803	574	529	498	272	446	374	298	205	103	7

3.1.4 Preliminary Portfolio A Resulting from Scenario 1 Emissions

Preliminary Portfolio A's aggressive movement toward the RPS targets and away from fossil fuel generation results in a significant reduction in CO2 emissions over the planning period. shows the reduction in CO2 emissions from 13.9 million tons of CO2 emitted in 2025 to 2.7 million tons of CO2 emitted in 2044.

Table 8: Preliminary Portfolio A Resulting from Scenario 1 CO2 Emissions

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Thousand Tons CO2	13,851	12,965	10,705	9,145	6,630	6,420	5,507	5,430	4,689	4,531
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**
Thousand Tons CO2	4,457	4,261	4,057	3,963	3,836	3,844	3,214	3,020	2,811	2,667

3.1.5 Preliminary Portfolio A Resulting from Scenario 1 Expected Unserved Energy

An important component of the expansion plan under consideration in the 2025 IRP is the ability of the portfolio to improve system reliability. An unreliable power system results in expected unserved energy and a large number of events that disrupt power supply. Table 9 lists the expected unserved energy amounts and expected unserved energy events for the 2025 to 2044 planning period. Forecast information for 2024 is also provided as a reference point.

The Preliminary Portfolio A reflects a reduction of expected unserved energy from 133.9 GWh in 2024 to 19.7 GWh in 2025, with the level of expected unserved energy reaching 0 GWh in 2030. Thereafter, the Preliminary Portfolio A indicates that only one year (2032) is projected to have a small amount of expected unserved energy (1.5 GWh). Similarly, the number of hours having expected unserved energy is projected to decrease from 976 hours in 2024 to zero by 2030. Thereafter, only two years (2032 and 2038) are projected to have expected unserved energy hours. Other measures of reliability include the maximum MW of expected unserved energy during an event and the number of events in which there is expected unserved energy. As can be seen in the last two columns of Table 9, there is a consistent improvement in these measures, and for most years from 2030 onward, the projection is that there will be no expected unserved energy events.

Another important indicator of system reliability is the LOLE. The LOLE target has been defined by LUMA as an indicator to define a progressive improvement in reliability targeted to achieve an industry standard level of LOLE performance of 0.1 days / year by 2038, which is equivalent to no more than 2.4 hours / year (2.4 hours equals 0.1 days) of expected unserved energy per year.[15] Table 9 shows the target improvement in expected unserved energy hours from 2030 onward. As can be seen in Table 9, the expected unserved energy hours achieved by the Preliminary Portfolio A exceed the target hours from 2030 onward.

[15] See LUMA's Motion Submitting Responses to the Third Set of IRP Prefiling Period Requests of Information: https://energia.pr.gov/wp-content/uploads/sites/7/2024/07/20240607-AP20230004-Responses-to-3rd-RFI-and-request-for-confidential-treatment-converted_Redacted.pdf

Table 9: Preliminary Portfolio A Resulting from Scenario 1 Expected Unserved Energy Target and Results

Target/ Results	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
LOLP Target Hours	-	-	-	-	-	-	60.6	40.4	26.9	18	12	8	5.3	3.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Results Expected Unserved Energy Hours	976	186	114	23	6	25	-	-	11	-	-	-	-	-	1	-	-	-	-	-	-
Results Expected Unserved Energy, GWh	133.9	19.7	25.7	3.6	0.4	4.9	-	-	1.5	-	-	-	-	-	-	-	-	-	-	-	-
Results Max Expected Unserved Energy, MW	968.2	602.3	808.1	407.1	172.3	428	-	-	324.3	-	-	-	-	-	0	-	-	-	-	-	-
Results Expected Unserved Energy Events	169	47	20	4	3	3	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0

3.1.6 Preliminary Portfolio A Resulting from Scenario 1 System Costs and PVRR

In addition to achieving adopted targets for RPS and system reliability, minimizing cost is a leading consideration for the recommended expansion planning scenario. Table 10 shows the cost components of Preliminary Portfolio A each year during the planning period and the total PVRR[16] needed to recover the Preliminary Portfolio A costs.

Table 10 includes the annual production costs of the system, including fuel costs, fixed operating and maintenance (O&M) costs, variable O&M costs, and costs associated with unit starts and shutdowns. Also listed are the fixed costs associated with the program costs for demand response programs, distributed BESS programs, and other unit additions. For each year, the total system cost in Table 10 is equal to the sum of the production cost and the fixed cost.

Table 10 shows in bold at the bottom right portion of the table, the PVRR for the Preliminary Portfolio A. The PVRR is the present value sum of the total system cost for each year in the planning horizon and equals $37 billion for the Preliminary Portfolio A. This PVRR value can be compared against the PVRR for other expansion plans to determine the relative ranking among competing expansion plans in a scenario. Finally, the last two columns of Table 10 indicate the production cost $/kWh and the total cost $/kWh, respectively, for each year in the plan.

[16] Regulation 9021 requires in Section 2.03(H)(2)(d)(i) In selecting the Preferred Resource Plan, [LUMA] shall use the minimization of the present value of revenue requirements as the primary selection criterion. (ii) [LUMA] shall also consider other criteria including, but not limited to, system reliability; short and long-term risk; environmental impacts; transmission needs and implications; distribution needs and implications; financial impacts on PREPA; and the public interest as set forth in Act 57-2014. Where meeting these needs is associated with quantifiable costs, these costs shall be included in the calculation of the present value of revenue requirements.

The PVRR is the current value of all future revenue a utility company needs to generate to cover its projected operating expenses, depreciation, taxes, and a reasonable return on investment, calculated using a discount rate to account for the time value of money; essentially, it is the total cost of a proposed resource plan, expressed in today's dollars, that a utility needs to recover from its customers to maintain reliable service and achieve a fair rate of return.

Table 10: Preliminary Portfolio A Resulting from Scenario 1 System Costs and PVRR

Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Fuel Production Cost ($M)	2012	1480	1349	1265	1271	1632	1640	1442	1467	1506	1534	1579	1673	1707	1846	1830	1917	1949	1990	2031
VO&M Production Cost ($M)	110	104	115	104	105	114	114	93	93	93	92	92	94	94	97	97	102	102	102	96
FO&M Production Cost ($M)	707	815	822	675	682	681	672	653	653	640	650	656	584	576	579	585	584	585	588	598
Start & Shutdown Production Cost ($M)	18.8	8.4	5.8	4.6	4.4	3.1	3.1	2.8	2.6	2.7	3.0	3.0	3.0	3.2	3.2	2.9	2.8	3.4	3.1	7.1
Variable Production Costs ($M)	2141	1592	1470	1373	1380	1749	1757	1538	1564	1601	1629	1674	1770	1805	1946	1931	2021	2054	2096	2134
Total Production Cost ($M)	2848	2407	2291	2049	2062	2430	2429	2191	2216	2241	2279	2330	2354	2381	2525	2516	2605	2639	2684	2732
DR Programs Lev. Cost ($M)	0.0	0.0	0.0	0.3	1.6	4.0	7.5	10.7	13.5	16.2	19.4	24.2	31.3	42.2	56.9	72.2	91.4	114.9	137.8	150.2
DBESS Program Cost ($M)	158	246	341	447	566	698	844	1009	1196	1396	1608	1853	2132	2449	2806	3174	3549	3975	4456	4933
Unit Additions Annualized Cap. Costs ($M)	-	16	153	293	389	435	435	552	552	552	552	638	638	638	638	642	642	642	642	642
Unit Additions Capital Costs ($M)	-	-	186	-	-	451	-	1123	-	-	-	817	-	-	-	45	-	-	-	-
Total System Costs ($M)	3006	2669	2786	2789	3019	3567	3715	3764	3978	4205	4459	4845	5155	5510	6026	6404	6888	7372	7921	8458
PVRR ($M)	2577	4696	6743	8641	10544	12625	14633	16515	18358	20162	21932	23714	25469	27206	28965	30696	32420	34128	35827	37507
Total Production Cost, $/kWh	0.153	0.132	0.126	0.114	0.115	0.137	0.138	0.126	0.129	0.131	0.135	0.14	0.143	0.146	0.157	0.157	0.164	0.168	0.172	0.176

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Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Total System Cost, $/kWh	0.162	0.147	0.154	0.155	0.169	0.201	0.211	0.217	0.231	0.246	0.263	0.291	0.313	0.339	0.374	0.401	0.433	0.469	0.508	0.545

3.2 Preliminary Portfolio B Resulting from Scenario 2 Resource Plan Overview

The Preliminary Portfolio B is the least cost resource plan that results from the conditions in Scenario 2, called the “System Stress Scenario,” includes assumptions that would result in higher stress on the system versus the base case in terms of the ability to serve load. The changes in major assumptions compared to the Preliminary Portfolio A are shown in Table 11. The changes include high load growth, low distributed energy resource growth, high resource costs, and no dispatch control over distributed BESS installations. Based on the Preliminary Portfolio B definitions, an optimized expansion plan and production costing model was determined for the system and is reported in this section.

Table 11: Preliminary Portfolio B Resulting from Scenario 2 Major Assumptions vs. Preliminary Portfolio A Resulting from Scenario 1

Scenario	Load Growth	DER Growth PV / BESS	PV Cost	Agri. Land Use	Storage Cost	Resource Capital Cost	Fossil Fuel Cost	Energy Effic.	DBESS control (%)			
									2025	2030	2035	2040
1. Base assumptions	Base	Base / base	Base	Less land	Base	Base	Base	Pr100-Base	5	10	10	10
2. System stress scenario	High	Low/ low	High	Less land	High	High	Base	Pr100-Base	0	0	0	0

3.2.1 Preliminary Portfolio B Resulting from Scenario 2 - System Capacity Balance, Capacity Additions and Retirements

The resource additions and retirements for the Preliminary Portfolio B resulting from Scenario 2 are presented in this section. Also presented is a capacity balance that compares the total installed resources and the total firm resources against the projected peak load for each year in the planning horizon.

provides a graphical representation of the Preliminary Portfolio B resulting from Scenario 2 capacity balance for the 2025 to 2044 planning period. Data for 2024 is also provided for reference. The figure includes the yearly resource additions and retirements during the planning period and includes the total installed resources as well as the total firm resources. Total installed resources include conventional generation, renewable generation, BESS, distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. In the figure, the total firm capacity is lower than the total installed resources given the intermittent nature of renewable energy resources (solar, wind, and hydro), which cannot be counted on to provide the full installed capacity on a firm basis at the time of system peak. BESS resources are also given partial capacity credit in the graph, as is some existing conventional generation having high outage rates.

As shown in Figure 5 the system peak demand is projected to trend slightly downward from 2025 to 2044. Conversely, the total installed resources and firm resources are projected to remain relatively level from 2027 through the remainder of the planning period. Additional details behind the trends shown in .

Figure 5: Preliminary Portfolio B Resulting from Scenario 2 Capacity Balance

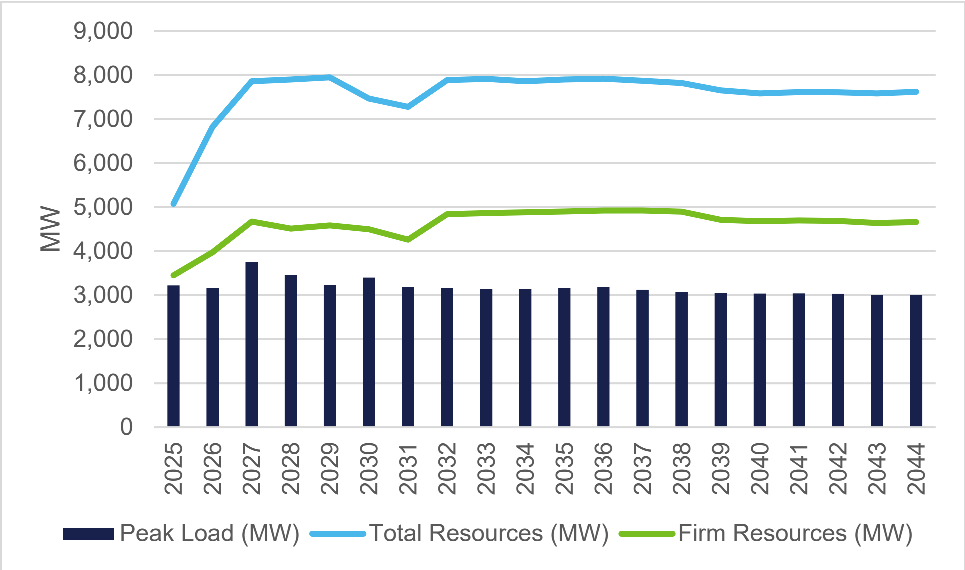

Table 12 presents the Preliminary Portfolio B Resulting from Scenario 2 resource balances year-by-year from 2025 through 2044. Total installed resources are shown for each year. Figure 5 shows the total MW of installed resources, regardless of capacity type. These resources include conventional generation, renewable generation, BESS, distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. This table also shows the firm resources available each year. Firm resources are less than the total installed resources due to reduced capacity values for intermittent renewable generation (wind, solar, and hydro), energy storage resources, and some unreliable conventional generating units now on the system.

The capacity balances in the table indicate that during the planning horizon, there is a positive balance between installed firm resources and peak load. Total firm resources begin at 3,450 MW in 2025 and end at 4,660 MW in 2044. When firm resources are compared to the projected peak demand, the capacity balance (and reserve margin) increases from 227 MW (7 percent) in 2025 to 1,656 MW (55 percent) in 2044. This increase will enable an increasingly reliable system, measured in terms of reduced levels of expected unserved energy, as discussed further below.

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Table 12: Preliminary Portfolio B Resulting from Scenario 2 Capacity Balance

Measure	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Peak MW Demand	3,223	3,168	3,758	3,464	3,233	3,400	3,189	3,165	3,147	3,147	3,167	3,189	3,123	3,068	3,050	3,036	3,041	3,032	3,010	3,004
Total Resources, MW	5,076	6,823	7,859	7,901	7,948	7,466	7,278	7,885	7,913	7,858	7,899	7,917	7,871	7,818	7,654	7,582	7,611	7,607	7,581	7,619
Firm Resources, MW	3,450	3,976	4,673	4,513	4,584	4,498	4,262	4,839	4,866	4,882	4,900	4,924	4,924	4,898	4,712	4,679	4,699	4,686	4,641	4,660
Firm Resources Above Peak Demand, MW (Capacity Reserves)	227	808	915	1,049	1,350	1,098	1,074	1,674	1,718	1,735	1,732	1,735	1,801	1,830	1,663	1,643	1,657	1,654	1,631	1,656
Firm Capacity % Above Peak (Reserve Margin)	7.05	25.49	24.35	30.30	41.77	32.30	33.67	52.88	54.60	55.13	54.69	54.40	57.68	59.64	54.51	54.10	54.49	54.53	54.21	55.11

Table 13 and Table 14 present information on the MW of generator and battery resource additions and retirements that occur under Preliminary Portfolio B Resulting from Scenario 2 Resulting. Combined, the information in the tables indicates significant activity with numerous additions (5,744 MW when including the conversion of conventional generation to burn biodiesel) and retirements (4,215 MW) over the planning period. This activity is primarily driven by the ramping up of renewable energy resources to meet the RPS targets and the targeted reduction of expected unserved energy levels. One (1) 230 kV transmission line was added in Scenario 2 as a component of the optimal expansion plan. The transmission line is added in the year 2030. The line added is the Ponce OE-Ponce ES 230 kV line.

Table 13: Preliminary Portfolio B Resulting from Scenario 2 Resource Addition Summary

[redacted]

Table 14: Preliminary Portfolio B Resulting from Scenario 2 Resource Retirements

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
Coal	-	-	-	(454)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(454)
Diesel	-	-	(147)	-	-	-	-	-	-	(200)	-	-	(48)			(143)	(75)	(75)	-	-	(687)
Fuel Oil	-	-	-	-	-	(530)	(250)	-	-	(350)	-	-	-	-	-	-	-	-	-	-	(1,130)
Landfill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(2)	(2)	-	-	(5)
LNG - EcoElec[17]	-	-	-	-	-	-	-	-	-	-	-	-	-	(350)	(250)	-	-	-	-	-	(600)
LNG – SJ[18]	-	-	-	-	-	(454)	-	-	-	-	-	(210)	-	-	-	-	-	(260)	(150)	(25)	(1,099)
LNG - Trucked	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(37)	(76)	-	-	(20)	(133)
Utility Scale Solar	-	-	-	-	-	-	-	(2)	(20)	-	-	(30)	(55)	-	-	-	-	-	-	-	(107)
Total	**-**	**-**	**(147)**	**(454)**	**-**	**(984)**	**(250)**	**(2)**	**(20)**	**(550)**	**-**	**(240)**	**(103)**	**(350)**	**(250)**	**(180)**	**(153)**	**(337)**	**(150)**	**(45)**	**(4,215)**

[17] EcoEléctrica Natural Gas Power Plant

[18] LNG Units located in San Juan power station

3.2.2 Preliminary Portfolio B Resulting from Scenario 2 Energy Production by Resource and Fuel Type

The Preliminary Portfolio B Resulting from Scenario 2 resource capacity additions will result in a significant change in the energy production by resource and fuel type. Figure 6 shows the year-by-year energy production information. Figure 7 shows the energy production source for selected years from 2025 to 2044. As can be seen in the figures, biodiesel will account for an increasing portion of energy production, while energy from BESS will also increase. Conversely, energy generated from coal will be phased out by the end of 2028, and energy generation from fuel oil and diesel will be phased out by 2030.

Figure 6: Preliminary Portfolio B Resulting from Scenario 2 Energy Production by Source

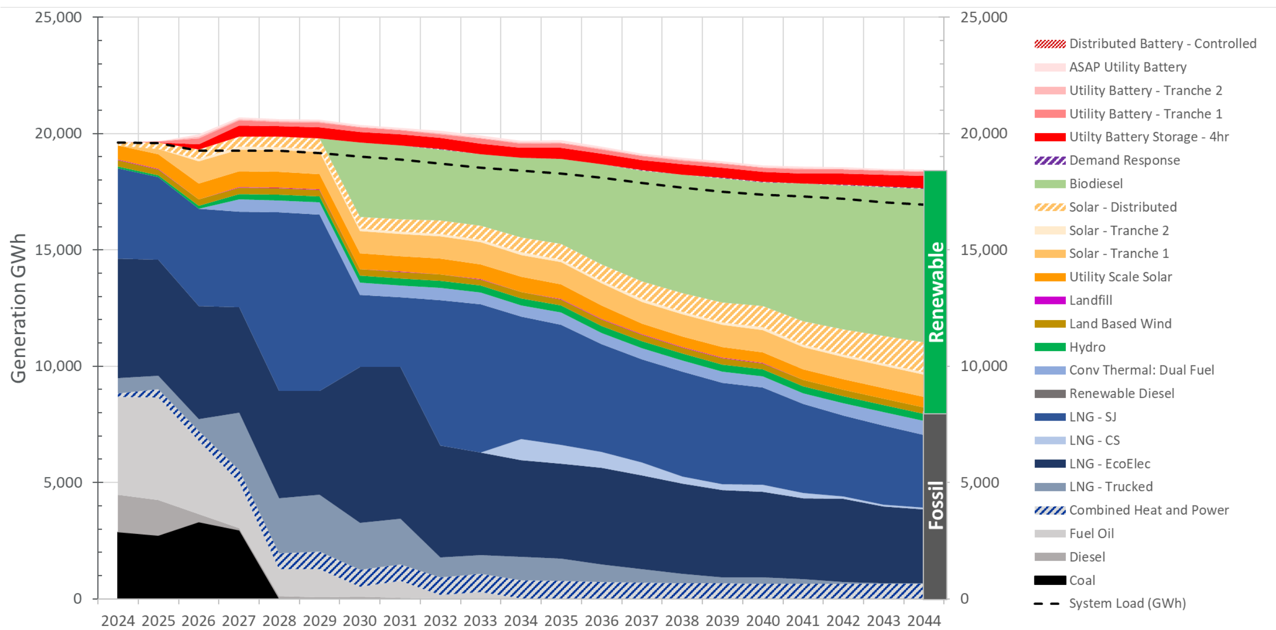

Figure 7: Preliminary Portfolio B Resulting from Scenario 2 Energy Production by Source for Selected Years

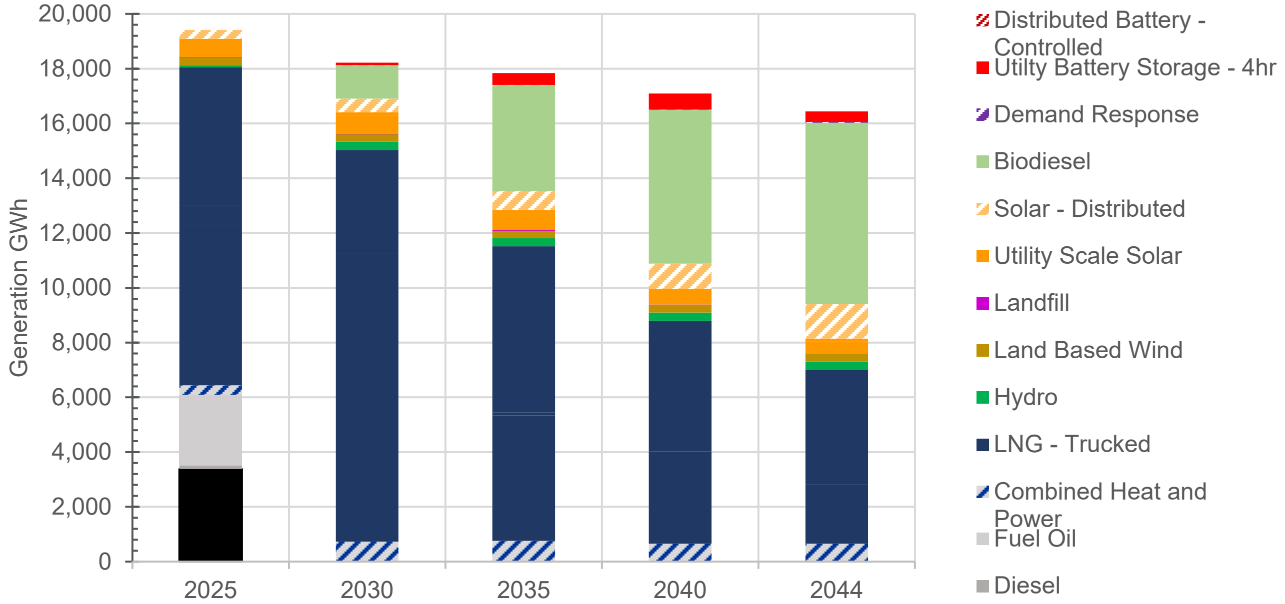

Table 15 provides additional detail on the source of energy production by fuel type and resource. The table shows notable growth in the generation of energy by biodiesel, which counts toward the RPS targets. The switch to biodiesel begins in 2031 in the Preliminary Portfolio B expansion plan. The table also shows the contribution of renewable generation to the overall energy production mix.

Table 15: Preliminary Portfolio B Resulting from Scenario 2 Energy Production by Fuel Type or Resources

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Coal	3383	3399	3049	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel	140	47	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil	2571	1668	206	394	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LNG - EcoElec[19]	5843	5420	4913	4997	4666	8283	8177	5381	4928	4745	4583	4569	4347	3962	3667	3355	3054	2755	2443	2147
LNG – SJ[20]	5023	4813	4750	7054	8057	3766	3390	7114	6886	6429	6057	5474	5147	5065	4898	4774	4618	4431	4297	4206
Hydro	82	116	243	243	243	300	300	301	300	300	300	301	300	300	300	301	300	300	300	301
Utility Scale Solar	675	675	676	677	674	676	675	672	632	631	631	575	457	457	457	458	457	457	457	459
Land Based Wind	269	269	269	270	269	269	269	270	268	268	269	270	269	269	269	269	268	269	269	270
Landfill	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	11	0	0	0
LNG - Trucked	737	991	3252	3560	3046	2257	1956	203	101	129	114	116	83	38	23	14	0	0	0	0
Biodiesel	0	0	0	0	0	1221	1843	2386	2943	3419	3874	4318	4793	5096	5367	5611	5954	6220	6416	6606
Solar - Tranche 1	235	943	945	946	944	943	943	945	944	945	943	946	944	944	945	946	945	944	943	947
Solar - Tranche 2	0	111	111	111	111	111	111	111	111	110	110	111	110	111	111	111	111	111	110	111
Combined Heat and Power	347	426	510	667	751	729	698	742	803	788	757	727	699	677	661	653	654	654	653	653
Dist. Solar	322	408	433	451	471	496	528	564	603	646	686	720	756	801	858	922	993	1076	1171	1272

[19] EcoEléctrica Natural Gas Power Plant

[20] LNG Units located in San Juan power station

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Demand Response	0	0	0	0	1	2	3	4	5	6	6	7	8	10	12	15	18	21	25	27
BESS (all)	0	0	674	767	564	108	115	64	189	324	525	483	568	617	677	679	661	455	428	451

3.2.3 Preliminary Portfolio B Resulting from Scenario 2 RPS Compliance

Puerto Rico has aggressive RPS targets for the contribution of renewable energy resources to the electric utility supply. Act 82-2010, as amended requires in Section 2.3(b):

> "*For each calendar year between 2015 and 2050, the Renewable Portfolio Standard applicable to each retail electricity supplier shall be at least the following minimum percentage:*

Year	*Required Renewable Energy Percentage (%)*
2015 to 2022	*20.0%*
2023 to 2025	*40.0%*
2026 to 2040	*60.0%*
2041 to 2050	*100.0%*

> *The required percentage shall be met by the last year of the period. However, a reasonable progress shall be shown for each year covered in a period, as determined by the Energy Bureau."*

Given that the actual RPS level in 2024 was below 10 percent, it is not realistic to meet the 2025 RPS targets. The goal of this IRP is to meet the 2040 targets and to ramp up to that level aggressively, while reflecting realistic timeframes for implementing new options that will help meet the 2040 RPS targets.

Figure 8 shows the RPS for Preliminary Portfolio B. In the figure, the green line shows the year-by-year RPS percentage achieved. The results achieved are compared to a theoretical ramp rate in the grey dotted line, which allows the overall system to quickly ramp up from the low actual levels of renewable production achieved in 2024 to reach the target of 60 percent mark by 2040. In Preliminary Portfolio B, the RPS levels represented by the grey line were adopted as a "soft" target and the results were reviewed to determine if the "soft" target was met or exceeded during the planning period.

As shown in the figure, the Preliminary Portfolio B expansion plan exceeds the "soft" RPS target ramp rate during in all but one year leading up to 2040, and it also exceeds the 60 percent mandate in 2040. Thereafter, the RPS percentage continues to increase through 2044, leaving the system positioned to meet the 2050 objective of attaining a 100 percent RPS level. Achieving these aggressive RPS targets helps explain the many resource additions that occur on the system and that are reflected in the tables summarizing resource additions and retirements.

Figure 8: Preliminary Portfolio B Resulting from Scenario 2 RPS Percentage Achieved vs the IRP Soft Target

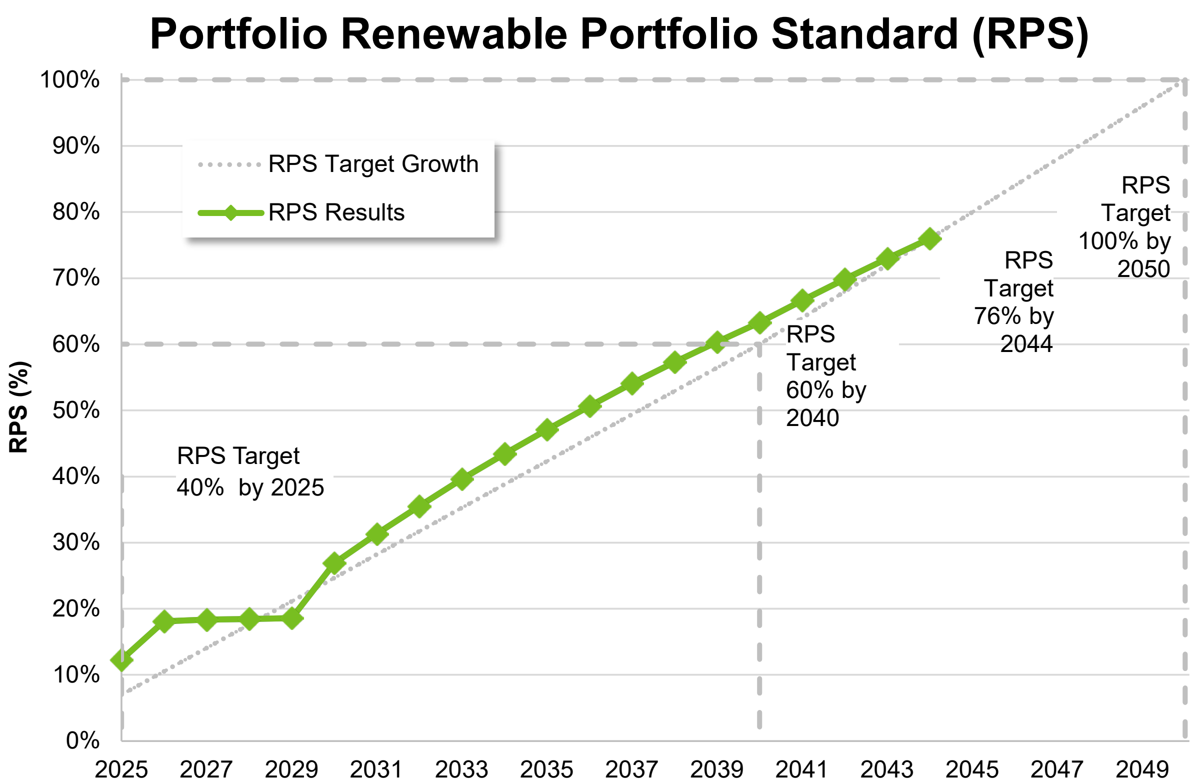

Table 16: Preliminary Portfolio B Resulting from Scenario 2 RPS Compliance vs Target

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
RPS Soft Target, %	7%	11%	14%	18%	21%	25%	28%	32%	35%	39%	42%	46%	49%	53%	56%	60%	64%	68%	72%	76
RPS Results, %	12%	18%	18%	18%	19%	27%	31%	36%	40%	43%	47%	51%	54%	57%	60%	63%	67%	70%	73%	76
Difference	5%	8%	4%	1%	-3%	2%	3%	4%	4%	5%	5%	5%	5%	4%	4%	3%	3%	2%	1%	0
RPS Target, GWh	1,071	1,557	2,056	2,551	3,043	3,500	3,955	4,375	4,792	5,210	5,611	5,962	6,310	6,649	6,975	7,301	7,700	8,006	8,323	8,633
RPS Results, GWh	1,972	2,869	2,882	2,900	2,904	6,156	6,194	5,953	5,944	6,012	6,183	6,491	6,807	6,921	7,423	7,675	7,998	8,211	8,427	8,640
Difference	901	1,312	827	349	(138)	2,655	2,240	1,578	1,152	802	572	529	498	272	448	374	298	205	104	7

3.2.4 Preliminary Portfolio B Resulting from Scenario 2 Emissions

The aggressive movement of Preliminary Portfolio B toward the RPS targets and away from fossil fuel generation has a significant impact on the emission of CO2 over the planning period. Table 17 shows the reduction in CO2 emissions from 12.9 million tons of CO2 emitted in 2025 to 2.7 million tons of CO2 emitted in 2044.

Table 17: Preliminary Portfolio B Resulting from Scenario 2 CO2 Emissions

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Thousand Tons CO2	12,932	11,354	9,785	7,295	7,096	6,560	6,509	5,335	5,156	5,110
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**
Thousand Tons CO2	4,941	4,557	4,221	3,952	3,743	3,754	3,512	3,066	2,855	2,694

3.2.5 Preliminary Portfolio B Resulting from Scenario 2 Expected Unserved Energy

An important component of the expansion plan under consideration in the 2025 IRP is the ability of the plan to improve system reliability. An unreliable power system results in expected unserved energy and a large number of events that disrupt power supply. Table 18 shows the expected unserved energy amounts and expected unserved energy events for the 2025 to 2044 planning period. Information for 2024 is also provided as a reference point.

The Preliminary Portfolio B Resulting from Scenario 2 projects a reduction in expected unserved energy from 59.6 GWh in 2025 to 0 GWh after 2030, with the level of expected unserved energy reaching 0 GWh after 2030. Similarly, the number of hours of expected unserved energy is projected to decrease from 706 hours in 2025 to zero by 2031 and for the remainder of the planning period. Other measures of reliability include the maximum MW of expected unserved energy during an event and the number of events with expected unserved energy. As can be seen in the last two columns of Table 18, there is consistent improvement in these measures, and for most years from 2030 onward, the projection is that there will be no events in most years.

Another important measure of system reliability is the Loss of Load Probability (LOLP). In Puerto Rico, the adopted target is 0.1 days per year, which corresponds to 2.4 hours per year. This IRP adopted a LOLP target number of hours that would reach the 2.4 hours per year requirements by 2038. Table 18 shows the targeted improvement in LOLP hours from 2030 onward. As can be seen in Table 18, the expected unserved energy hours achieved in Preliminary Portfolio of Scenario 2 exceed the LOLP target hours from 2031 onward.

Table 18: Preliminary Portfolio B Resulting from Scenario 2 Expected Unserved Energy Target and Results

Target/ Results	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
LOLP Target Hours	-	-	-	-	-	-	60.6	40.4	26.9	18	12	8	5.3	3.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Results Expected Unserved Energy Hours	1,785	706	424	64	67	31	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Results Expected Unserved Energy, GWh	297.2	59.6	44.2	15.8	13.9	4	37.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Results Max Expected Unserved Energy, MW	1,197.8	782.2	933.8	846.6	847	468.2	1,320.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Results Expected Unserved Energy Events	260	165	94	8	7	9	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.2.6 Preliminary Portfolio B Resulting from Scenario 2 System Costs

In addition to achieving adopted targets for RPS and system reliability, minimizing costs is an important consideration for the recommended expansion planning scenario. Table 19 shows the cost components of Preliminary Portfolio B for each year during the planning period and it indicates the total PVRR needed to recover the Preliminary Portfolio B costs.

Table 19 includes the production costs for the system each year, and these costs include fuel costs, fixed O&M costs, variable O&M costs, and costs associated with unit starts and shutdowns. Also listed are the fixed costs associated with the program costs for demand response programs, distributed BESS programs, and other unit additions. For each year, the total system cost in Table 19 is equal to the sum of the production costs and the fixed costs.

Table 19 shows in bold at the bottom right portion of the table, the PVRR for Preliminary Portfolio B. The PVRR is the present value sum of the total system costs for each year in the planning horizon and equals $42.1 billion for Preliminary Portfolio B. This PVRR figure can be compared to the PVRR for other expansion plans to determine the relative ranking among competing expansion plans in a scenario. Finally, the last two columns of Table 19 show the production $/kWh and the total $/kWh, respectively, for each year of the plan.

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Table 19: Preliminary Portfolio B Resulting from Scenario 2 System Costs: Derivation of Present Value Revenue Requirements (PVRR)

Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Fuel Production Cost ($M)	2228	1687	1520	1449	1456	1733	1782	1609	1649	1712	1775	1887	1972	2049	2087	2128	2303	2325	2373	2432
VO&M Production Cost ($M)	129	112	123	115	116	108	105	103	105	114	114	115	116	118	119	120	123	123	126	129
FO&M Production Cost ($M)	696	804	807	661	669	648	638	653	652	636	645	642	619	602	595	585	581	572	575	583
Start & Shutdown Production Cost ($M)	18.8	10.1	5.8	4.5	4.3	3.2	3.1	2.7	2.7	2.7	2.9	2.8	2.7	3.1	3.0	3.3	3.2	2.8	2.2	2.7
Variable Production Costs ($M)	2376	1809	1649	1569	1577	1844	1890	1714	1757	1829	1892	2004	2091	2170	2209	2251	2430	2451	2501	2564
Total Production Cost ($M)	3072	2614	2456	2230	2246	2492	2528	2367	2409	2464	2537	2646	2710	2772	2804	2836	3011	3023	3076	3147
DR Programs Lev. Cost ($M)	0.0	0.0	0.0	0.3	1.6	4.0	7.5	10.7	13.5	16.2	19.4	24.2	31.3	42.2	56.9	72.2	91.4	114.9	137.8	150.2
DBESS Program Cost ($M)	158	246	341	447	566	698	844	1009	1196	1396	1608	1853	2132	2449	2806	3174	3549	3975	4456	4933
Unit Additions Annualized Cap. Costs ($M)	-	16	471	611	707	730	734	881	881	983	983	991	991	1047	1047	1047	1047	1052	1052	1052
Unit Additions Capital Costs ($M)	-	-	3153	-	-	122	-	1404	-	972	-	41	-	536	-	-	-	47	-	-
Total System Costs ($M)	3230	2876	3269	3288	3521	3925	4114	4268	4499	4859	5147	5513	5865	6311	6715	7130	7699	8166	8723	9282

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Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Present Value Rev. Requirements (PVRR) ($M)	2769	5052	7455	9693	11911	14202	16424	18559	20643	22727	24771	26799	28795	30785	32745	34672	36599	38491	40362	**42206**
Total Production Cost, $/kWh	0.157	0.136	0.128	0.116	0.117	0.131	0.134	0.127	0.13	0.134	0.139	0.146	0.152	0.157	0.16	0.163	0.174	0.176	0.181	0.186
Total System Cost, $/kWh	0.165	0.149	0.17	0.171	0.184	0.207	0.218	0.228	0.243	0.264	0.281	0.305	0.328	0.357	0.383	0.41	0.445	0.475	0.512	0.548

3.3 Preliminary Portfolio C Resulting From Scenario 3 Resource Plan Overview

The Preliminary Portfolio C is the least cost resource plan resulting from the conditions in Scenario 3. It is the "More Agricultural Land Use" scenario and includes the same assumptions as Scenario 1, except that it assumes that more agricultural land is available for the installation of solar and wind generation. This change in assumption compared to Preliminary Portfolio A Resulting from Scenario 1 is shown in Table 20.

Based on the definition of Preliminary Portfolio C, an optimized expansion plan and production costing model was determined for the system using PLEXOS. The results are presented in this section, and it can be seen that the results closely mirror the results of Preliminary Portfolio A. This is because PLEXOS did not select additional renewable solar and wind resources that were available under the more land assumption in Preliminary Portfolio C.

Table 20: Preliminary Portfolio C Resulting from Scenario 3 Major Assumptions vs Preliminary Portfolio A Resulting from Scenario 1

Scenario	Load Growth	DER Growth PV / BESS	PV Cost	Agri. Land Use	Storage Cost	Resource Capital Cost	Fossil Fuel Cost	Energy Effic.	DBESS Control (%)			
									2025	2030	2035	2040
1. Base Assumptions	Base	Base / Base	Base	Less Land	Base	Base	Base	PR100-Base	5	10	10	10
3. More Ag. Land Use	Base	Base/ Base	Base	More Land	Base	Base	Base	PR100-Base	5	10	10	10

3.3.1 Preliminary Portfolio C Resulting from Scenario 3 System Capacity Balance, Capacity Additions and Retirements

The resource additions and retirements for Preliminary Portfolio C is the least cost resource plan resulting from the conditions in Scenario 3, as it is presented in this section. Also presented is a capacity balance, which compares the total installed resources and the total firm resources to the projected peak load for each year in the planning horizon.

Figure 9 is a graphical representation of the Preliminary Portfolio C capacity balance from the 2025 to 2044 planning period. Data for 2024 is also provided for reference. The figure shows the yearly resource additions and retirements during the planning period and includes total installed resources as well as the total firm resources. Total installed resources include conventional generation, renewable generation, BESS, distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. In the figure, total firm capacity is lower than total installed resources given the intermittent nature of renewable energy resources (solar, wind, and hydro), which cannot be counted on to provide the full installed capacity on a firm basis at the time of system peak. BESS resources are also given partial capacity credit in the graph, as are some existing but unreliable conventional generating units with high outage rates.

As shown in Figure 9, the system peak demand is projected to generally trend downward from 2025 to 2044. Additional details behind the trends shown in Figure 9 are provided in Table 21.

Figure 9: Preliminary Portfolio C Resulting from Scenario 3 Capacity Balance

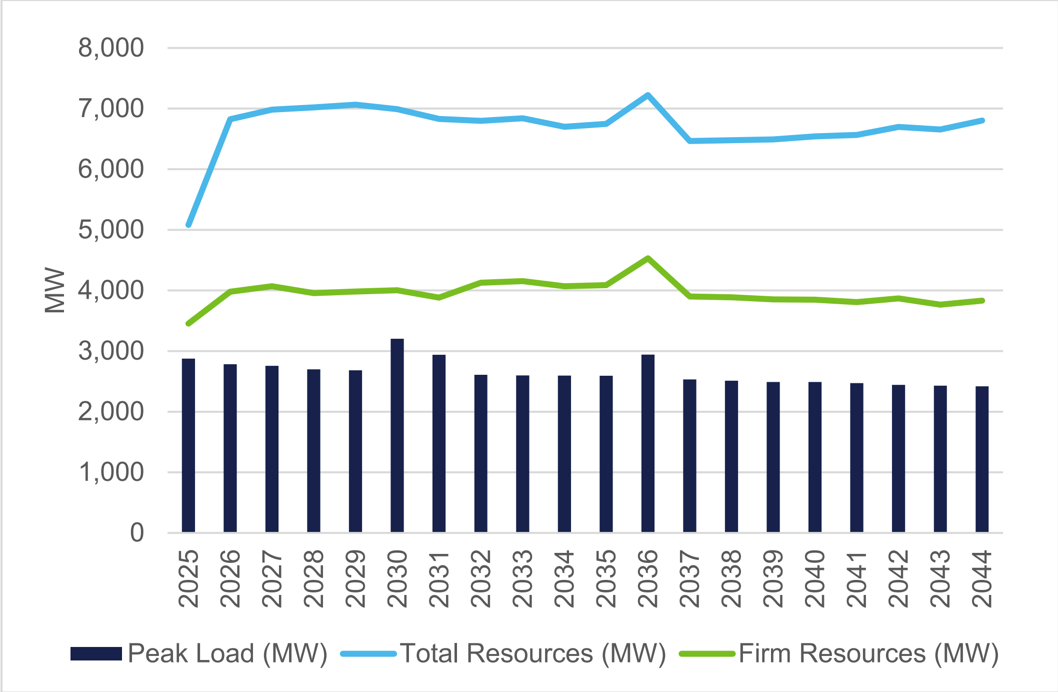

Table 21 shows the Preliminary Portfolio C resource balances year-by-year from 2025 through 2044. For each year shown, the total installed resource figure reflects the total MW of installed resources, regardless of capacity type. These resources include conventional generation, renewable generation, BESS, distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. This table also shows the firm resources available each year. Firm resources are less than the total installed resources due to reduced capacity values for intermittent renewable generation (wind, solar, and hydro), BESS resources, and some conventional generating with high outage rates.

The capacity balances in the table show that during the planning horizon, there is a positive balance between firm resources installed and peak load. Total firm resources begin at 3,453 MW in 2025 and end at 3,831 MW in 2044. When firm resources are compared to the projected peak demand, the capacity balance (and reserve margin) increases from 579 MW (20.13 percent) in 2025 to 1,413 MW (58.41 percent) in 2044. This will enable an increasingly reliable system, measured in terms of reduced levels of expected unserved energy, as discussed further below.

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Table 21: Capacity Balance for Preliminary Portfolio C Resulting from Scenario 3

Measure	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Peak MW Demand	2875	2784	2756	2698	2684	3202	2939	2608	2599	2596	2593	2940	2532	2512	2491	2489	2472	2443	2430	2419
Total Resources MW	5081	6824	6983	7020	7065	6991	6830	6798	6839	6700	6747	7222	6465	6479	6492	6542	6565	6697	6654	6804
Firm Resources, MW	3453	3980	4070	3956	3982	4004	3882	4127	4155	4070	4089	4531	3902	3887	3852	3847	3807	3869	3767	3831
Firm Resources Above Peak Demand, MW (Capacity Reserves)	579	1195	1314	1258	1299	802	944	1519	1556	1474	1496	1590	1370	1375	1361	1358	1335	1426	1337	1413
Firm Capacity % Above Peak (Reserve Margin)	20.13	42.93	47.70	46.64	48.40	25.04	32.11	58.23	59.86	56.77	57.67	54.09	54.10	54.74	54.62	54.57	54.01	58.36	55.00	58.41

Table 22 and Table 23 present information on the MW of generator and battery resource additions and retirements that occur under Preliminary Portfolio C. Combined, the information in the tables indicates significant activity with numerous additions (6,949 MW when including the conversion of conventional generation to burn biodiesel) and retirements (5,033 MW) over the planning period. This activity is primarily driven by the ramping up of renewable energy resources to meet RPS targets and the targeted reduction of expected unserved energy levels. Two (2) 115 kV transmission lines are added in the Preliminary Portfolio C. The lines added are: 1) a 115 kV line between Caguas and Carolina; and 2) a 115 kV line between Caguas and San Juan. These two (2) transmission lines will be added in the year 2030.

Table 22: Preliminary Portfolio C Resulting from Scenario 3 Resource Addition Summary Planning Horizon

[redacted]

Table 23: Preliminary Portfolio C Resulting From Scenario 3 Resource Retirements

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total

Coal	-	-	-	(454)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(454)
Diesel	-	-	(147)	-	-	-	-	(100)	-	(195)	-	-	(170)	(75)	-	-	-	-	-	-	(687)
Fuel Oil	-	-	-	-	-	(350)	(230)	(550)	-	-	-	-	-	-	-	-	-	-	-	-	(1,130)
Landfill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(2)	(2)	-	-	(5)
LNG - EcoElec[21]	-	-	-	-	-	-	-	-	-	-	-	-	(600)	-	-	-	-	-	-	-	(600)
LNG – SJ[22]	-	-	-	-	-	(454)	-	-	-	-	-	-	-	-	(301)	(285)	(100)	-	-	(551)	(1,691)
LNG - Trucked	-	-	-	-	-	-	-	-	-	-	-	(17)	(17)	(9)	(25)	-	(25)	(40)	(226)	-	(359)
Utility Scale Solar	-	-	-	-	-	-	-	(2)	(20)	-	-	(30)	(55)	-	-	-	-	-	-	-	(107)
Total	-	-	**(147)**	**(454)**	-	**(804)**	**(230)**	**(652)**	**(20)**	**(195)**	-	**(47)**	**(842)**	**(84)**	**(326)**	**(285)**	**(127)**	**(42)**	**(226)**	**(551)**	**(5,033)**

[21] EcoEléctrica Natural Gas Power Plant

[22] LNG Units located in San Juan power station

3.3.2 Preliminary Portfolio C Resulting from Scenario 3 Energy Production by Resource and Fuel Type

The Preliminary Portfolio C is the least cost resource plan that results from the conditions in Scenario 3. The resource capacity additions in Portfolio C will result in a significant change in energy production by resource and fuel type. Figure 10 shows the year-by-year energy production information, and Figure 11 shows the source of energy production for selected years from 2025 to 2044. As can be seen in the figures, biodiesel will account for an increasing portion of energy production, while energy from BESS will also increase. Conversely, energy generated from coal will be phased out by the end of 2028 and energy generation from fuel oil will be phased out by 2032 of the planning period.

Figure 10: Preliminary Portfolio C Resulting from Scenario 3 Energy Production by Source

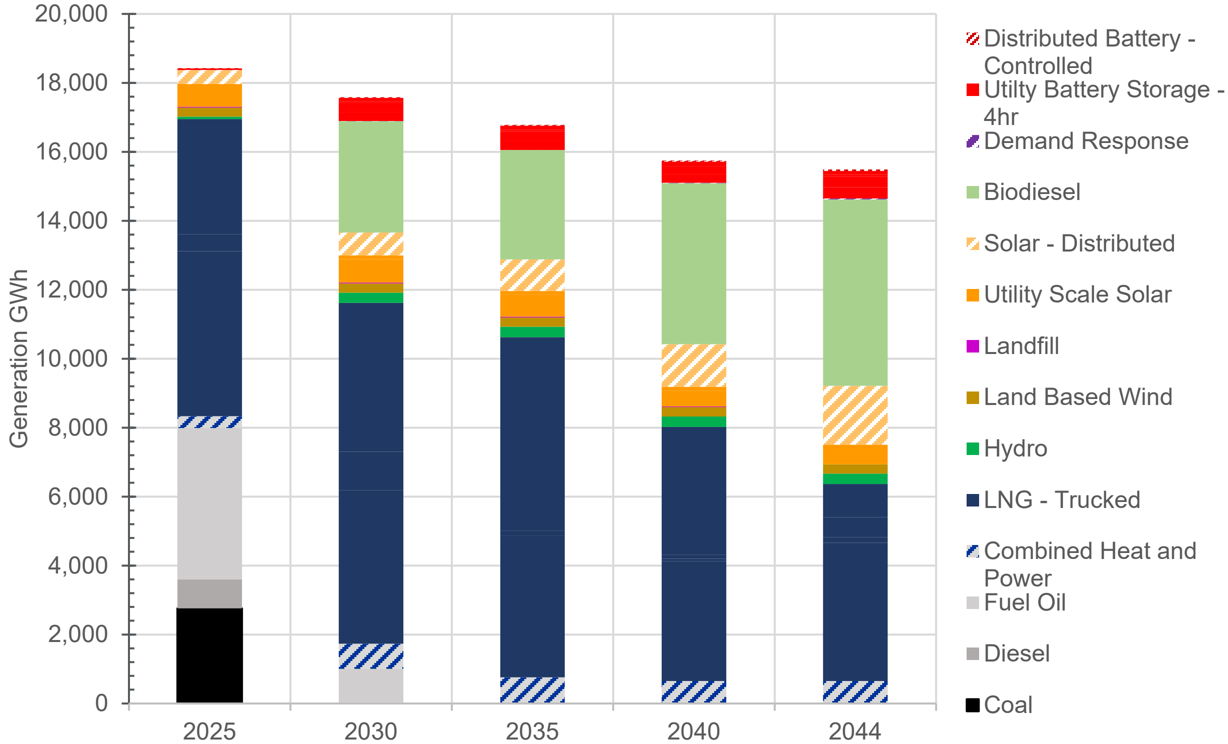

Figure 11: Preliminary Portfolio C Resulting from Scenario 3 Energy Production by Technology or Fuel

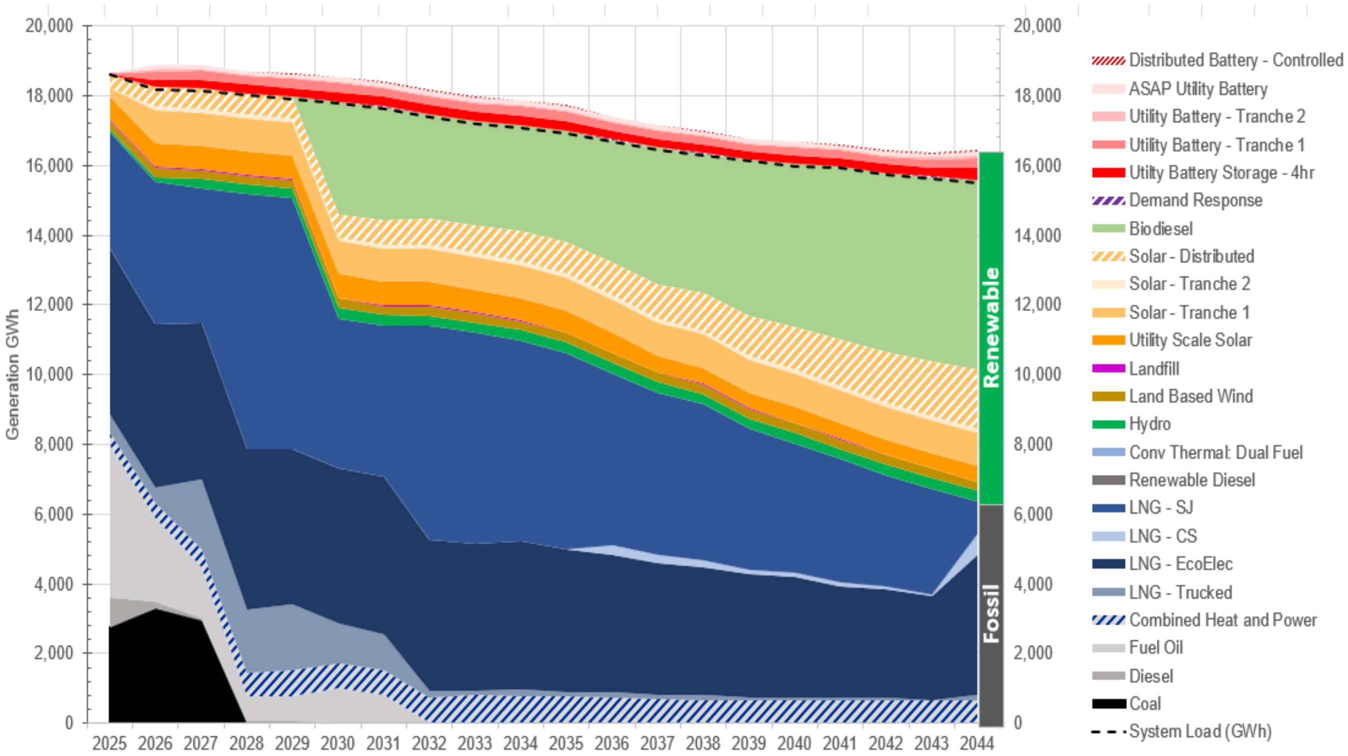

Table 24 provides additional detail on the source of energy production by fuel type and resource. The table shows notable growth in the generation of energy by biodiesel, which counts toward the RPS target. The switch to biodiesels begins in 2031 in the Preliminary Portfolio C expansion plan. The table also shows the contribution of renewable generation to the overall energy production mix.

Table 24: Preliminary Portfolio C Resulting from Scenario 3 Energy Production by Fuel Type or Resource

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Coal	2760	3291	2951	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diesel	841	215	72	69	78	37	17	12	8	4	2	1	1	1	2	1	0	1	1	1
Fuel Oil	4387	2390	1457	703	715	966	792	0	0	0	0	0	0	0	0	0	0	0	0	0
LNG - EcoElec[23]	4781	4673	4505	4585	4450	4457	4519	4339	4178	4250	4111	3920	3780	3662	3543	3476	3208	3105	2993	4007
LNG – SJ[24]	3336	4107	3873	7352	7234	4313	4347	6136	6066	5753	5620	4942	4658	4494	4041	3704	3540	3193	3040	957
Hydro	71	116	243	244	243	301	300	301	301	300	300	301	300	300	300	301	300	300	300	301
Utility Scale Solar	660	677	677	680	676	677	677	675	633	633	633	576	458	458	458	459	458	458	459	460
Land Based Wind	263	270	270	271	269	269	269	270	269	269	270	271	269	270	270	271	268	270	269	271
Landfill	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	11	0	0	0
LNG - Trucked	499	448	1990	1821	1854	1112	1029	162	140	178	136	165	108	126	79	68	73	77	6	164
Biodiesel	0	0	0	0	0	3233	3251	2981	2990	3027	3173	3507	3923	4002	4466	4667	4956	5121	5275	5405
Solar - Tranche 1	233	945	946	948	946	945	945	947	946	947	945	948	946	946	946	948	946	946	945	948
Solar - Tranche 2	0	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Combined Heat and Power	347	426	510	667	751	730	698	742	803	788	757	727	699	677	661	653	654	654	652	653
Dist. Solar	410	547	580	604	630	664	707	756	808	865	919	964	1014	1074	1150	1236	1332	1443	1571	1707
Demand Response	0	0	0	0	0	2	3	4	5	4	2	7	7	10	12	13	16	21	25	27
BESS (All)	55	641	698	638	665	706	722	714	709	737	740	675	645	657	612	656	619	648	699	855

[23] EcoEléctrica Natural Gas Power Plant

[24] LNG Units located in San Juan power station

3.3.3 Preliminary Portfolio C Resulting from Scenario 3 RPS Compliance

Puerto Rico has aggressive RPS targets for the production of renewable energy resources. The mandate is to achieve an RPS target of 40 percent by 2025, 60 percent by 2040, and 100 percent by 2050. Given that the actual RPS level in 2024 was below 10 percent, it is not realistic to meet the 2025 RPS targets. The goal of this IRP is to meet the 2040 target and to ramp up to that level aggressively, while reflecting realistic timeframes for implementing new options that will help meet the 2040 RPS targets.

Figure 12 shows the RPS results for Preliminary Portfolio C. In the figure, the green line shows the year-by-year RPS percentage achieved. The results achieved are compared to a theoretical ramp rate in the grey dotted line, which allows the overall system to quickly ramp up from the low actual levels of renewable production achieved in 2024 to meet the targeted 60 percent mark by 2040. In Preliminary Portfolio C, the RPS levels represented by the grey line were adopted as a “soft” target and the results were reviewed to determine if the “soft” target was met or exceeded during the planning period.

As shown in the figure, the Preliminary Portfolio C expansion plan exceeds the “soft” RPS target ramp rate in all but one year leading up to 2040, and also exceeds the 60 percent mandate in 2040. Thereafter, the RPS percentage continues to increase through 2044, leaving the system primed to meet the 2050 objective of attaining a 100 percent RPS level. Achieving these aggressive RPS targets helps explain the many resource additions that occur on the system and are reflected in the tables summarizing resource additions and retirements.

Figure 12: Preliminary Portfolio C Resulting from Scenario 3 RPS Percentage Achieved vs the IRP Soft Target

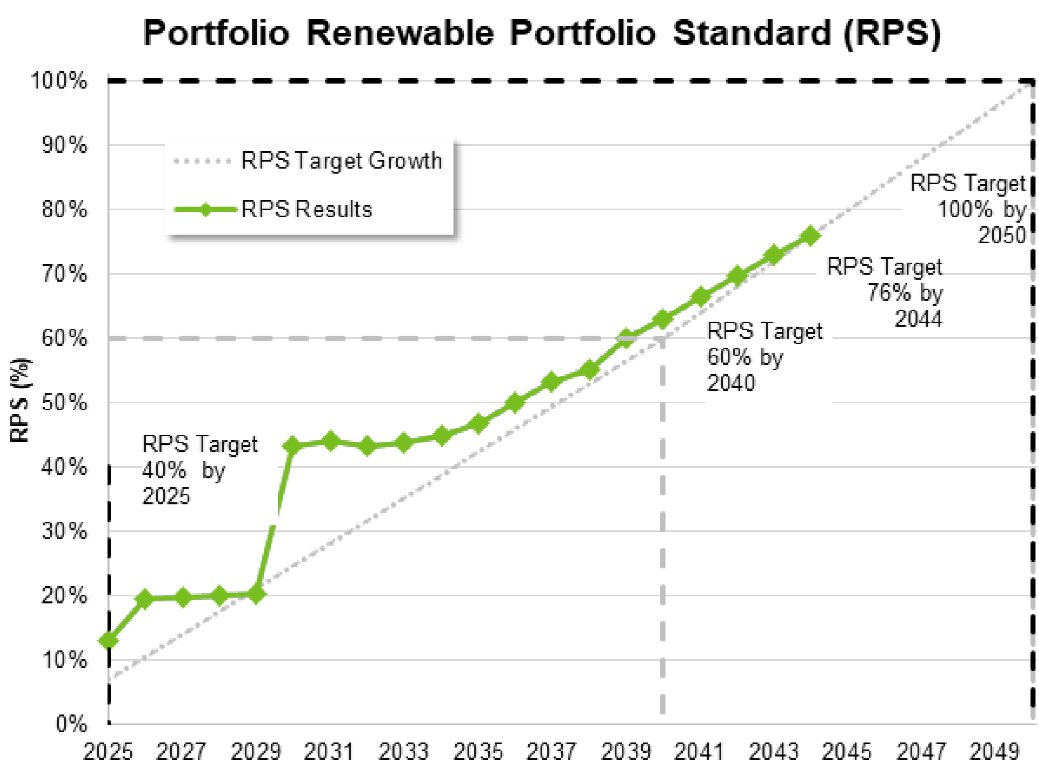

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Table 25: Preliminary Portfolio C Resulting from Scenario 3 RPS Compliance vs Target

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
RPS Soft Target, %	7	11	14	18	21	25	28	32	35	39	42	46	49	53	56	60	64	68	72	76
RPS Results, %	13	19	20	20	20	43	45	43	43	45	47	50	54	57	60	63	66	70	73	76
Difference	6	8	6	2	(1)	18	17	11	8	6	5	4	5	4	4	3	2	2	1	0
RPS Target, GWh	1071	1557	2056	2551	3043	3500	3955	4375	4792	5210	5611	5962	6310	6649	6975	7301	7700	8006	8323	8633
RPS Results, GWh	1972	2869	2882	2900	2904	6156	6194	5953	5944	6012	6183	6491	6807	6921	7423	7675	7998	8211	8427	8640
Difference	901	1312	827	349	-138	2655	2240	1578	1152	802	572	529	498	272	448	374	298	205	104	7

3.3.4 Preliminary Portfolio C Resulting from Scenario 3 Emissions

The Preliminary Portfolio C aggressive movement toward the RPS targets and away from fossil fuel generation has a significant impact on CO2 emissions over the planning period. Table 26 shows the reduction in CO2 emissions from 11.9 million tons of CO2 emitted in 2025 to less than 3.5 million tons of CO2 emitted in 2044.

Table 26: Preliminary Portfolio C Resulting from Scenario 3 CO2 Emissions

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Thousand Tons CO2	11,937	10,388	9,115	6,557	6,382	5,565	5,420	4,701	4,529	4,461
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**
Thousand Tons CO2	4,261	4,060	3,962	3,837	3,839	3,299	3,129	2,815	2,671	3,464

3.3.5 Preliminary Portfolio C Resulting from Scenario 3 Expected Unserved Energy

An important component of the expansion plan under consideration in the 2025 IRP is the ability of the plan to improve system reliability. An unreliable power system results in expected unserved energy and a large number of events that disrupt power supply. Table 27 shows the expected unserved energy amounts and expected unserved energy events for the 2025 to 2044 planning period. Information for 2024 is also provided as a reference point.

The Preliminary Portfolio C results anticipate a reduction in expected unserved energy from 19.7 GWh in 2025 to 0 GWh from 2033 onward. Similarly, the number of hours of expected unserved energy is projected to decrease from 185 hours in 2025 to zero after 2032. Other measures of reliability include the maximum MW of expected unserved energy during an event and the number of events with expected unserved energy. As can be seen in the last two columns of Table 27, there is consistent improvement in these measures, and from 2033 onward the projection is that there are no events.

Another important measure of system reliability is the LOLP. In Puerto Rico, the adopted target is 0.1 days per year, which corresponds to 2.4 hours per year. This IRP adopted a LOLP target number of hours that would meet the 2.4 hours per year requirements by 2038. Table 27 shows the targeted improvement in LOLP hours from 2030 onward. As can be seen in Table 27, the expected unserved energy hours achieved in Preliminary Portfolio C are less than the LOLP target hours from 2030 onward.

Table 27: Preliminary Portfolio C Resulting from Scenario 3 Expected Unserved Energy Target and Results

Target/ Results	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
LOLP Target Hours	-	-	-	-	-	-	60.6	40.4	26.9	18	12	8	5.3	3.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Results Expected Unserved Energy Hours	976	185	116	22	8	24	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-
Results Expected Unserved Energy, GWh	133.9	19.7	25.6	3.6	0.4	4.9	-	-	1.5	-	-	-	-	-	-	-	-	-	-	-	-
Results Max Expected Unserved Energy, MW	968.2	602.4	808.1	354	227.2	329.4	-	-	324.3	-	-	-	-	-	-	-	-	-	-	-	-
Results Expected Unserved Energy Events	169	46	19	4	3	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0

3.3.6 Preliminary Portfolio C Resulting from Scenario 3 System Costs

In addition to achieving adopted targets for RPS and system reliability, minimizing costs is an important consideration for the recommended expansion planning scenario. Table 28 shows the cost components of Preliminary Portfolio C each year during the planning period and it indicates the total PVRR needed to recover the costs of Preliminary Portfolio C.

Table 28 includes the production costs of the system each year, including include fuel costs, fixed O&M costs, variable O&M costs, and costs associated with unit starts and shutdowns. Also listed are the fixed costs associated with the program costs for demand response programs, distributed BESS programs, and other unit additions. For each year, the total system cost in Table 28 is equal to the sum of the production costs and the fixed costs.

Table 28 shows in bold at the bottom right portion of the table, the PVRR for Preliminary Portfolio C. The PVRR is the present value sum of the total system costs for each year in the planning horizon and equals $37.5 billion for Preliminary Portfolio C. This PVRR figure can be compared to the PVRR for other expansion plans to determine the relative ranking among competing expansion plans in a scenario. Finally, the last two columns of Table 28 show the production $/kWh and the total $/kWh, respectively, for each year in the plan.

Table 28: System Costs: Derivation of Present Value Revenue Requirements (PVRR)

Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Fuel Production Cost ($M)	2015	1480	1349	1265	1267	1634	1642	1442	1467	1506	1534	1580	1673	1708	1845	1832	1915	1950	1991	2031
VO&M Production Cost ($M)	110	104	115	104	106	113	114	93	93	93	92	92	94	94	97	98	102	102	102	96
FO&M Production Cost ($M)	707	815	822	675	682	681	672	653	653	640	650	656	584	576	579	585	584	585	588	598
Start & Shutdown Production Cost ($M)	18.8	8.4	5.8	4.5	4.4	3.2	3.2	2.8	2.7	2.8	3.0	3.1	2.9	3.2	3.3	3.1	2.8	3.3	3.1	6.7
Variable Production Costs ($M)	2144	1592	1469	1374	1377	1750	1759	1538	1563	1601	1629	1675	1770	1806	1946	1933	2020	2055	2097	2134
Total Production Cost ($M)	2850	2407	2291	2049	2060	2431	2431	2191	2216	2241	2279	2331	2354	2382	2525	2517	2604	2640	2685	2732
DR Programs Lev. Cost ($M)	0.0	0.0	0.0	0.3	1.6	4.0	7.5	10.7	13.5	16.2	19.4	24.2	31.3	42.2	56.9	72.2	91.4	114.9	137.8	150.2
DBESS Program Cost ($M)	158	246	341	447	566	698	844	1009	1196	1396	1608	1853	2132	2449	2806	3174	3549	3975	4456	4933
Unit Additions Annualized Cap. Costs ($M)	-	16	95	230	326	372	372	489	489	489	489	575	575	575	575	580	580	580	580	580
Unit Additions Capital Costs ($M)	-	-	186	-	-	451	-	1123	-	-	-	817	-	-	-	45	-	-	-	-
Total System Costs ($M)	3008	2669	2728	2726	2953	3505	3654	3700	3915	4143	4396	4782	5092	5448	5963	6343	6824	7309	7859	8395

First Interim 2025 IRP Filing

Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Present Value Rev. Requirements (PVRR) ($M)	2579	4698	6703	8558	10420	12465	14439	16290	18103	19880	21626	23385	25118	26836	28576	30291	31998	33692	35378	**37046**
Total Production Cost, $/kW	0.153	0.132	0.126	0.114	0.115	0.137	0.138	0.126	0.129	0.131	0.135	0.14	0.143	0.146	0.157	0.157	0.164	0.168	0.172	0.176
Total System Cost, $/kWh	0.162	0.147	0.154	0.155	0.168	0.201	0.211	0.216	0.231	0.246	0.263	0.291	0.313	0.339	0.374	0.401	0.433	0.469	0.508	0.541

3.4 Preliminary Portfolio D Resulting from Scenario 4 Resource Plan Overview

The Preliminary Portfolio D is the least cost resource plan resulting from the conditions in Scenario 4. The Preliminary Portfolio D is referred to as the "Optimistic Load Growth and Cost Scenario" and includes assumptions that result in higher load growth and lower resource capital costs for candidate resources from which PLEXOS can select. The changes in major assumptions compared to Preliminary Portfolio A of Scenario 1 are shown in Table 29. The changes include high load growth, low distributed energy resource growth, high resource costs, and no dispatch control for distributed BESS installations. Based on these scenario definitions, an optimized expansion plan and production costing model was determined for the system and is presented in this section.

Table 29: Preliminary Portfolio D Resulting from Scenario 4 Major Assumptions vs Preliminary Portfolio A Resulting from Scenario 1

Scenario	Load Growth	DER Growth PV / BESS	PV Cost	Agri. Land Use	Storage Cost	Resource Capital Cost	Fossil Fuel Cost	Energy Effic.	DBESS Control (%)			
									2025	2030	2035	2040
1. Base Assumptions	Base	Base / Base	Base	Less Land	Base	Base	Base	PR100 -Base	5	10	10	10
4. Optimistic Load Growth and Costs	High	High/ High	Low	More Land	Low	Low	Low	PR100 -Base	5	15	20	20

3.4.1 Preliminary Portfolio D Resulting from Scenario 4 System Capacity Balance, Capacity Additions and Retirements

The resource additions and retirements for Preliminary Portfolio D are presented in this section. Also presented is a capacity balance, which compares the total installed resources and the total firm resources to the projected peak load for each year in the planning horizon.

Figure 13 is a graphical representation of the Preliminary Portfolio D capacity balance from the 2025 to 2044 planning period. Data for 2024 is also provided for reference. The figure shows the yearly resource additions and retirements during the planning period and includes total installed resources as well as the total firm resources. Total installed resources include conventional generation, renewable generation, BESS, distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. In the figure, the total firm capacity is lower than the total installed resources given the intermittent nature of renewable energy resources (solar, wind, and hydro), which cannot be counted on to provide the full installed capacity on a firm basis at the time of system peak. BESS resources are also given partial capacity credit in the graph, as are some existing conventional generating units with high outage rates.

As shown in Figure 13, the system peak demand is projected to generally trend downward from 2025 to 2044. Conversely, firm resources are projected to remain relatively level from 2027 through the remainder planning period. Additional detail behind the trends is shown in Figure 13.

Figure 13: Preliminary Portfolio D Resulting from Scenario 4 Capacity Balance

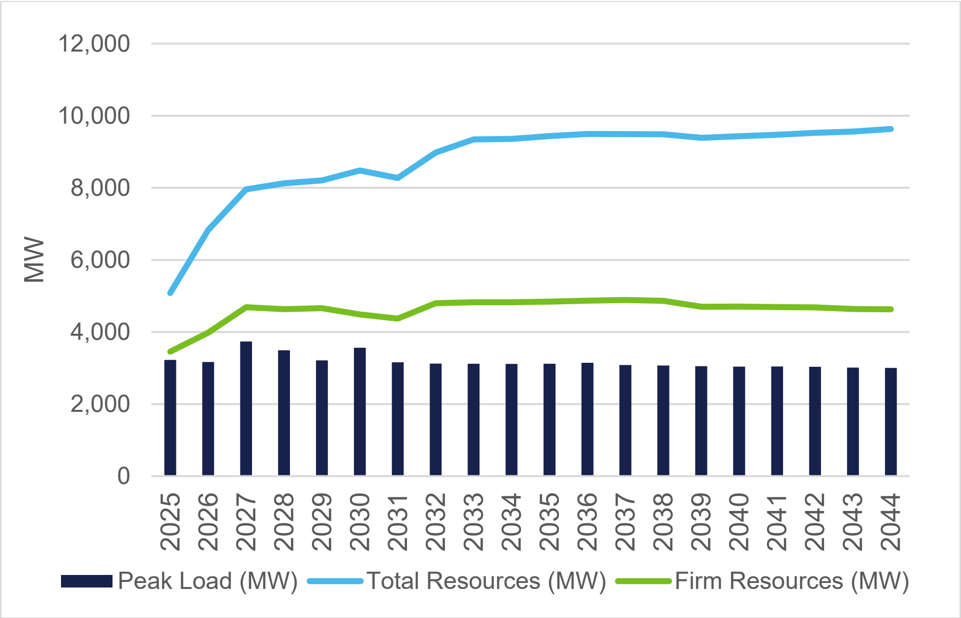

Table 30 shows the Preliminary Portfolio D resource balances year-by-year from 2025 through 2044. For each year shown, the total installed resource figure reflects the total MW of installed resources regardless of capacity type. These resources include conventional generation, renewable generation, BESS, distributed storage under utility control, distributed solar export to the grid, and the capacity impact of demand response programs. This table also shows the firm resources available each year. Firm resources are less than the total installed resources due to reduced capacity values for intermittent renewable generation (wind, solar, and hydro), energy storage resources, and some existing conventional generating units with high outage rates.

The capacity balances in the table show that during the planning horizon, there is a positive balance between firm resources installed and peak load. Total firm resources begin at 3,453 MW in 2025 and end at 4,631 MW in 2044. When firm resources are compared to the projected peak demand, the capacity balance (and reserve margin) grows from 230 MW (7 percent) in 2025 to 1,627 MW (54 percent) in 2044. This will enable an increasingly reliable system, measured by the reduced level of expected unserved energy, as discussed further below.

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Table 30: Capacity Balance for Preliminary Portfolio D Resulting from Scenario 4

Measure	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Peak MW Demand	3,223	3,168	3,737	3,492	3,213	3,563	3,158	3,124	3,118	3,116	3,120	3,146	3,085	3,068	3,050	3,036	3,041	3,032	3,010	3,004
Total Resources, MW	5,081	6,830	7,955	8,128	8,208	8,483	8,273	8,979	9,342	9,358	9,438	9,496	9,493	9,485	9,388	9,435	9,471	9,525	9,561	9,633
Firm Resources, MW	3,453	3,980	4,686	4,633	4,661	4,487	4,372	4,797	4,826	4,823	4,844	4,869	4,888	4,864	4,698	4,703	4,692	4,682	4,639	4,631
Firm Resources Above Peak Demand, MW (Capacity Reserves)	230	812	949	1,141	1,448	924	1,214	1,673	1,708	1,708	1,724	1,723	1,803	1,796	1,648	1,667	1,651	1,649	1,630	1,627
Firm Capacity % Above Peak (Reserve Margin)	7	26	25	33	45	26	38	54	55	55	55	55	58	59	54	55	54	54	54	54

Table 31 and Table 32 provide information on the MW of generator and battery resources additions and retirements that occur under Preliminary Portfolio D. Combined, the information in the tables indicates significant activity with numerous additions (8,581 MW when including the conversion of conventional generation to burn biodiesel) and retirements (3,875 MW) over the planning period. This activity is primarily driven by the ramping up of renewable energy resources to meet the RPS targets and the targeted reduction of expected unserved energy levels. No transmission lines were added in Scenario 4 as a component of the optimal expansion plan.

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Table 31: Preliminary Portfolio D Resulting from Scenario 4 Resource Addition Summary

[redacted]

[redacted]

Table 32: Preliminary Portfolio D Resulting from Scenario 4 Resource Retirements

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	Total
Coal	-	-	-	454	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	454
Diesel	-	-	147	-	-	-	-	-	-	200	-	-	48	-	-	95	123	75	-	-	687
Fuel Oil	-	-	-	-	-	350	530	160		90	-	-	-	-	-	-	-	-	-	-	1,130
Landfill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	5
LNG - EcoElec[25]	-	-	-	-	-	-	-	-	-	-	-	-	-	350	250	-	-	-	-	-	600
LNG – SJ[26]	-	-	-	-	-	-	-	-	-	-	454	-	-	-	-	-	-	50	125	75	704
LNG - Trucked	-	-	-	-	-	-	9	34	50	-	-	-	-	-	-	-	-	-	25		118
Utility Scale Solar	-	-	-	-	-	-	-	2	20	6	6	36	61	6	6	6	6	6	6	6	177
Total	-	-	**147**	**454**	-	**350**	**539**	**196**	**70**	**296**	**460**	**36**	**109**	**356**	**256**	**101**	**131**	**134**	**156**	**81**	**3,875**

[25] EcoEléctrica Natural Gas Power Plant

[26] LNG Units located in San Juan power station

3.4.2 Preliminary Portfolio D Resulting from Scenario 4 Energy Production by Resource and Fuel Type

The Preliminary Portfolio D resource capacity additions will result in a significant change in energy production by resource and fuel type. Figure **14** shows the source of energy production for selected years from 2025 to 2044. As can be seen in the figure, biodiesel will account for an increasing portion of energy production while energy from BESS will also increase. Conversely, energy generated from coal is phased out by the end of 2028 and energy generation by fuel oil (phased out by 2032) is also phased out during the planning period. Figure 14 shows year-by-year energy production information.

Figure 14: Preliminary Portfolio D Resulting from Scenario 4Energy Production by Source

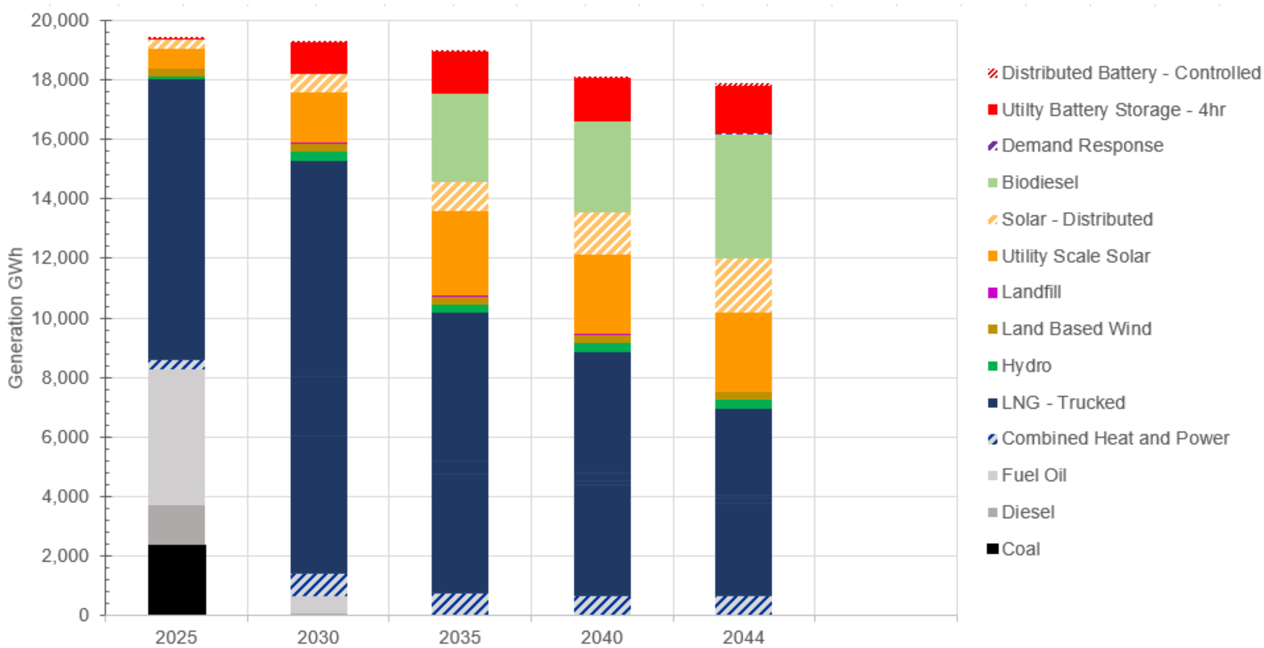

Figure 15: Preliminary Portfolio D Resulting From Results of Scenario 4 Energy Production by Technology or Fuel

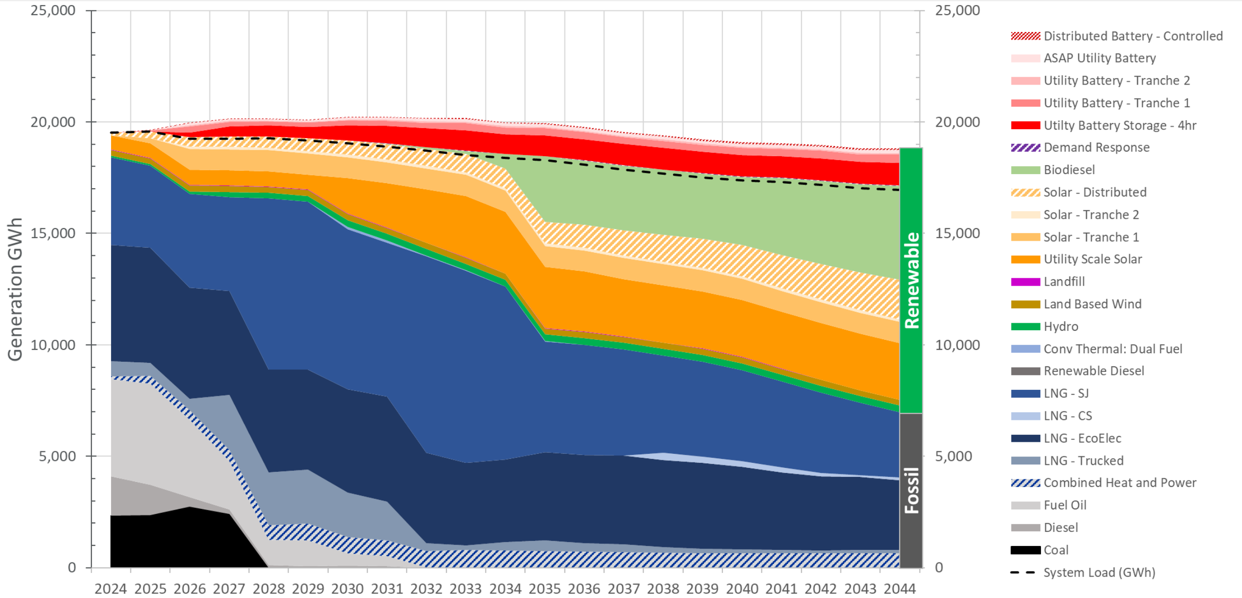

Table 33 provides additional detail about the source of energy production by fuel type and resource. The table shows notable growth in the generation of energy by biodiesel, which counts toward the RPS target. The switch to biodiesel begins in 2031 in the Preliminary Portfolio D expansion plan. The table also shows the contribution of renewable generation to the overall energy production mix.

First Interim 2025 IRP Filing

Table 33: Preliminary Portfolio D Resulting from Scenario 4 Energy Production by Fuel Type or Resource

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Coal	2,372	2,731	2,403	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diesel	1,353	427	203	113	66	92	83	4	0	2	0	4	2	0	-	1	-	-	0	-
Fuel Oil	4,530	3,481	2,175	1,132	1,176	566	447	7	-	-	-	-	-	-	-	-	-	-	-	-
LNG - EcoElec[27]	5,166	4,993	4,642	4,597	4,469	4,621	4,706	4,048	3,710	3,693	3,977	3,960	3,973	3,904	3,841	3,701	3,488	3,316	3,270	3,128
LNG – SJ[28]	3,691	4,200	4,204	7,696	7,554	7,178	6,898	8,833	8,614	7,752	4,961	4,919	4,764	4,362	4,256	4,085	3,844	3,599	3,238	2,925
Hydro	67	116	242	244	243	300	300	301	300	300	301	301	300	300	300	301	300	300	300	301
Utility Scale Solar	655	677	677	680	676	1,587	1,978	2,381	2,756	2,762	2,740	2,702	2,569	2,563	2,551	2,557	2,542	2,545	2,527	2,531
Land Based Wind	259	270	270	271	269	269	269	270	269	269	270	271	269	270	270	271	268	270	269	271
Landfill	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	11	-	-	-
LNG - Trucked	581	506	2,475	2,368	2,417	1,995	1,743	348	200	381	461	381	351	240	203	172	148	127	144	154
Biodiesel	-	-	-	-	-	-	24	66	131	646	2,945	2,880	2,913	2,912	2,929	3,065	3,443	3,731	3,948	4,189
Solar - Tranche 1	230	945	946	948	946	945	945	947	946	947	945	948	946	946	946	948	946	946	945	948
Solar - Tranche 2	-	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
Combined Heat and Power	347	427	510	668	751	729	698	742	796	783	757	727	699	676	660	653	654	651	652	650
Dist. Solar	305	408	454	507	568	630	698	761	831	893	968	1,040	1,126	1,213	1,308	1,396	1,497	1,593	1,704	1,802
Demand Response	-	-	-	0	1	2	3	4	5	6	3	7	7	10	12	11	18	21	25	27
BESS (All)	60	653	874	847	892	1,200	1,345	1,500	1,711	1,647	1,723	1,737	1,742	1,768	1,755	1,773	1,783	1,844	1,846	1,931

[27] EcoEléctrica Natural Gas Power Plant

[28] LNG Units located in San Juan power station

3.4.3 Preliminary Portfolio D Resulting from Scenario 4 RPS Compliance

Puerto Rico has aggressive RPS targets for the production of renewable energy resources. The mandate is to achieve an RPS target of 40 percent by 2025, 60 percent by 2040, and 100 percent by 2050. Given that the actual RPS level in 2024 was below 10 percent, it is not realistic to meet the 2025 RPS targets. The goal of this IRP is to meet the 2040 target and to ramp up to that level aggressively, while reflecting realistic timeframes for implementing new options that will help meet the 2040 RPS targets.

Figure 15 shows the RPS results for Preliminary Portfolio D. In the figure, the green line shows the year-by-year RPS percentage achieved. The results achieved are compared to a theoretical ramp rate in the grey dotted line, which allows the overall system to quickly ramp up from the low actual levels of renewable production achieved in 2024 to reach the targeted 60 percent target by 2040. In the Preliminary Portfolio D, the RPS levels represented by the grey line were adopted as a "soft" target and results were reviewed to determine if the "soft" target was met or exceeded during the planning period.

As shown in Figure 15, the Preliminary Portfolio D expansion plan exceeds the "soft" RPS target ramp rate during the years leading up to 2040, and also exceeds the 60 percent mandate in 2040. Thereafter, the RPS percentage continues to increase through 2044, leaving the system primed to meet the 2050 objective of attaining a 100 percent RPS level. Achieving these aggressive RPS targets helps explain the many resource additions that occur on the system and that are reflected in the tables summarizing resource additions and retirements.

Figure 15: Preliminary Portfolio D Resulting from Scenario 4 RPS Percentage Achieved vs the IRP Soft Target

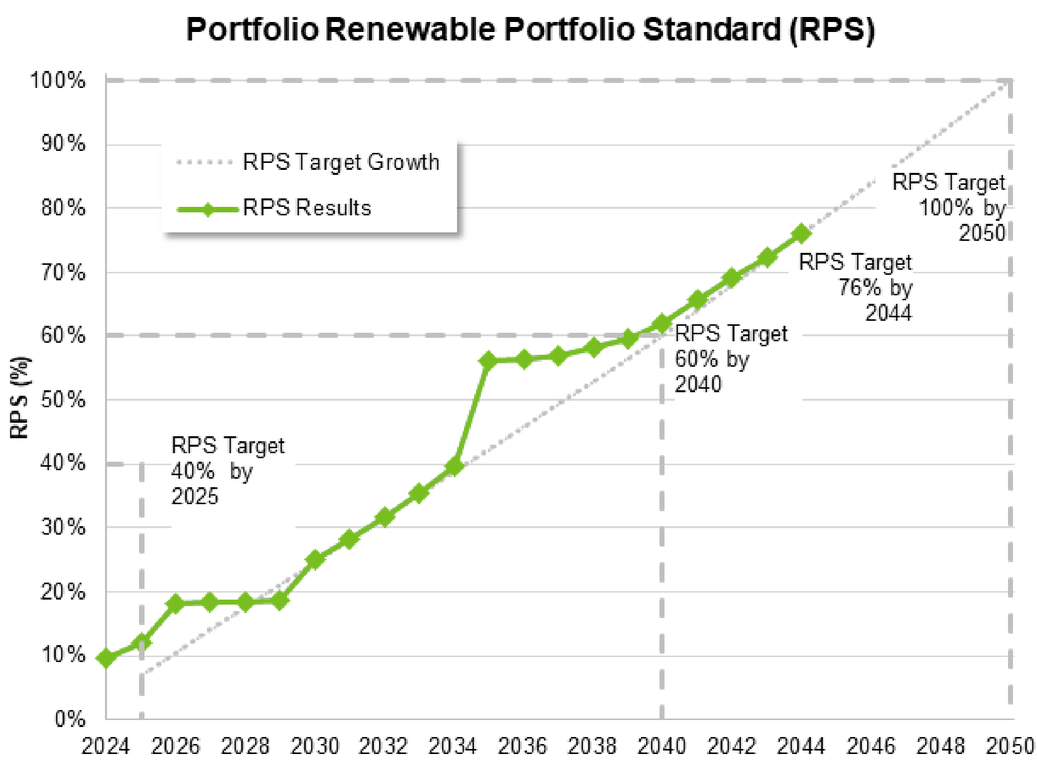

Table 34: Preliminary Portfolio D Resulting from Scenario 4 RPS Compliance vs. Target

Units	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
RPS Soft Target, %	7%	11%	14%	18%	21%	25%	28%	32%	35%	39%	42%	46%	49%	53%	56%	60%	64%	68%	72%	76%
RPS Results, %	12%	18%	18%	19%	19%	25%	28%	32%	35%	40%	56%	57%	57%	58%	60%	62%	66%	69%	72%	76%
Difference	5%	8%	4%	1%	-2%	0%	0%	0%	0%	1%	14%	11%	8%	5%	3%	2%	2%	1%	0%	0%
RPS Target, GWh	1135	1665	2203	2753	3281	3773	4262	4729	5180	5636	6082	6485	6850	7214	7568	7925	8363	8759	9112	9497
RPS Results, GWh	1961	2869	2882	2900	2904	3833	4268	4743	5207	5761	8063	7989	7909	7936	7979	8171	8569	8907	9169	9495
Difference	826	1,204	679	148	(376)	60	6	15	28	125	1,980	1,504	1,059	722	411	246	206	148	57	(2)

3.4.4 Preliminary Portfolio D Resulting from Scenario 4 Emissions

The Preliminary Portfolio D aggressive movement toward the RPS targets and away from fossil fuel generation has a significant impact on the CO2 emission over the planning period. Table 35 shows the reduction in CO2 emissions from 13.8 million tons of CO2 emitted in 2025 to 2.8 million tons of CO2 emitted in 2044.

Table 35: Preliminary Portfolio D Resulting from Scenario 4 CO2 Emissions

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Thousand Tons CO2	13,782	11,695	9,771	7,307	7,065	6,525	6,263	5,450	5,115	4,982
Year	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**
Thousand Tons CO2	4,046	3,999	3,908	3,820	3,692	3,541	3,305	3,101	2,897	2,781

3.4.5 Preliminary Portfolio D Resulting from Scenario 4 Expected Unserved Energy

An important component of the expansion plan under consideration in the 2025 IRP is the ability of the plan to improve system reliability. An unreliable power system results in expected unserved energy and a large number of events that disrupt power supply. Table 36 shows the expected unserved energy amounts and expected unserved energy events for the 2025 to 2044 planning period. Preliminary Portfolio D results anticipate a reduction of expected unserved energy from 94.2 GWh in 2025, with 794 expected unserved hours in 2025. Expected unserved energy decreases to 0 in 2032; and remains at 0 through 2044. In the Preliminary Portfolio D results, all years are under the LOLP target hours. The number of hours with expected unserved energy is projected to decrease from 794 hours in 2025 to zero hours in 2032. Other measures of reliability include the maximum MW of expected unserved energy during an event and the number of events with expected unserved energy. As can be seen in the last two columns of Table 36 there is consistent improvement in these measures, and for all years from 2032 onward, the projection is that there will be zero (0) events in all years.

Another important measure of system reliability is the LOLP. In Puerto Rico, the adopted target is 0.1 days per year, which corresponds to 2.4 hours per year. This IRP adopted a LOLP target number of hours that would reach the 2.4 hours per year requirements by 2038. Table 36 shows the targeted improvement in LOLP hours from 2030 onward. As seen in Table 36, the expected unserved energy hours achieved in Preliminary Portfolio D are below the LOLP target hours from 2030 onward.

First Interim 2025 IRP Filing

Table 36: Preliminary Portfolio D Resulting from Scenario 4 Expected Unserved Energy Target and Results

Target/ Results	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
LOLP Target Hours	-	-	-	-	-	-	60.6	40.4	26.9	18	12	8	5.3	3.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Results Expected Unserved Energy Hours	1,979	794	435	101	50	11	13	23	-	-	-	-	-	-	-	-	-	-	-	-	-
Results Expected Unserved Energy, GWh	400.3	94.2	56.9	23	12.7	1.6	4	6.7	-	-	-	-	-	-	-	-	-	-	-	-	-
Results Max Expected Unserved Energy, MW	1,403.8	1,009.2	1,223.3	878.1	848.3	271.2	770.1	767.6	-	-	-	-	-	-	-	-	-	-	-	-	-
Results Expected Unserved Energy Events	259	163	91	16	10	4	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0

3.4.6 Preliminary Portfolio D Resulting from Scenario 4 System Costs

In addition to achieving adopted targets for RPS and system reliability, minimizing costs is an important consideration for the recommended expansion planning scenario. Table 37 shows the cost components of Preliminary Portfolio D for each year of the planning period and indicates the total PVRR needed to recover the costs of Preliminary Portfolio D.

Table 37 includes the production costs of the system each year, including fuel costs, fixed O&M costs, variable O&M costs, and costs associated with unit starts and shutdowns. Also listed are the fixed costs associated with the program costs for demand response programs, distributed BESS programs, and other unit additions. For each year, the total system cost in Table 37 is equal to the sum of the production costs and the fixed costs.

Table 37 shows in bold at the bottom right portion of the table, the PVRR for Preliminary Portfolio D. The PVRR is the present value sum of the total system costs for each year in the planning horizon, and equals $40.24 billion for the Preliminary Portfolio D. This PVRR figure can be compared to the PVRR for other expansion plans to determine the relative ranking among competing expansion plans in a scenario. Finally, the last two columns of Table 37 show the production $/kWh and the total $/kWh, respectively, for each year of the plan.

First Interim 2025 IRP Filing

Table 37: Preliminary Portfolio D Resulting from Scenario 4 System Costs and PVRR

Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Fuel Production Cost $M	2214	1738	1570	1438	1444	1309	1285	1083	1081	1206	1450	1451	1467	1493	1481	1514	1571	1632	1684	1753
VO&M Production Cost $M	124	110	123	115	115	113	109	89	88	88	88	87	87	87	85	86	86	86	85	88
FO&M Production Cost $M	696	804	807	661	669	677	662	667	671	659	666	664	641	625	618	616	605	597	600	607
Start & Shutdown Production Cost ($M)	19.9	11.3	6.4	4.5	4.4	3.3	2.5	1.9	1.9	2.3	2.9	2.9	2.7	3.2	3.0	3.5	3.4	3.5	3.5	3.7
Variable Production Costs ($M)	2358	1859	1699	1557	1563	1425	1396	1174	1170	1297	1540	1541	1556	1582	1569	1603	1660	1721	1773	1845
Total Production Cost ($M)	3054	2663	2506	2219	2232	2102	2058	1841	1841	1956	2207	2204	2197	2207	2187	2219	2265	2317	2373	2452
DR Programs Lev. Cost ($M)	0.0	0.0	0.0	0.3	1.6	4.0	7.5	10.7	13.5	16.2	19.4	24.2	31.3	42.2	56.9	72.2	91.4	114.9	137.8	150.2
DBESS Program Cost $M	158	246	341	447	566	698	844	1009	1196	1396	1608	1853	2132	2449	2806	3174	3549	3975	4456	4933
Unit Additions Annualized Cap. Costs $M	-	16	503	678	774	1475	1049	1883	1117	1067	775	775	775	1097	824	775	775	775	775	775
Unit Additions Capital Costs $M	-	-	3443	335	-	0	1	0	0	0	0	-	0	0	0	0	0	0	0	0
Total System Costs $M	3212	2926	3350	3344	3575	4279	3958	4744	4167	4435	4610	4856	5136	5795	5874	6240	6681	7183	7742	8311
Present Value Rev. Requirements (PVRR) $M	2753	5076	7538	9814	12067	14564	16702	19075	21005	22907	24738	26523	28272	30099	31814	33500	35172	36836	38498	**40149**

First Interim 2025 IRP Filing

Cost	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Total Production Cost, $/kWh	0.156	0.138	0.13	0.115	0.116	0.11	0.109	0.098	0.099	0.106	0.121	0.122	0.123	0.125	0.125	0.128	0.131	0.135	0.139	0.145
Total System Cost, $/kWh	0.164	0.152	0.174	0.174	0.186	0.225	0.21	0.254	0.225	0.241	0.252	0.268	0.287	0.328	0.335	0.359	0.386	0.418	0.454	0.49

3.5 Description of Preliminary Portfolio Results and Scorecard

Table 38: Ranking and Evaluation Indicators for the Evaluated Scenarios

#	Objective	Indicators	Scenarios/ Portfolios			
			1 / A	2 / B	3 / C	4 / D
1	Define a least cost, least risk, plan to achieve RPS targets required by law as soon as reasonably possible given current grid conditions	PVRR for source scenario ($B)	37.04	42.2	37.05	40.2
		Year when 40% RPS target attained	2030	2033	2030	2034
		Year when 60% RPS target attained	2039	2039	2039	2039
2	Reduce nominal costs of energy supply	5 Year LCOE -2025 to 2029 ($/kWh)	0.155	0.167	0.155	0.169
		10 Year LCOE -2025 to 2034 ($/kWh)	0.180	0.192	0.180	0.194
		20 Year LCOE -2025 to 2044 ($/kWh)	0.240	0.254	0.240	0.241
3	Reduce carbon emission of energy supply	Avg CO_{2e} - 2025 to 2044 (tons/GWh)	299	299	295	285
		Avg CO_{2e} - 2044 (tons/GWh)	211	150	211	146
4	Reduce impact on Agricultural Land	Acres of Ag Land Used	2,200	2,200	2,200	6,725
5	Define a resilient IRP recommended strategy, which provides a flexible platform to accommodate the expected Utility Resource Planning trends	% TPA Peak MW Load served internally (with DPV&CHP) - San Juan	100.0%	100.0%	100%	100%
		% TPA Peak MW Load served internally (with DPV&CHP) – Bayamon	17.5%	42.9%	21.1%	46.8%
		% TPA Peak MW Load served internally (with DPV&CHP) – Arecibo	17.8%	14.1%	17.8%	35.6%
		% TPA Peak MW Load served internally (with DPV&CHP) - Mayaguez	4.6%	6.3%	3.5%	2.8%
		% TPA Peak MW Load served internally (with DPV&CHP) – Ponce	87.5%	13.1%	100%	100%
		% TPA Peak MW Load served internally (with DPV&CHP) – Guayama	100%	100%	100%	100%
		% TPA Peak MW Load served internally (with DPV&CHP) – Humacao	27.6%	23.5%	24.5%	31.3%
		% TPA Peak MW Load served internally (with DG) – Carolina	24.7%	56.7%	17.8%	19.6%
		% of Distributed Storage monitored and controlled	10	0	10	20
6	Minimize time to achieve industry standard of 1 day in 10-	Year 0.1/year LOLE achieved and sustained	2033	2031	2033	2032

#	Objective	Indicators	Scenarios/ Portfolios			
			1 / A	2 / B	3 / C	4 / D
	yr Loss of Load Expectation (LOLE)	Total LOLP Hours (2025 to 2044)	366	1392	366	1427
7	Improve integration of DER Resources to improve resiliency and reduce costs	% Annual Energy from DER - 2044	10.6%	7.29%	10.6%	9.85%
		% distributed storage vs total utility+distributed storage	4.90%	0%	4.93%	4.02%
8	Define a supply-side generation portfolio with adequate diversity to optimize for costs and risks for all feasible technology solutions	Number of clean technologies screened	13[29]	13	13	13
		Number of clean technologies incorporated	5[30]	5	5	5
		Percent energy from Fossil in 2044	33%	38%	35%	33%
		Percent energy from Solar in 2044 (including DPV)	19%	16%	20%	28%
		Percent energy from Biodiesel in 2044	31%	37%	33%	20%
		Percent energy from Wind in 2044	2%	2%	2%	1%
9	Define earliest potential retirement dates for fossil fuels units that are able to retire by 2044	Year last heavy fuel unit operates	2031	2033	2031	2033

[29] Solar, Biodiesel, Onshore Wind, Hydro, Lithium Batteries, Non-Battery Energy Storage, Offshore Wind, Hydrogen for Combustion, Hydrogen for Fuel Cells, Renewable Diesel, Small Modular Reactors, Non-Lithium Batteries, Municipal Waste to Energy

[30] Solar, Biodiesel, Onshore Wind, Hydro, Lithium Batteries

4.0 Description of Existing Transmission, Distribution and Advanced Control Facilities and Equipment

4.1 State of System When LUMA Started

When LUMA began operation of the electric system about three years ago, the effects of decades of under-investment and neglect under the previous operator were evident. In fact, prior to LUMA's operation, due to the mismanagement of the previous operator, Puerto Rico's electric system was well below the minimally acceptable utility reliability standards, multiple times worse than any peer utility, as defined by benchmarking conducted in accordance with IEEE 1366-2022. To understand whether the current infrastructure and its condition met utility standards for safe and reliable operation, LUMA conducted a system-wide gap assessment which resulted in the identification of over 1,000 gaps which determined that the majority of system assets were in poor health – again, due to decades of neglect and mismanagement under the previous operator. These deficiencies in physical assets correspond to negative effects on system performance and reliability that would require significant improvement, resources, and capital. As recognized in the Transmission and Distribution Operation and Management Agreement (T&D OMA, Section 4.1(d)), LUMA began operating an electrical system which could not meet Prudent Utility Practice and could not meet the T&D OMA Contract Standards. LUMA developed the System Remediation Plan (SRP) to provide an appropriate transition from the initial state of the system and utility processes at commencement, to one where conditions are met for prudent utility practice and compliance with contract standards.

Since then, LUMA has been implementing multiple programs that focus on improvements to the T&D System and have made tremendous progress across all facets of Puerto Rico's electric grid. Examples of the significant progress made over the last three years include:

- **Strengthened the energy system against storms and hurricanes**: by replacing more than 19,600 utility poles with new stronger poles able to withstand winds of 160+ mph;
- **Reduced the size and the impact of outages:** by installing over 9,000 grid automation devices, which has served to avoid over 195 million service interruption minutes for our customers;
- **Addressed the largest cause of outages:** by clearing vegetation from over 5,300 miles of powerlines and electric infrastructure;
- **Improved community safety and energy efficiency:** by replacing over 148,100 streetlights as part of LUMA's Community Streetlight Initiative;
- **Enabled the adoption of DPV:** by connecting over 118,000 customers to rooftop solar, representing 860 megawatts of clean, renewable energy for Puerto Rico, and;
- **Improved reliability during generation shortfalls:** by launching the Customer Battery Energy Sharing (CBES) initiative.

4.2 Existing Transmission Facilities Descriptions

This First Interim 2025 IRP filing includes a brief narrative description of the existing electric transmission system. LUMA may have additional information that enables it to expand upon this description in the final 2025 IRP filing on May 16, 2025.

The Puerto Rico electrical grid is a highly complex, interconnected system. Delivering power to any individual customer can require dozens of complex pieces of equipment to work perfectly in concert. Specifically, providing reliable, resilient power to nearly 1.5 million customers across Puerto Rico requires not only a functioning generation system, but also hundreds of substations, more than 19,000 miles of transmission lines and distribution feeders, and the telecommunications, control and protection capabilities to operate them all in concert, safely and effectively. An illustration of the LUMA transmission and substation facilities is provided in Appendix A.

LUMA plans and operates a transmission system with an extensive network of transmission lines at 230 kV and 115 kV voltage levels, as well as sub-transmission lines at the 38 kV voltage level. The transmission system's main objective is to provide an efficient interconnection between the generation sites and the load centers throughout the island to supply the distribution substations and customer loads. The transmission system is composed of 424 miles of 230 kV lines that serve as the critical backbone of the T&D infrastructure to transmit large volumes of power across the grid; 711 miles of 115 kV transmission lines that function as a supply to the 1,563 miles of the sub-transmission 38 kV system and as a direct source to distribution substations, consisting of 299 substation sites and 431 transformers. The primary function of the 38 kV network is to supply customers and communities, either through directly connected large customer loads and/or distribution substation transformers.

The transmission system provides an efficient and reliable interconnection between the generation sites and the load centers throughout the island, and functions as a highway for electricity between major substations from one region to the other. The system allows for the transfer of power from utility-scale generation units to the large Transmission Centers (TC) to customers and communities in every part of the grid. The system must have available capacity to interconnect existing and future projects to enhance grid reliability and flexibility. The grid's available capacity and potential constraints at specific locations, however, change with each successive interconnection. The characteristics of each interconnection point area analyzed individually to ensure that projects under development can be interconnected safely and at a reasonable cost while maintaining a reliable, safe, and secure grid. LUMA's focus is on safety, reliability, and affordability for each interconnection project.

LUMA is executing a series of aggressive programs to rebuild the system in alignment with industry standards. LUMA utilizes the industry best practices and established standards to model, assess, and plan the system. These drives long-term capital plans to strengthen the grid, improve reliability performance and integrate renewable generation by incorporating modern industry best-practices, including those established by North American Electric Reliability Corporation (NERC). For example, LUMA builds substation redundancy into its designs by requiring reliable bus configurations, such as breaker-and-a-half and ring-bus, that allow the substation to continue operating even during maintenance, or an outage that affects crucial substation equipment.

LUMA continues to regularly analyze the grid using industry-standard, rigorous planning processes and tools to identify weak points in the grid to prioritize efforts to strengthen them. This analysis evolves over time as conditions change. Factors that can affect the system include new loads associated with businesses and residences, new generation, including renewable deployments, and the loss of critical substation and transmission equipment. LUMA has addressed many areas of the grid where a critical contingency could have caused system issues since the commencement of LUMA's operational responsibilities.

Substation transformers are perhaps one of the most critical components of the electric grid. A reliable design therefore will typically include a second, redundant transformer that can share the load if the adjacent unit fails. Transformer redundancy, however, is intended to provide short-term mitigation to allow for scheduled routine maintenance or critical repairs in the event of an unplanned loss due to equipment failure or an event. This is called N-1 reliability.[31] For example, if one transformer fails, it requires the load to be shifted to the remaining functioning transformer, which means that the remaining transformer carries all the load and is therefore in a more vulnerable state. Failure of a second redundant transformer fail can often lead to connected transmission and distribution lines being unable to transmit power to serve customers; note that in this instance the system is not designed to handle loss of two redundant units, also referred to as not being N-2 reliable.[32] LUMA also continues to regularly analyze transmission lines to assess their health and condition, evaluate operational performance, identify capacity constraints, and determine adequacy to handle future growth and usage trends for the electric grid. Power flow models are updated to represent the 'as-operated' status of each transmission line and ensure that reliable operation can be maintained for a range of operating conditions, including those specified in the NERC Transmission Planning (TPL) criteria. The contingency scenarios are run to determine the potential risks and customer impacts, and alternatives developed to mitigate or eliminate issues identified. These alternatives may include adjustments to operations, system reconfiguration, or rebuild recommendations.

LUMA's improvement programs cover critical transmission asset categories and utility processes, including transmission line rebuilds, transmission reliability improvement plans, and substation rebuild programs. The Transmission Line Rebuild program increases resilience by reconstructing or deploying new transmission lines that will help the system withstand high wind loads and increasing reliability by addressing poor performing assets or assets impacting system operations, and reducing concerns related to contingency security violations. As part of the Transmission Line Rebuild program, LUMA performs comprehensive modeling and analysis on the transmission lines to verify criteria such as equipment loading, voltage profile, automation device placement, and coordination of protective devices. This program includes numerous 230 kV, 115 kV, and 38 kV projects to harden and upgrade the transmission system.

Part of LUMA's system reliability improvement plan is to conduct yearly evaluations of the system condition and reliability performance. The yearly reliability improvement plan for transmission focuses on specific transmission line segments that have experienced multiple failures resulting in customer outages over the previous fiscal year (July 2023 – June 2024). From this analysis, it was determined that 51 transmission line segments out of 150-line segments that experienced at least one (1) unplanned outage

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[31] See Appendix 8 on page 66 of the Resource Adequacy Study at https://energia.pr.gov/wp-content/uploads/sites/7/2023/12/20231220-AP20230004-Motion-Submitting-Final-Version-of-Resource-Adequacy-Analysis-Report.pdf

[32] Id. Resource Adequacy Study defines N-2 when describing Guam Power Authority planning criteria as requiring sufficient generation to cover the loss of the Island's generation sources. See Pages 24 and 48.

during the year contributed to approximately 75 percent of all transmission-related customer minute interruptions.

The Substation Rebuilds program focuses on improvements to substations to strengthen the electric grid and includes required high-level assessments, minor substation repairs, rebuilding of damaged or end-of-life substations, and the deployment of new substations. This includes upgrades to the latest codes and industry standards to achieve reliability improvement and the integration of renewable generation. The primary objectives of this program are to rebuild existing substations that are in poor physical condition, to rebuild substations with a history of operational deficiencies, to mitigate flood risk where applicable, and to relocate high-risk substations where flood mitigation alone is not an option. Based on the analysis conducted by LUMA, 87 of the 299 substation sites, or nearly 1 in 3 sites, are located in areas determined by FEMA as being within a recognized Flood Hazard Area.

4.3 Existing Distribution Facilities Description

Puerto Rico's electric distribution system includes distribution substations (transformers that step down the voltage from transmission levels to primary distribution voltage, plus associated switchgear, equipment, and infrastructure), primary distribution lines that originate at the substation and supply a defined geographic area including directly serving customers (through customer-owned distribution transformers), and utility owned and operated distribution transformers that step down the primary voltage to a secondary voltage (e.g., 13.2 kV to 240/120V) for use by end-use customer loads, and the secondary voltage circuits that run through neighborhoods and directly connect customers. Puerto Rico's distribution system is currently comprised of 342 distribution substations that supply loads to 1,127 distribution circuits (also referred to as feeders). These substations and feeders are energized at one of five primary voltage levels: 13.2 kV, 8.32 kV, 7.2 kV, 4.8 kV or 4.16 kV. Table 39 below shows a breakout of the number of substations per voltage level, and Table 40 shows the number of feeders per voltage level. Table 39 provides counts and aggregated capacities of distribution substation transformers by the voltage level on the low side of the transformer. Table 40 details distribution circuits by voltage level as depicted in Figure 16.

Table 39: Distribution Substations by Primary Voltage Level

Voltage level	Number of substations	Percent of total	Aggregated capacity (MVA)	Percent of total
4.8 kV	1	0.3%	6.25	0.1%
4.16 kV	176	51.5%	1,693.6	31.8%
7.2 kV	6	1.75%	74.9	1.4%
8.32 kV	54	15.8%	598.4	11.2%
13.2 kV	105	30.7%	2,955	55.5%
Total	**342**	**100%**	**5,328.15**	**100%**

Table 40: Distribution Feeders by Primary Voltage Level

Distribution voltage	Number of circuits	Percent of total
4.8 kV	2	0.2%
4.16 kV	612	54%

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Distribution voltage	Number of circuits	Percent of total
7.2 kV	18	1.6%
8.32 kV	164	15%
13.2 kV	331	29%
Total	**1,127**	**100%**

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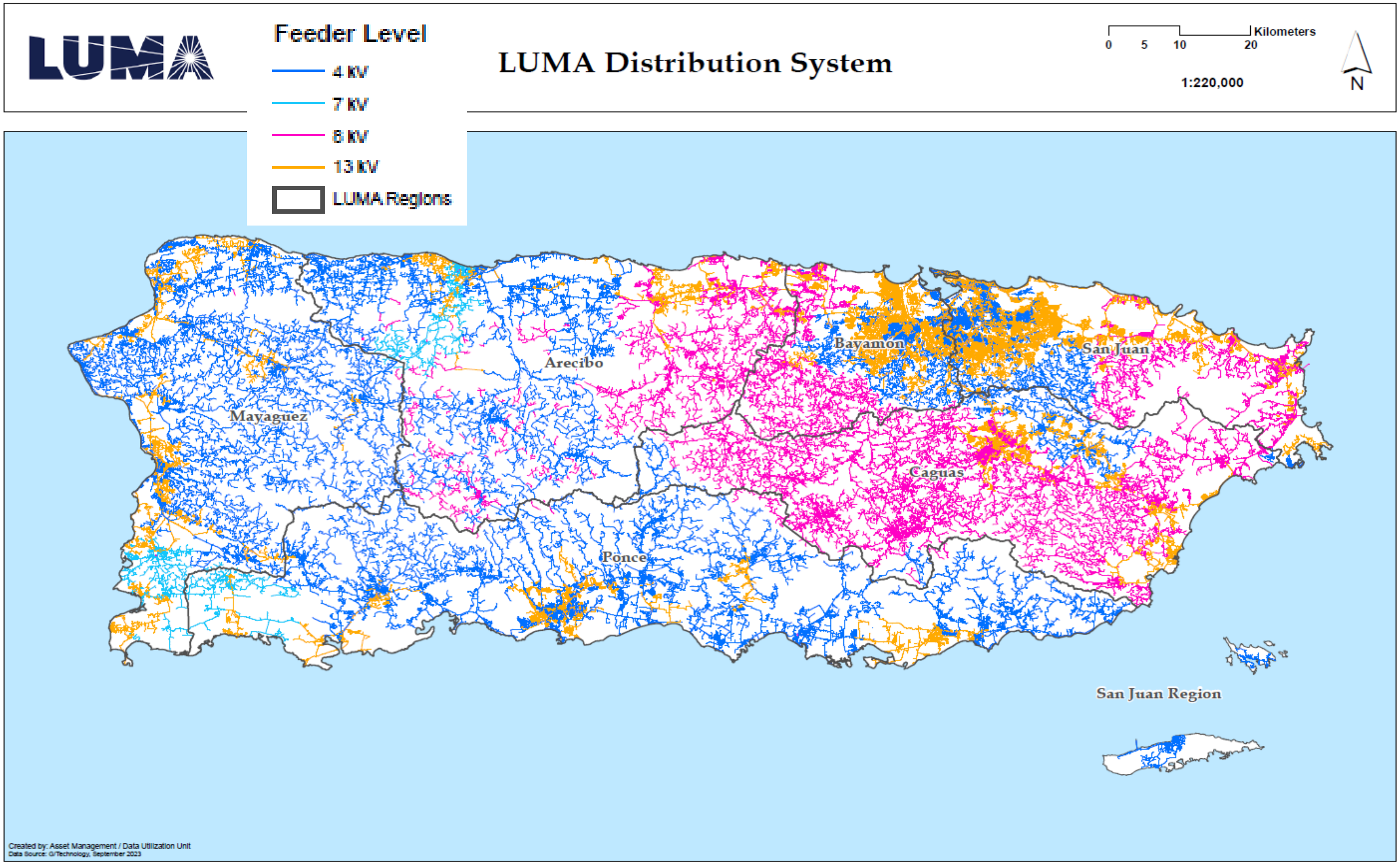
Figure 16: Distribution Feeders by Voltage Level



4.3.1 Existing Distribution Substations

Distribution substations change the voltage level from the transmission level to the primary distribution level by means of a transformer. These transformers are supplied by the transmission system (on the high side). The transformer supplies a distribution bus which typically feeds three (3) to five (5) distribution circuits.

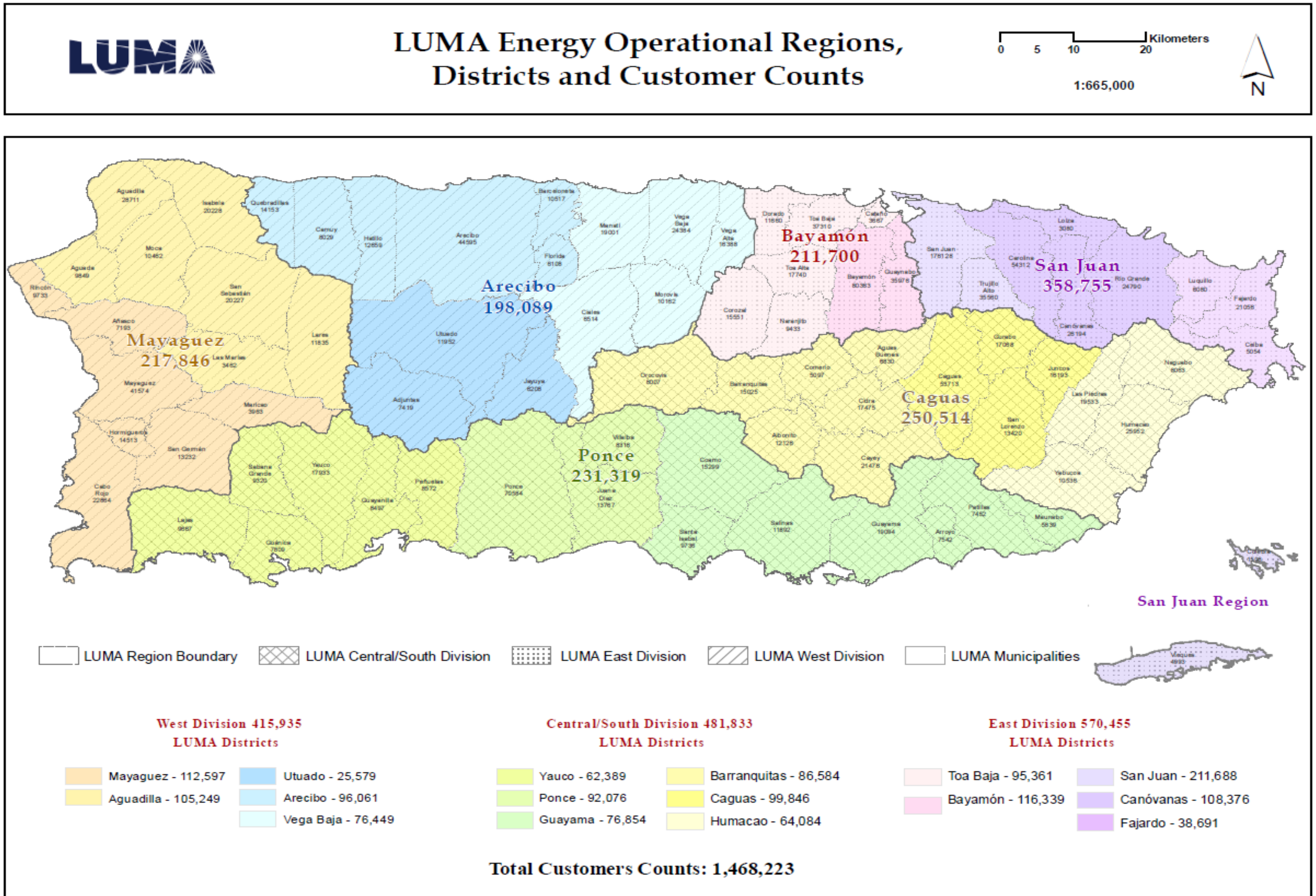
Figure **16** above, identifies the distribution feeders and voltage levels that are supplied, and Appendix A below shows the location of substations. LUMA manages six operational regions across Puerto Rico: Arecibo, Bayamón, Caguas, Mayaguez, Ponce and San Juan. Table 41 shows the association of substations per voltage level for each LUMA Operational Region, while Figure 17 shows a map of the Operational Regions and Districts.

Table 41: Distribution Substations by LUMA Operating Region

Region	Voltage Level	Number of Substations	Aggregated Capacity (MVA)	Customer Estimates**
Arecibo	**All**	**37**	**492**	**198,089**
	13.2 kV	7	164	
	8.32 kV	9	111	
	7.2 kV	2	33	
	4.16 kV	19	181	
Bayamón	**All**	**48**	**3852**	**211,700**
	13.2 kV	7	79	
	8.32 kV	7	79	
	4.16 kV	19	203	
	4.8 kV	1	6	
Caguas	**All**	**57**	**770**	**250,514**
	13.2 kV	14	330	
	8.32 kV	35	381	
	4.16 kV	8	59	
Mayaguez	**All**	**58**	**689**	**217,846**
	13.2 kV	14	302	
	7.2 kV	4	72	
	4.16 kV	40	345	
Ponce	**All**	**50**	**590**	**231,319**
	13.2 kV	11	255	
	4.16 kV	39	335	
San Juan	**All**	**93**	**1846**	**358,755**
	13.2 kV	38	1236	
	8.32 kV	3	28	
	4.16 kV	52	582	

***The customer counts presented are based on best estimate per region. Note that there are an estimated 166,000 meters that are known to be missing. Missing meters are actively being identified and customer data sets being updated accordingly.*

Figure 17: LUMA Operational Regions and Municipalities with approximate customer counts



Created by: Engineering and Asset Management / Data Utilization Unit / 2/01/2024 Data Source: Operations

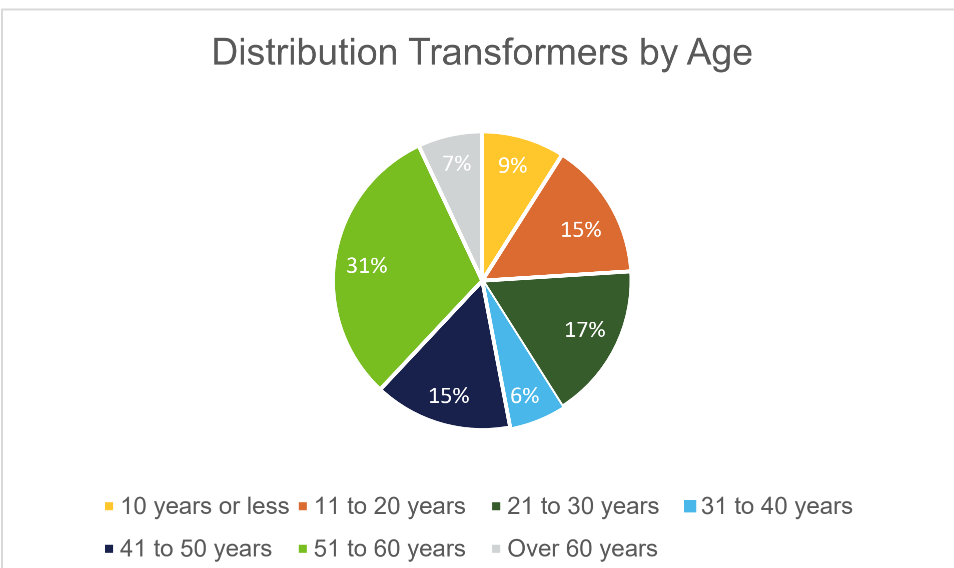
Existing distribution substations vary in size, voltage levels, and configurations. For example, substation transformer capacities can vary from 4 to 44.8 MVA, with typical capacities varying by voltage level: 4.16 kV and 8.32 kV transformer sizes 7.5 – 11.3 MVA, and 13.2, 22.4, 33.6 kV, or 44.8 MVA. A site may have one or more distribution transformers. Single-transformer distribution substations predominate throughout the Puerto Rico grid. Larger TC may have multiple distribution transformers; however, it is common for each transformer to operate at a different distribution voltage level, so redundancy, and therefore industry normal reliability, is not inherent in existing substation designs. Table 42 below shows the number of sites with single or multiple distribution transformers.

Table 42: Transformer Counts at Substations Sites

Distribution transformer counts	Number of distribution substation sites	Number of distribution transformers
1	225	225
2	46	92
3	7	21
4	1	4
Subtotals	279	341

Distribution transformer ages vary significantly, with approximately half the fleet at 40 years or older. Figure 18 below depicts distribution of transformers by age. The aging transformer fleet that was historically not well-maintained increases the likelihood of catastrophic transformer failure. The prevalence of single-transformer sites, or even multiple transformers at a site but operating at different distribution voltages means that a transformer failure results in extended outage impact and duration to customers.

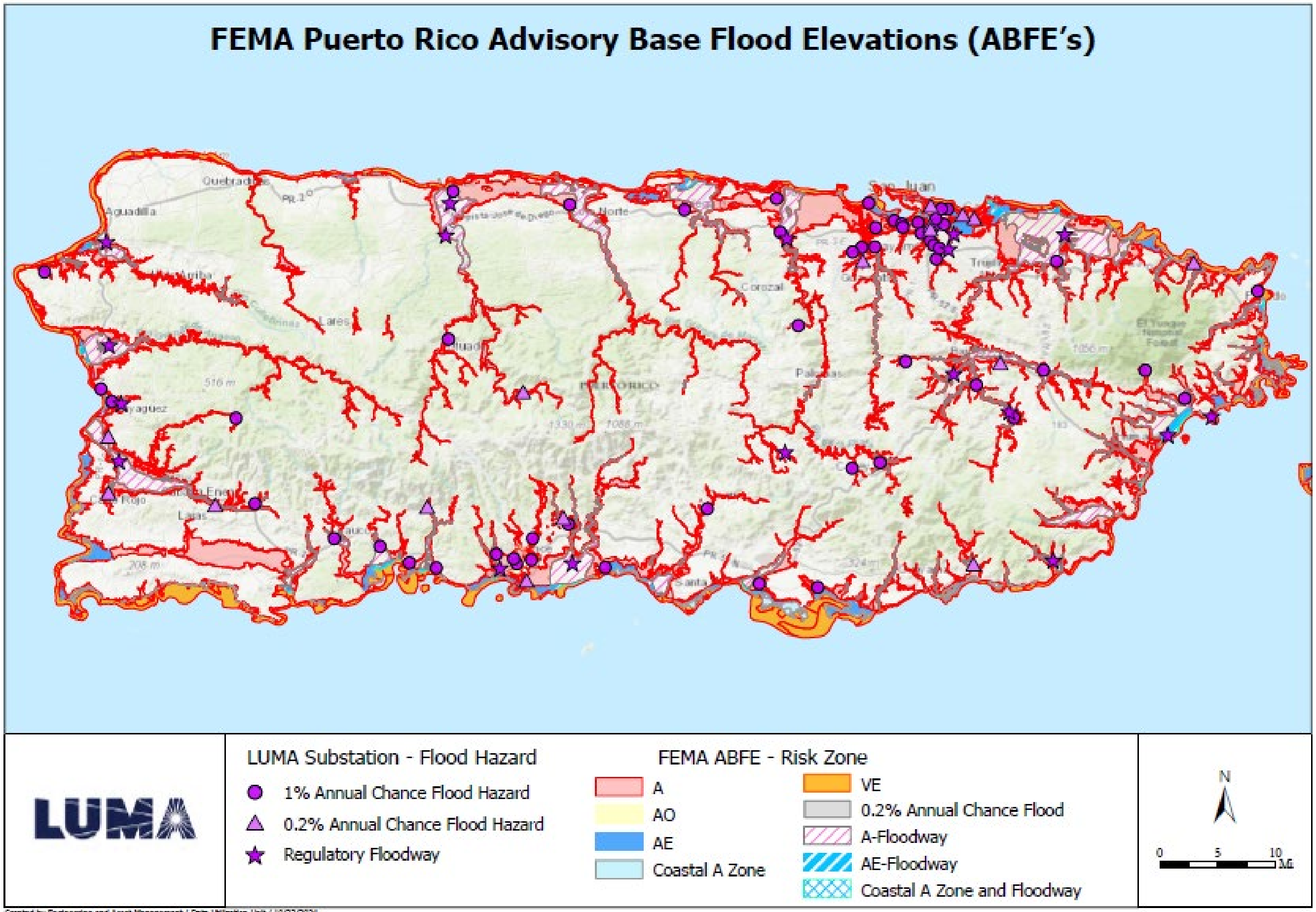
Figure 18: Distribution Transformers by Age Group



The factors above impact the reliability design of a substation. Single transformer stations are generally less reliable, since customers experience an outage for planned or unplanned loss of the transformer. This is especially true where adjacent circuits have no ties and when adjacent circuits are of different voltage levels. Multiple transformer circuits are generally more reliable and are an industry planning standard. However, this is only true when the multiple transformers at the substation are able to provide redundancy and backup to each other; for example, loads connected to the first transformer can transferred to the adjacent unit for planned maintenance or due to unplanned failure. Again, the ability to transfer to adjacent units is not possible if the units are different sizes and voltage levels, which is often the case in Puerto Rico's grid.

LUMA has identified 87 of its 299 substation sites with flooding risk based on the FEMA Advisory Base Flood Elevation (ABFE) maps. Eighteen of these sites are located in areas identified as a Regulatory Floodway, which represents a high probably of flooding – many have flooded in each of the recent severe weather events experienced in Puerto Rico. Of the remainder, 55 are located in 1 percent, and 14 sites in 0.2 percent Annual Chance of Flood Hazard respectively. Substations located in Regulatory Floodways are planned to be relocated, while those in 1 percent and 0.2 percent Annual Chance of Flood Hazard must be evaluated and mitigated using preventive barriers, equipment elevation, or relocation to address flooding hazards. illustrates the FEMA ABFE map for the island of Puerto Rico – substations in high-risk flood areas must be evaluated and mitigated or relocated.

Figure 19: Map showing FEMA flood zones



Created by Engineering and Asset Management / Data Utilization Unit / 10/22/2024

4.3.2 Existing Distribution Feeders

A distribution feeder originates at a distribution substation and has historically been designed to be radial, one-way power supply to the customer loads. Feeders can consist of overheard infrastructure that includes poles, conductors, and supporting insulators and hardware, or underground infrastructure, or a combination of both. Generally, rural areas with long circuits and sparse loads are fed predominantly by overhead feeders, while suburban and urban areas are fed by a combination of overhead and underground feeders. Newer residential and commercial developments typically feature underground distribution circuit infrastructure.

The main portion of a distribution feeder is called the mainline or backbone and typically uses larger conductor sizes to support a larger volume of customer loads. Like a tree, the circuit typically branches further away from the substation, also known as taps or lateral circuits, which extend out to supply adjacent areas. These lateral circuits typically use smaller conductor sizes as a function of the load served. Feeder mainlines are three-phase, while laterals can contain one, two or three-phases depending on the load and types of loads connected. Urban feeders often have multiple tie points. Rural feeders, particularly those in mountainous areas, have limited or no tie points.

The reliability improvement and strengthening of distribution feeders involve a series of design and technology investments. Feeder extensions and feeder ties create connections to adjacent feeders. These are often operated as normally open tie points, but in the event of a fault in one feeder section, portions of the load can be transferred to the healthy adjacent feeders, while only the customers on the faulted section remain out of service until repairs can be made. Strengthening these feeders involve rebuilding the backbone and selected laterals to a higher wind-loading standard to withstand severe storms as well as the deployment of protection and automation and sensing technology, as discussed subsequently. Covered conductors (such as Hendrix or spacer cable) are used in areas with heavy vegetation cover to reduce the number of vegetation-induced outages. Undergrounding can also provide security from both wind, and vegetation related outage causes. Additionally, the feeder protection and automation technologies can also help improve distribution circuit reliability.

4.3.3 Distribution Feeder Protection

Feeder mainlines are protected by a circuit breaker at the distribution substation. Out on the circuit, three-phase reclosers are installed strategically along the mainline, or larger laterals, to provide multiple zones of protection, and to sectionalize the feeder. In this case, only the nearest recloser will operate to clear a fault, reducing both the number of outages and the duration of outages experienced by all customers on the circuit.

Single-phase laterals are protected by fuses or by single-phase reclosers. Reclosers and fuses are installed to reduce the number of customers affected by an outage, in addition to protecting against faults. These devices are coordinated so that the first device upstream of a fault operates first to isolate the faulted segment. More details are provided in the Advanced Grid Technologies discussion.

4.3.4 Distribution Feeder Voltage Control

In a well-designed distribution system, a variety of devices operate together to control feeder voltage and supply reactive power balance. Substation transformers may have load-tap changers that can adjust automatically to regulate source-end voltage, while capacitor banks and voltage regulators are installed in distribution feeders to maintain the voltage at acceptable levels, +/- 5 percent deviation from nominal at the customer service entrance in accordance with the American National Standards Institute (ANSI) C84.1. Voltage boosters (transformers that provide fixed 5 a percent voltage increase) are used in selected grid applications. Voltage performance of a distribution feeder varies, but are typically driven by operating voltage, conductor size, and circuit length. For example, feeders energized at 13.2 kV typically have larger wire size, and therefore see acceptable voltage regulation across the entire feeder. This example feeder may employ capacitor banks for power factor correction and to maintain voltage at acceptable levels. The higher voltage level, coupled with the use of higher capacity conductors typically found on these feeders, leads to reduced voltage drop.

Conversely, feeders energized at lower voltage levels, particularly 4.16, 7.2, and 8.32 kV, are more susceptible to voltage drop along the circuit. This is especially true when older infrastructure where smaller wires, and/or very long radial circuits serving remote communities are commonplace. Also characteristic of feeders serving remote communities are single-phase and two-phase laterals along the long, radial feeder, which leads to large imbalances in the three-phase system. This combination of factors may lead to areas experiencing low voltage (below the ANSI specified ranges) during heavy demand periods. The characteristics of lower operating voltage levels, longer circuits, and unbalanced single and two-phase laterals require higher load currents per unit of demand and unbalanced flows on each phase, which results in higher voltage drop (due to impedance) along the feeder. These circuits depend on the use of voltage regulators and capacitor banks to maintain acceptable voltage along the feeder.

Among the investments LUMA is making to provide more reliable service and manage voltage and reactive power flows across its system are technologies like switchable capacitor banks, transformers with Load Tap Changer (LTC) capabilities, and upgrade line voltage regulators. Additionally, LUMA has planned investments in tools and technology that provide visibility and control of the system of individual circuit level components, and down to the individual customer level. Investments that provide system and circuit level visibility and control include an upgraded Energy Management System (EMS) and functionality including an Advanced Distribution Management System (ADMS), and Distributed Energy Resource Management System (DERMS). At the neighborhood and individual customer level, investments like Advanced Metering Infrastructure (AMI) and smart meters will enhance visibility into voltage performance and both individual and aggregate customer demand. These capabilities will enable more accurate planning and forecasting thereby improving the identification and mitigation of potential issues before they arise.

4.4 Description of Existing Distribution Infrastructure by Primary Voltage Level

4.4.1 13.2 kV Distribution Infrastructure

The highest primary voltage level on the island is 13.2 kV. Widespread use of this voltage level on the island began in the 1960s to early 1970s and is predominant on the major metropolitan areas (San Juan Metro Area, Caguas-Humacao Region, Ponce, Mayaguez) and the urban centers along the coastline. With the exception of areas in the Caguas Region, the central part of the island is mostly devoid of substations or circuits energized at this voltage level. Although second in terms of number of distribution substations, it is first in terms of aggregated transformer capacity, with 55 percent of aggregated distribution transformer capacity. Typical 13.2 kV substation transformer sizes are 22.4 MVA, 33.6 MVA and 44.8 MVA, and average transformer age is 27 years. The relative (to other voltage classes) lower average age of 13.2 kV infrastructure means it is not as prone to age-related equipment failure, but still subject to equipment failures resulting from poor maintenance practices. Distribution feeders energized at 13.2 kV have more load carrying capacity, better voltage regulation and more capacity to absorb distributed generation than the other voltages employed on the island. These feeders are typically urban and suburban feeders serving high load density areas. Feeder mainlines (backbones) are typically built with higher ampacity conductors, and a significant portion of underground distribution infrastructure is energized at this voltage level. All new distribution loads are now connected to the 13.2 kV whenever possible. LUMA plans to continue with efforts to standardize the distribution system to 13.2 kV by converting existing substations and circuits currently energized at lower voltage levels to 13.2 kV. Currently 331 feeders and 562,070 customers are served at 13.2 kV.

4.4.2 8.32 kV Distribution Infrastructure

The 8.32 kV distribution system is concentrated in the central-eastern part of the island. It is the predominant voltage level in the Caguas Region and supplies significant portions of the San Juan, Bayamón, and Arecibo Regions. It ranks third in both the number of distribution substations and the aggregated capacity. Typical distribution transformer capacities are 10.5 MVA and 11.3 MVA, and average transformer age is 37 years which means many are beyond their designed useful life. The average age of the transformers means LUMA’s 8.32 kV distribution grid is beyond its useful life design and prone to increasingly frequent equipment failures due to both the age and condition of poorly maintained assets. Distribution feeders energized at 8.32 kV predominantly serve more rural areas in the Caguas, San Juan and Bayamon Regions, and account for 164 feeders and 304,038 customers. Due to the lower voltage level, and the fact that many feeders employ lower capacity conductors, 8.32 kV feeders have lower load carrying capacity and less ability to connect distributed generation when compared to 13.2 kV circuits. Voltage regulation issues (undervoltage) may also occur, particularly on long, rural feeders with low-capacity conductors.

4.4.3 7.2 kV Distribution Infrastructure

The 7.2 kV distribution system consists of six (6) substations and eighteen (18) feeders serving 36,900 customers. The six (6) distribution substations are located in the municipalities of Arecibo (2 substations), Cabo Rojo (3 substations), and Lajas (1 substation) and their 7.2 kV circuits extend into adjacent municipalities. These substations account for 1.4 percent of the aggregated distribution substation capacity in the island. Typical transformer capacity is 10.5 MVA, and average transformer age is 39 years. The distribution feeders served by these substations primarily serve suburban or rural areas, with some feeders serving more urban areas near the substation. As in the case of 8.32 kV feeders, these circuits have less load carrying capacity and less ability to connect distributed generation.

4.4.4 4.16 kV Distribution Infrastructure

Distribution infrastructure energized at 4.16 kV is predominant in the Bayamón and San Juan Regions (including the San Juan metropolitan area from Carolina to the east to Toa Alta in the west), the Mayaguez and Ponce Regions, as well as supplying a significant portion of the Arecibo Region and a smaller portion of the Caguas Region. There are more total substations with a secondary voltage of 4.16 kV than any other voltage, but there is lower substation aggregated customer demand than the 13.2 kV system. There are 613 feeders serving 565,133 customers. Typical 4.16 kV substation transformer capacities are 10.5 MVA and 11.3 MVA, and average transformer age is 44 years which means there are many end-of-life assets in substations. Many 4.16 kV feeders have lower capacity conductors, and 4.16 kV feeders have the lowest load carrying capacity and less ability to connect distributed generation than any other voltage level. Voltage regulation issues, particularly undervoltage, are more likely to occur in these feeders, particularly in long, radial feeders typical of the more rural areas.

4.4.5 4.8 kV Distribution Infrastructure

One distribution substation operating at 4.8 kV exists in the municipality of Bayamón. This substation supplies two (2) feeders and a total of 82 customers.

LUMA is continuing efforts started by PREPA to standardize the rebuilds and the infrastructure to 13.2 kV voltage level. All new primary distribution equipment (breakers, switchgear, insulators, etc.) is being procured at 15 kV voltage class, even if the equipment will be initially energized at a lower voltage level, to simplify logistics and facilitate future voltage conversion to 13.2 kV.

4.5 Distribution System actual system performance

4.5.1 Thermal (transformers near capacity, feeders near capacity)

LUMA is performing system wide assessment of its distribution system with Area Planning studies that evaluate the present condition of the distribution system and its ability to supply future forecasted load, both under normal conditions and a system designed to provide industry standard reliability performance. An integral part of these Area Planning studies are the load flow studies of the feeders to evaluate the voltage profile and load along all circuit sections. Voltage and thermal violations are identified, and mitigation measures proposed, which include both operating adjustments and infrastructure upgrades. These mitigation measures become the foundation for feeder or substation rebuild projects. The Area Planning studies are ongoing and are expected to be completed by June 2025.

LUMA has completed 187 (of the 1127) distribution feeder studies with load flow analyses. Violations were identified on 81 of the 187 feeders (43 percent) outside ANSI C84.1 allowing ranges under peak load conditions. As discussed in the prior section, lower voltage levels see more violations. Most voltage violations occurred on 4.16 kV feeders (42), followed by 8.32 kV feeders (25), 13.2 kV (13) and 7.2 kV feeders (1). Voltage violations observed on 13.2 kV feeders were generally related to utilization of step-down transformers to 4.16 kV, which was also previously identified as a risk. The Mayaguez Region had the highest number of violations (with 25 of 81 cases), followed by Caguas (22) and Arecibo (11). The load flow analyses for these feeders also showed heavy loading, with 58 (31 percent) feeders (90 percent or above) the thermal rating. Table 43 below details the number of voltage and thermal violations found in these 187 circuits.

Table 43: Voltage and Thermal Violations

Region	Voltage Level (kV)	Voltage Violations	Loading Violations
Arecibo	**All**	**11**	**6**
	13.2	0	3
	8.32	6	2
	7.2	1	0
	4.16	4	1
Bayamón	**All**	**7**	**11**
	13.2	2	8
	8.32	2	1
	4.16	3	2
	4.8	0	0
Caguas	**All**	**22**	**6**
	13.2	3	1
	8.32	15	3
	4.16	4	2
Mayagüez	**All**	**25**	**16**

Region	Voltage Level (kV)	Voltage Violations	Loading Violations
	13.2	5	6
	8.32	0	0
	7.2	0	0
	4.16	20	10
Ponce	**All**	**7**	**3**
	13.2	0	0
	8.32	0	0
	4.16	7	3
San Juan	**All**	**9**	**16**
	13.2	3	10
	8.32	2	2
	4.16	4	4

For distribution substations, eleven (11) substations were identified with peak demands above 90 percent and are summarized in Table 44 below.

Table 44: Substations with Peak Demand above 90 percent

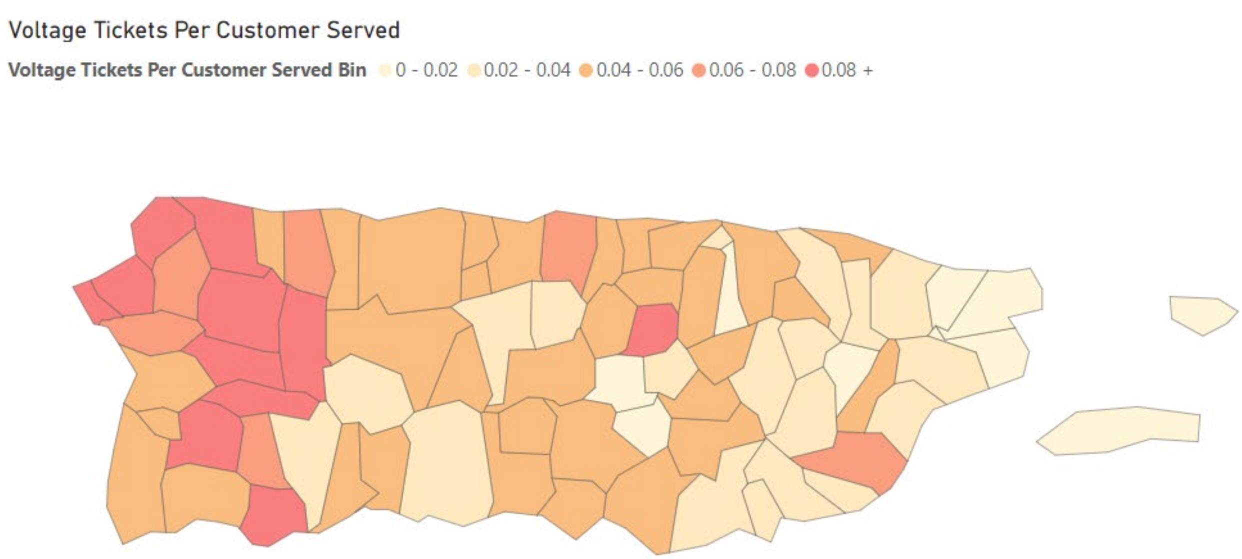
Region	Voltage Level (Kv)	Loading Over 90%
Arecibo	**All**	**2**
	13.2	0
	8.32	1
	7.2	1
	4.16	0
Bayamón	**All**	**1**
	13.2	0
	8.32	1
	4.16	0
	4.8	0
Caguas	**All**	**3**
	13.2	2
	8.32	1
	4.16	0
Mayagüez	**All**	**3**
	13.2	0
	8.32	0
	7.2	0
	4.16	3
Ponce	**All**	**0**

Region	Voltage Level (Kv)	Loading Over 90%
	13.2	0
	8.32	0
	4.16	0
San Juan	**All**	**2**
	13.2	1
	8.32	0
	4.16	1

4.5.2 Voltage (Customer Call Heat Mapping) and Transformer LTC's

LUMA's distribution grid is limited in its ability to maintain customer voltage to industry standards. maps the rate of customer call tickets referencing high or low voltage issues on a heat map by customers served. One contributing factor is the lack of maintenance and upkeep of substation transformer LTC assets, many of which were disabled due to skipped maintenance cycles, or past failure but never replaced. A second contributing factor is a lack of asset records and maintenance, as well as distribution feeder voltage and reactive power control assets such as capacitor banks and voltage regulators. These devices asset records in models and operational datasets are often inconsistent with field condition, and many are out of service due to failure or damage. A third contributing factor impacting customer voltage performance is the distributed energy resources that connect to the distribution circuits without prior study and approval by knowledgeable utility personnel.

Figure 20: Heat Map displaying customer voltage tickets per customer served



Another common practice in the Puerto Rico grid that impacts voltage performance is the prevalence of multiple distribution voltages (which is not a common practice across the industry) and the step-down transformers, also referred to as voltage converters, that are used to allow circuits originating from a substation at one voltage level (e.g., 8.32 kV) to convert to a voltage (e.g., 4.16 kV) to supply a neighborhood or small load pocket. Step-down transformers provide necessary flexibility to supply loads at different voltage levels; however, these devices fail frequently and become single-points-of-failure with negative reliability consequences. Without an adjacent circuit at the "stepped down" voltage level, there is no way to restore the customer loads when a converter fails except to replace the converter.

The design and operation of the distribution grid as described in this section presents physical limitations on achievable reliability improvement. The combination of substation transformers and circuits energized at different voltage levels, and the long and radial distribution circuits with limited feeder ties because circuits operate at different voltage levels, this creates operational and logistical challenges to the reliable system operations. Equipment (such as service transformers) must be procured, and the inventory must be maintained for each voltage level. Additionally, the step-down transformers described previously are single-points-of-failure affecting large amounts of customers, especially in rural and mountain communities.

4.6 Distributed Energy Resources (DERs) and its impact on the Distribution System

4.6.1 Evolution of DERs in Puerto Rico

Distributed Energy Resources (DER) are defined as smaller-scale energy resources, such as rooftop solar, which are interconnected to the electric grid, typically the distribution system. Across the industry, DER penetration is increasing as the cost of technologies such as solar panels and battery energy storage are decreasing, and the understanding of the potential benefits, including to mitigate climate change, is increasing. The acceleration of DERs in Puerto Rico can be traced back to the passage of Act 114 in 2007, which established the first legal framework for Net Energy Metering (NEM). NEM provided an attractive incentive for customers by offering one-to-one credit for the energy they exported to the grid, a benefit that has continued to the present day. This policy made it more financially feasible for residential and commercial customers to invest in DERs, particularly rooftop solar photovoltaic (PV) systems. However the current NEM program unfairly burdens customers without PV systems by overcompensating NEM customers for the power they export to the system.

Puerto Rico's energy regulations, specifically Regulations 8915 and 8916, have allowed DERs to connect at both the distribution and sub-transmission levels and receive NEM. At the distribution level, systems up to 1 MW are permitted, while at the transmission level, the limit is set at 5 MW. In the early 2010s, the number of customers interconnecting DERs remained relatively low, but this trend changed dramatically after Hurricane María in 2017.

Act No.17 of April 11, 2019, introduced a major regulatory shift, requiring the utility to automatically approve any DER system below 25 kW. This law further accelerated DER adoption by expediting the NEM process. Customers rapidly began installing rooftop PV systems, often coupled with energy storage, to mitigate the effects of an increasingly unreliable grid.

In June 2021, LUMA Energy commenced operations of Puerto Rico's T&D system. LUMA centralized and streamlined the NEM program, significantly reducing activation times and simplifying the interconnection process. As shown in Figure 21, LUMA had over 26,000 customers with distributed PV systems at commencement and has over 136,000 active customer accounts with a distributed PV system as of September 2024. The graph shows only residential and small commercial systems with an aggregate NEM capacity of 942 MWs. Also notable is the attachment rate of 83% of systems paired with battery energy storage as shown in Figure , a customer investment in enhanced reliability and resilience to keep the lights on during grid outages or after major events such as hurricanes.

Figure 21: DER Installations and Aggregate Capacity

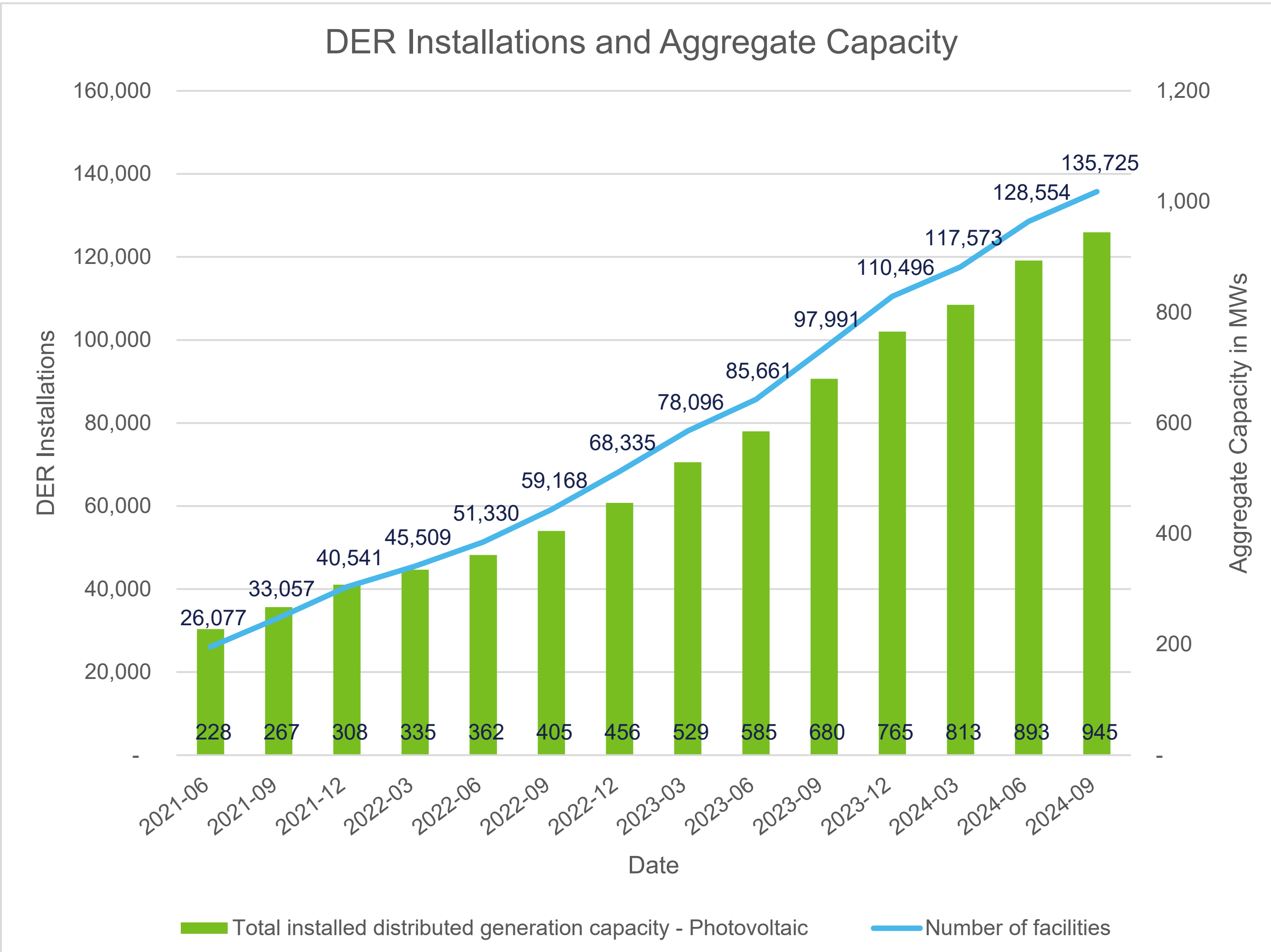
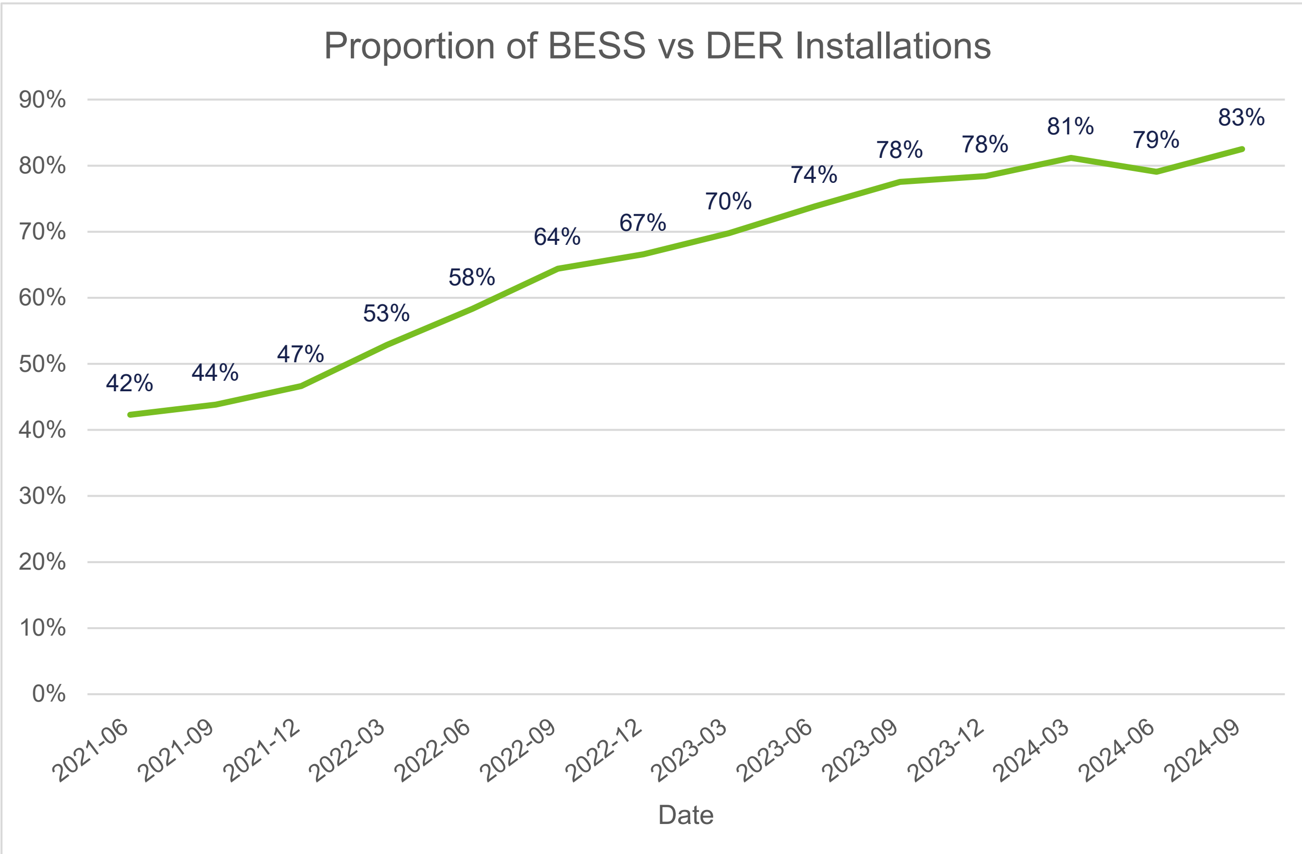


Figure 22: Proportion of BESS vs DER Installations

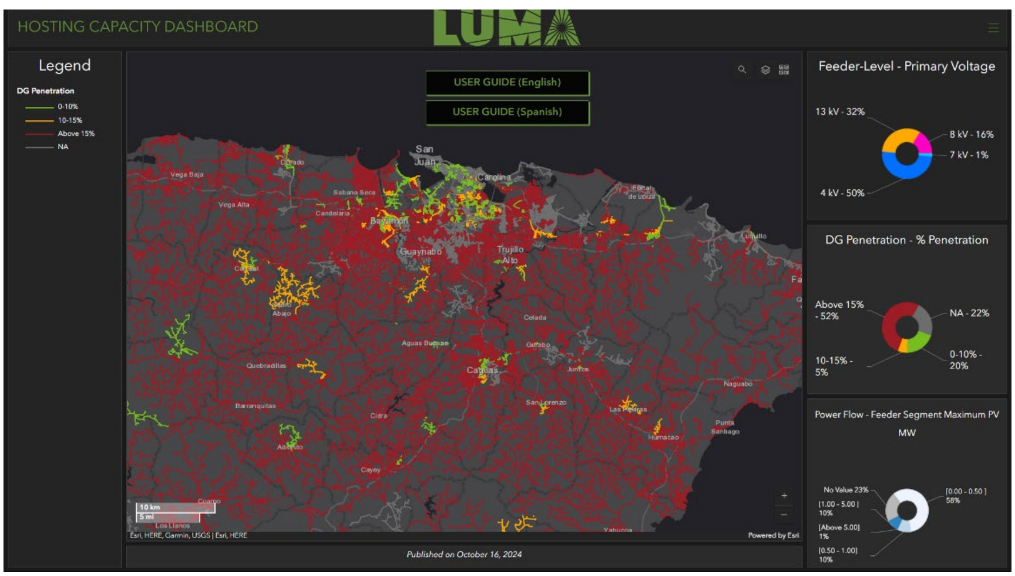


4.6.2 Effects of DER Integration

The rapid growth of DERs in Puerto Rico has had profound effects on the island's energy landscape. In 2021, there were approximately 1,200 monthly connections of new distributed PV connections. This has tripled to around 3,600 monthly applications notifications in October 2024. The current regulatory framework requires automatic connection of customer distributed PV systems below 25 kW, which account for 99 percent of all notifications received. The result is approximately 20 MW of renewable energy being added to the grid each month. According to the Energy Bureau's orders impending Act 17-2019, the customer connection proceeds without utility assessment of grid performance or safety impacts. Only after the system is interconnected can the utility retroactively assess impact of the connection, after the interconnection has already exacerbated a grid performance or safety issue.

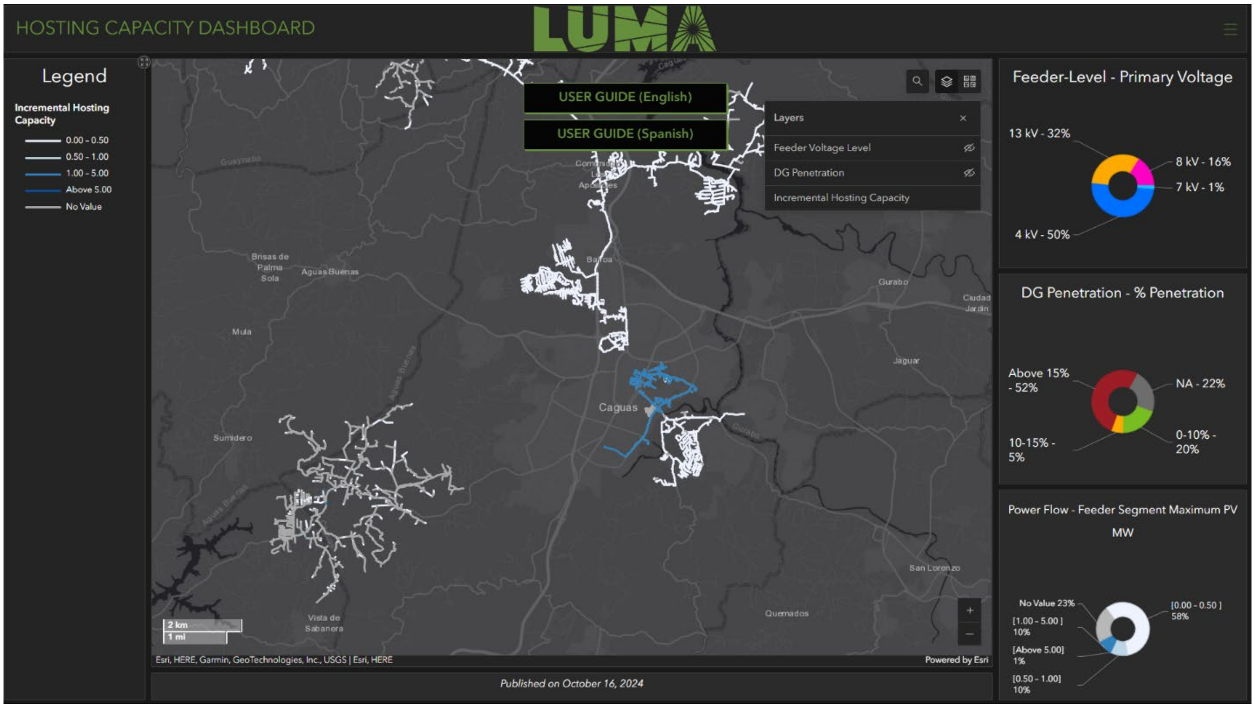
LUMA has responded by studying the impact of DERs on individual feeders, focusing on those with penetration levels exceeding 15 percent of the feeder's maximum demand. LUMA distribution circuits see average penetration rate of 38 percent, which is considered high relative to all other states and territories. The most common network upgrades required to accommodate this level of DER integration include service transformer upgrades, voltage regulation improvements, and capacitor bank installations. Thermal issues have also been identified and are expected to continue to become more prevalent as unconstrained distributed PV adoption takes place.

Figure 23: DER Penetration Map



To support customers in making informed decisions about DER installations, LUMA has developed DER penetration maps and Incremental Hosting Capacity Maps (IHCM). These tools provide valuable information on network conditions and potential upgrades that may be required before a customer connects their DER. These resources are essential for balancing the growth of DERs with the stability and reliability of the island's energy grid.

Figure 24: Incremental Hosting Capacity Map



4.7 Existing Advanced Grid Technologies Description

LUMA is progressing its advanced grid technologies by deploying automated switchgear and fault sensors across distribution feeders to bolster reliability. Additionally, LUMA will implement automatic switching distribution feeder automation systems to further enhance reliability. The included switchgear consists of three-phase and single-phase reclosers. Communicating fault sensors have been deployed to provide fault location information to the control center to improve service restoration times for customers. The scope of the program consists of the installation of communication ready smart reclosers with microprocessor-based controllers for remote monitoring, and control.

The program scope includes communication devices for the reclosers and all associated networking upgrades to provide Supervisory Control and Data Acquisition (SCADA) operators remote control and visibility of the recloser status. Fleet Management Software is included to provide stakeholders visibility of operations to improve fault analysis and response times to feeder outage restoration. The scope includes upgrading outdated protection devices at the feeder head in the substations to modern digital devices that can be used in conjunction with the reclosers.

Additionally, the program includes the installation of communicating Fault Circuit Indicators in strategic locations to provide more granularity to operators as to the location of faults on a feeder to speed up restoration actions. The program includes the communication integration required, including networking devices to communicate the fault locations to SCADA and Outage Management Systems. LUMA has deployed 2,523 Fault Circuit Indicators (FCI) during the previous fiscal years and is planning to install 1,000 additional FCI during fiscal year 2025. LUMA is expecting to receive a purchase of 8,000 FCI for the next four years as shown in the Table 45.

Table 45: FCI Devices Installed

Actual/ Targeted FCI Installed	2022	2023	2024	2025	2026	2027	2028	2029
Period Start	7/1/2021	7/1/2022	7/1/2023	7/1/2024	7/1/2025	7/1/2026	7/1/2027	7/1/2028
Period End	6/30/2022	6/30/2023	6/30/2024	6/30/2025	6/30/2026	6/30/2027	6/30/2028	6/30/2029
Actual FCI Devices Installed	93	996	1,381	53	-	-	-	-
Targeted FCI Devices Installed	N/A	1,000	1,000	1,000	1,000	1,000	1,000	1,000

The optimal locations for the installations of the three phase reclosers (T&D), fault circuit indicators and single phase reclosers are identified as part of studies to improve reliability of the feeders. The location of reclosers will ensure the required coordination of substation circuit breakers, reclosers and fuses. The intent of the deployment of the reclosers is to minimize permanent[33] outages for temporary faults on the distribution feeders. The engineering philosophy and standards are being established to ensure long term continuation of feeder protection and control designs.

The program includes the automation of distribution feeders and 38 kV line to further improve feeder reliability. Grid automatic switching schemes will leverage the reclosers to tie two feeders through an open tie recloser. The intent of the feeder automation schemes is to provide feeder segments between reclosers with redundant power sources. The feeder automation schemes will automatically isolate faulted feeder segments and restore power to healthy feeder segments form an alternate power source. This includes the replacement of outdated protection devices at the 38 kV lines headend including engineering and construction. The new protection devices will provide required functionality to better coordinate with the reclosers.

LUMA is also deploying advanced sensor capabilities, both to improve the reliability and resilience of the energy system, as well as to support the integration of renewable generation sources. One key capability to do so, which has been identified by agencies including the Department of Energy and the US National Labs, consists of Phasor Measurement Units (PMUs), an electronic device capable of measuring voltage and current waveforms and calculating their magnitudes and phase angles (phasors), frequency, and power quantities, and stream these monitoring variables to a central unit like the network control center. PMUs collect data synchronized in a μsec (microsecond) level, which is crucial in the root cause analysis of large events as the team can truly identify the sequence of happenings. PMUs report their measurements to the central unit at 30 or 60 frames/sec, which is an order of magnitude faster than SCADA system and enable system operators to monitor the dynamic security of the system and be proactive against the events to minimize their impacts rather than just being reactive.

LUMA is deploying this capability in a number of ways. As part of projects that include substation rebuilds, LUMA is deploying technologies such as digital relays or recloser controllers that have integrated PMU capability into their products. Where prudent, LUMA is also deploying independent advanced sensors, including PMUs and optical sensors, in substations allowing for visibility across the transmission system. LUMA is also looking to deploy PMUs to prioritize distribution feeders, including as part of the Vieques and

[33] Permanent outages refer to those that require repair before re-energizing.

Culebra microgrid project, which will provide incremental value including 1) situational awareness beyond the current SCADA information, 2) forensic analysis to diagnose issues that led to events, 3) power quality monitoring, and 4) fault detection in combination with other measuring devices to help pinpoint the problematic sections.

Within Vieques and Culebra, the distribution PMUs will work alongside transmission PMUs and other communicating devices in the implementation of microgrids in the island municipalities. The data from the PMUs are going to be used by the microgrid controller to make the right decision for transitioning between the islanded, microgrid cluster or grid-connected operation modes.

5.0 Transmission Facilities Support of Preferred Resource Plan

5.1 Overview of Transmission Planning for the IRP

LUMA plans to provide a comprehensive transmission plan for Puerto Rico as part of the Final IRP report to be filed on May 2025. The transmission plan will provide a long-term plan to improve reliability of the transmission system and to enable known, future changes to the Puerto Rico customer loads and energy resources, including both additions and retirements. In addition to the comprehensive transmission plan for improving system reliability and supporting any known customer load or resource changes, LUMA will also perform an assessment of the 230/115 kV transmission system's ability to support LUMA's preferred resource plan, together with its proposed energy resource additions and retirements and forecasted customer loads, to be filed in May 2025.

For the IRP to be filed in May 2025, LUMA plans to perform a preliminary planning assessment of the 230/115 kV transmission system for the Preferred Resource Portfolio under the conditions defined by the System Stress Scenario (Scenario 2) which can be found in Section 2.2 of this filing.

The transmission analysis of the Preferred Resource Portfolio will include a load flow analysis, using Siemens PSSe, that will assist to identify areas which require transmission infrastructure modifications to enable the transmission network flows forecasted for the Preferred Resource Plan and the System Stress Scenario 2 conditions through 2034, i.e., the first 10-years of the 20-year IRP. The analysis of the Preferred Case will be performed under the conditions of the System Stress Scenario, since the higher loads in the scenario more closely align with the extreme load conditions typically used in transmission planning. The transmission analysis will identify system planning criteria violations, candidate infrastructure modifications to alleviate any violations, and a planning level estimate of the costs of any needed modifications to enable the Preferred Resource Plan. A methodology description and results of the transmission analysis will be included in Appendix 1 of the May 2025 IRP report. It is LUMA's intention that the transmission analysis of the Preferred Resource Plan will be in full compliance with the requirements of Regulation 9021.

LUMA believes that evaluating the transmission system under the high loads of Scenario 2 is more likely to create an extreme set of conditions for which the transmission system performance and upgrade requirements will be most useful. In addition, even if the future generally results in the loads that follow the Base Case load forecast of Scenario 1, which represents LUMA's forecasts of the most likely scenario conditions, LUMA still expects to experience occasional system peak loads that exceed the Base Case load forecast due to increasing volatility in Cooling Degree Days (CDDs) resulting in higher air conditioning loads and other differences between the actual future conditions and those used as assumptions in the Base Case load forecast. Choosing to assess the Preferred Resource Plan under extreme load conditions is consistent with the methodology typically used for transmission and distribution planning.

First Interim 2025 IRP Filing

Appendix A: Puerto Rico Electric Transmission System

[redacted]

Exhibit 2

(to be submitted via email)