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**: Petition to Appear as Amicus Curiae and Accompanying Brief

PETITION TO PARTICIPATE AS AMICUS CURIAE AND ACCOMPANYING BRIEF

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COMES NOW Robert A. Garcia Cooper, in his individual capacity as a state-certified Engineer in Training (EIT, Certificate No. 28591), licensed Expert Electrician (Perito Electricista, License No. 10971), PhD student in electrical engineering at the University of Puerto Rico at Mayaguez (UPRM), published researcher in energy systems and resilience economics, and Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), and respectfully petitions this Honorable Energy Bureau to be permitted to appear in the above-captioned proceeding as amicus curiae pursuant to Section 7.01 of Regulation No. 8543, and in compliance with the procedural calendar established by the Resolution and Order of February 27, 2026.

I. DESCRIPTION OF PETITIONER AND INTEREST IN THE CONTROVERSY

Robert A. Garcia Cooper is an Engineer in Training (EIT, Certificate No. 28591), a Certified Energy Manager (CEM), a Project Management Professional (PMP), and an IEEE Senior Member currently pursuing a Doctor of Philosophy in Electrical Engineering at the University of Puerto Rico at Mayaguez, with a focus on power systems, energy burden quantification, and the economic consequences of electric service unreliability. He holds a Master of Science in Electrical Engineering from UPRM and a Bachelor of Science in Electrical Engineering, Magna Cum Laude, from the Universidad Politecnica de Puerto Rico.

The petitioner has contributed to peer-reviewed research published in The Electricity Journal (2024) under Sandia National Laboratories Contract No. 1999908, informed by the DOE Puerto Rico 100 (PR100) Grid Resilience and Transition to 100% Renewable Energy Study and FEMA-funded resilience work, with technical management by the DOE Grid Deployment Office. He has

also published research presented at the IEEE Photovoltaic Specialists Conference (PVSC 2023) and the 10th International Conference on Appropriate Technology (ICAT 2022). His published research includes the development of the Customer Electric Service Impact Cost (CESIC) methodology, which quantifies the hidden household costs of electric service unreliability -- costs including food spoilage, meal replacement expenditures, and lost productive time -- that are systematically excluded from standard energy burden calculations and from conventional power system cost models. Ongoing research further extends this methodology to critique the limitations of power capacity and energy modeling frameworks, including those derived from PR100, when applied to systems with chronic baseline unreliability.

The petitioner is the first named inventor of a provisional patent application filed by the University of Puerto Rico with the United States Patent and Trademark Office on October 12, 2023, titled "Automatic Transfer-Switching Transient Phenomena Mitigation Sequence for Buck-Boost Transformer" (Application No. 63/589,731), co-developed with Dr. Lionel Orama Excusa, P.E., and has managed federal energy resilience and efficiency programs in Puerto Rico representing a combined investment exceeding one billion dollars, including programs funded through HUD CDBG-DR and IRA DOE appropriations.

The petitioner has a direct and substantial interest in the methodology and outcomes of the 2025 Integrated Resource Plan proceeding. The resource portfolio selected through this proceeding will govern Puerto Rico's electric infrastructure investment for the next two decades. The petitioner's interest arises specifically from his technical expertise in integrated resource planning methodology and in the measurement of economic costs that are borne by Puerto Rico households and businesses due to electric service unreliability, costs that the petitioner contends are not reflected in the cost metrics used in the 2025 IRP to evaluate and compare resource portfolios.

II. JUSTIFICATION FOR PARTICIPATION

The petitioner's participation as amicus curiae is justified because he possesses specialized technical knowledge directly relevant to a significant methodological gap in the 2025 IRP that the Commission and its consultants may benefit from having placed formally in the record. Specifically, the petitioner has developed and published peer-reviewed methodology for quantifying the costs of electric service unreliability borne by Puerto Rico households and businesses, costs that the petitioner contends are not reflected in any of the cost metrics, namely Present Value Revenue Requirement (PVRR), Expected Unserved Energy (EUE), or Loss of Load Expectation (LOLE), used in the 2025 IRP to evaluate and compare resource portfolios.

The Commission has previously recognized that outage cost quantification belongs in integrated resource planning. The 2018-2019 IRP included an attempt to estimate the Value of Lost Load for Puerto Rico, using survey data from New Zealand and Hawaii that the petitioner's published

research demonstrates were methodologically inappropriate for Puerto Rico's economic conditions. The 2025 IRP does not attempt this quantification at all, representing a regression from even the prior IRP's imperfect effort, at precisely the moment when Puerto Rico-specific analytical tools have become available to do it correctly.

The Commission's review will require it to assess whether the Preferred Resource Plan represents a least-cost path toward Puerto Rico's energy policy objectives consistent with Act 57-2014 and Act 17-2019. The petitioner respectfully submits that this determination cannot be made solely on the basis of PVRR if the PVRR calculation excludes the substantial economic costs that chronic outage frequency and duration impose on ratepayers, businesses, and the overall Puerto Rico economy. No party currently before the Commission has placed this specific methodological critique in the record with the technical and evidentiary foundation necessary to support it. The petitioner's participation would fill this gap and contribute to a more complete record upon which the Commission can base its determinations.

III. INTRODUCTORY EXPLANATION OF CONTRIBUTIONS TO THE COMMISSION

The petitioner intends to contribute the following analytical perspectives to assist the Commission in adjudicating the 2025 IRP:

First, the petitioner will present the CESIC methodology and its application to Puerto Rico, demonstrating that the economic cost of electric service unreliability borne by Puerto Rico households, measured using consumption data filed in docket NEPR-MI-2019-0007 before this Energy Bureau, supplemented by Bureau of Labor Statistics data, is of sufficient magnitude that its exclusion from resource portfolio cost comparisons materially affects the economic ranking of resource plan alternatives.

Second, the petitioner will present a technical critique of the production cost and capacity expansion modeling approaches used in the 2025 IRP. Models such as PLEXOS are structurally designed to minimize the cost of supplying electricity to the grid; they are not designed to measure the cost that ratepayers bear when electricity is not supplied. EUE and LOLE metrics capture whether load can be served in aggregate, but they do not capture the household-level economic impact of unserved hours. A resource plan that produces lower PVRR but higher outage cost burden on ratepayers is not, in the economically meaningful sense required by Act 57-2014, a least-cost plan.

Third, the petitioner will direct the Commission's attention to findings disclosed in LUMA's responses to the Energy Bureau's First Set of Post-Filing Requests for Information, filed January 15, 2026, which reveal that the 2025 IRP models the existing generation fleet with a capacity-weighted average forced outage rate of 29% and a capacity-weighted average fleet age of 46 years,

and that these outage rates are held constant as static assumptions throughout the entire 20-year planning horizon in the PLEXOS modeling. Under CESIC methodology, the petitioner contends that the economic cost to ratepayers of a chronic 29% forced outage rate applied across a generation fleet of this scale warrants quantification in direct comparison to the PVRR differences between the competing resource plan alternatives presented in the 2025 IRP. The Commission should have this context when evaluating the significance of cost differences between resource plan alternatives and when assessing the adequacy of the reliability improvement trajectory projected under the PRP.

Fourth, the petitioner will demonstrate that when outage costs of sufficient magnitude are excluded from resource planning models, the demand forecasts that feed into both production cost and capacity expansion modeling understate the rate at which ratepayers will adopt distributed energy resources to avoid those costs, introducing a cascading distortion into the resource portfolio selection process. The petitioner's published research documents the rising trend in photovoltaic and battery energy storage system adoption in Puerto Rico as consistent with ratepayer load defection driven by chronic service unreliability, and submits that this dynamic must be reflected in the demand assumptions underlying future IRP modeling.

Fifth, the petitioner will present a developed methodology for incorporating grid unreliability costs into production cost and capacity expansion modeling frameworks through the integration of outage cost estimates, providing the Commission with a technically grounded approach for requiring that future IRP submissions reflect the full cost of electric service to ratepayers. This methodology has been developed as part of ongoing research currently being prepared for publication.

IV. DECLARATION

In compliance with Section 7.01(B)(4) of Regulation No. 8543, the petitioner declares as follows:

A) No party or lawyer in this proceeding assisted in drafting this brief.

B) No party or lawyer in this proceeding contributed funds or any other type of resource for the preparation or submission of this brief.

C) No person other than the petitioner contributed funds or any other type of resource for the preparation or submission of this brief.

V. ARGUMENTS

A. The 2025 IRP Omits Outage Cost Quantification Entirely, Regressing from Even the Flawed Attempt Made in the Prior IRP

The 2025 IRP evaluates competing resource portfolios primarily on the basis of Present Value Revenue Requirement (PVRR), which captures the discounted cost of building, fueling, operating, and maintaining the generation and storage assets in each resource plan. PVRR is a measure of what ratepayers pay to the utility. It does not measure what ratepayers pay because of the utility's service failures.

Puerto Rico's electric service has been characterized by chronic unreliability that imposes substantial economic costs on households beyond their utility bills. Research published by the petitioner in The Electricity Journal (2024), conducted under Sandia National Laboratories Contract No. 1999908 with support from the DOE PR100 Study and FEMA, developed the CESIC methodology and quantified these costs for Puerto Rico households. CESIC captures food spoilage resulting from extended outages, increased expenditures on prepared meals when cooking and refrigeration fail, replacement costs for food and medications requiring refrigeration, and lost wages and productive time. Households that have not taken mitigation measures bear these costs in full. Households that have acquired emergency generators to avoid these losses instead incur a different set of costs: emergency electrical generation costs, including fuel purchase and consumption, operation and maintenance, and the time and mileage costs associated with obtaining fuel during an outage event. The same dynamic applies to businesses: commercial and industrial customers that cannot absorb production losses, spoiled inventory, or data loss instead incur emergency electrical generation costs to maintain operations during outage events.

Either way, whether the affected party is a household or a business, and whether they absorb the losses directly or invest in emergency generation to avoid them, ratepayers and customers bear costs beyond their utility bills that are directly caused by grid unreliability and are invisible to the PVRR framework. These costs do not remain at the household or business level. When aggregated across the residential sector, they reduce personal consumption expenditures throughout the local economy, as households divert income toward outage-related replacement costs and emergency generation rather than productive spending. When aggregated across the commercial and industrial sector, they reduce output, delay supply chains, and erode the competitiveness of Puerto Rico businesses that operate under chronic energy insecurity conditions that their counterparts in mainland jurisdictions do not face. The petitioner's published research estimated losses of approximately $286 million attributable to Hurricane Fiona and approximately $65 million attributable to the Costa Sur fault blackout of April 2022 from a macroeconomic perspective applied to the residential sector alone, using Personal Consumption Expenditure data for Puerto Rico. See Garcia Cooper et al., "True cost of electric service: What reliability metrics alone fail to communicate," The Electricity Journal, Vol. 37 (2024), Article 107386, DOI:

10.1016/j.tej.2024.107386, Section 4.2. These figures represent a lower bound, as they do not capture the full commercial and industrial dimension. These costs represent a component of the true cost of electric service that standard energy burden formulas, which measure only what households and businesses pay to the utility, and conventional IRP cost frameworks systematically exclude.

A cost framework built on PVRR alone measures the cost of building and operating the grid; it does not measure the cost of failing to serve the customers whom the grid exists to serve. A resource evaluation based exclusively on supplier-side costs cannot be the basis for a determination that a resource plan satisfies the least-cost standard under Act 57-2014 or serves the long-term interests of Puerto Rico ratepayers under Act 17-2019, when the costs ratepayers bear directly from service failure are not quantified in the comparison.

The Commission has previously recognized that outage cost quantification belongs in integrated resource planning. The 2018-2019 IRP included an attempt to estimate the Value of Lost Load (VoLL) for Puerto Rico, producing estimates of $12.27/kWh using survey data adapted from New Zealand by Siemens, and $4.04/kWh using the Lawrence Berkeley National Laboratory Interruption Cost Estimate (ICE) Calculator applied to the state of Hawaii. Both approaches were methodologically inappropriate. New Zealand's median income is substantially higher than Puerto Rico's. Hawaii's median income is more than four times greater than Puerto Rico's and its cost of living is approximately 1.3 times greater. The ICE Calculator survey data used for the Hawaii estimate was over 20 years old, was not statistically representative for widespread long-duration interruptions, and Puerto Rico was not even listed as an available jurisdiction within the application at the time. Applying either dataset to Puerto Rico produced VoLL estimates that bore no defensible relationship to the actual economic experience of Puerto Rico households during outage events.

The 2025 IRP does not attempt VoLL quantification at all. It evaluates resource portfolios using Expected Unserved Energy (EUE) and Loss of Load Expectation (LOLE) metrics only. This represents a regression from even the imperfect effort made in the prior IRP, at precisely the moment when the analytical tools to do it correctly have become available.

As of February 19, 2026, the Lawrence Berkeley National Laboratory ICE Calculator released its first Puerto Rico-specific interruption cost model (version puerto-rico.interruption.1.0.0) and reliability benefit model (version puerto-rico.reliability.1.0.0), based on Phase 1 and Phase 2 surveying activities conducted in Puerto Rico. See ICE Calculator Model Version History, available at https://icecalculator.com/documents. This model version did not exist when the prior IRP was filed and was not available when the 2025 IRP was developed. It became publicly available weeks before this proceeding's amicus curiae deadline.

Additionally, the CESIC methodology developed by the petitioner provides a peer-reviewed, Puerto Rico-specific, market-based framework for quantifying household outage costs using

consumption data filed in docket NEPR-MI-2019-0007 before this Energy Bureau. That methodology was available before the 2025 IRP was filed and was not incorporated.

The Commission now has before it two independent tools for Puerto Rico-specific outage cost quantification that did not exist or were not available in prior proceedings. The petitioner respectfully submits that this is precisely the moment to revise and require that the record be completed with the analysis the prior IRP attempted poorly and the 2025 IRP did not attempt at all. The petitioner respectfully urges the Commission to acknowledge this limitation explicitly in any final order on the 2025 IRP, and to direct that future IRP submissions include a quantitative assessment of outage cost burden to ratepayers under each resource plan alternative evaluated.

B. The PLEXOS Modeling Framework Is Structurally Incapable of Capturing Ratepayer Unreliability Costs

The 2025 IRP relies on PLEXOS production cost and capacity expansion modeling to perform reliability analysis and to generate the hourly dispatch simulations from which EUE and LOLE metrics are derived. PLEXOS is a commercially available power system modeling platform well-suited to minimizing the cost of supplying electricity to the grid under defined reliability constraints. It is not designed to measure the economic cost that ratepayers bear when those constraints are not met.

Within the 2025 IRP's framework, EUE is expressed in megawatt-hours of demand that cannot be served. This metric is used to assess whether a resource plan meets acceptable reliability thresholds. However, megawatt-hours of unserved energy do not translate into economic cost to ratepayers through a simple conversion factor, because the cost of an outage hour depends on when it occurs, how long it lasts, what the affected household has stored in refrigeration, whether the household has access to alternative meal preparation, and numerous other factors that are household-specific and time-dependent. CESIC methodology bridges this gap by constructing a bottom-up economic cost estimate from measurable household behavior and consumption data linked to outage frequency and duration, using docket NEPR-MI-2019-0007 consumption data filed before this Energy Bureau as a primary source.

Furthermore, LUMA's responses to the Energy Bureau's First Set of Post-Filing Requests for Information, filed in this docket on January 15, 2026, confirm that the 2025 IRP applied static forced outage rates across the entire 20-year planning horizon, with a capacity-weighted average FOR of 29% for the legacy generation fleet and a capacity-weighted average fleet age of 46 years. The PLEXOS model therefore embeds chronic baseline unreliability as a fixed structural parameter and evaluates resource plans on their ability to offset this deficit through new generation and storage additions. The EUE convergence results in the IRP report measure the residual unserved energy after resource plan additions reduce the deficit to an acceptable modeling

threshold; they do not measure the chronic baseline unreliability that ratepayers experience and that is projected to persist across the planning horizon under all modeled scenarios.

A resource plan evaluation framework that treats chronic baseline unreliability as a fixed external condition, rather than as a cost variable attributable to the existing resource mix, cannot fully characterize the economic value to ratepayers of accelerating the retirement of that fleet. The Commission should have this context available when evaluating the relative benefits of resource plan alternatives that differ in their pace of transition away from legacy fossil generation.

C. The Commission Should Establish Explicit Requirements for Outage Cost Quantification in Future IRP Filings

The petitioner does not ask the Commission to reject the 2025 IRP or to require its complete resubmission on methodological grounds. The petitioner recognizes the substantial analytical investment represented by the 2025 IRP filing and the importance of advancing the IRP process in a manner consistent with Puerto Rico's energy transition objectives and the procedural calendar established by the Commission.

However, the petitioner respectfully urges the Commission to use this proceeding as an opportunity to establish methodological requirements for future IRP submissions that would mandate the quantification of ratepayer outage cost burden under each resource plan alternative evaluated. Such requirements would be consistent with the Commission's mandate under Act 57-2014 to ensure that resource planning serves the long-term interests of Puerto Rico ratepayers, including those ratepayers whose economic burden is most severely compounded by chronic service unreliability.

Two independent tools for performing this quantification now exist and have been applied to Puerto Rico. The CESIC framework and the granular consumption data available in docket NEPR-MI-2019-0007 provide a peer-reviewed, market-based, bottom-up methodology developed under Sandia National Laboratories funding as part of the DOE PR100 Study. The Lawrence Berkeley National Laboratory ICE Calculator Puerto Rico-specific interruption cost and reliability benefit models, released February 19, 2026, provide a second independent instrument based on Phase 1 and Phase 2 surveying activities conducted in Puerto Rico. Either or both frameworks could be applied to the hourly EUE outputs across resource plan scenarios already present in the 2025 IRP record to produce a ratepayer outage cost comparison that supplements the PVRR analysis currently provided.

With respect to the present proceeding, the Commission is in a position to direct that this supplemental analysis be incorporated into the record during the discovery and testimony phases, without requiring the IRP process to restart or the procedural calendar to be significantly disrupted. With respect to future proceedings, the Commission is in a position to establish that outage cost

quantification is a required component of every IRP submission, so that this gap does not recur in the next planning cycle.

VI. ADDITIONAL ARGUMENTS

The petitioner notes that the 2025 IRP applies PR100 cost scaling factors to adjust NREL Advanced Technology Baseline cost estimates for Puerto Rico conditions, as confirmed in LUMA's responses to Question 1 of the First Set of Post-Filing Requests for Information, filed January 15, 2026. The petitioner conducted research as part of the University of Puerto Rico at Mayaguez Electrical and Computer Engineering Department team, led by professors Marcel Castro Sitiriche, Agustin Irizarry Rivera, and Lionel Orama Excusa, which participated in and contributed to the PR100 Study. The outage cost methodology developed as part of that research was subsequently published in The Electricity Journal (2024) under Sandia National Laboratories Contract No. 1999908; however, as the publication followed the completion of the PR100 capacity expansion modeling, the outage cost estimates were not available for integration into the resource portfolio recommendations that the 2025 IRP now draws upon. To the extent that the 2025 IRP inherits cost scaling assumptions derived from PR100, it also inherits this structural gap. The Commission should have this context when evaluating the 2025 IRP's cost projections and their relationship to the full cost of service for Puerto Rico ratepayers.

Moreover, the petitioner notes that LUMA's fuel price forecast for the PRP reflects continued reliance on liquefied natural gas across significant portions of the 20-year planning horizon. In a modeling framework that excludes outage costs, the economic disadvantage of generation resources with elevated forced outage rates, including legacy LNG-dependent thermal generation with a capacity-weighted average FOR of 29%, is systematically understated relative to generation and storage resources with lower failure rates. The Commission should consider whether the PVRR advantage of LNG-heavy resource plan alternatives would persist if the chronic unreliability cost of those alternatives were incorporated into the cost comparison.

The petitioner further notes that a capacity-weighted average forced outage rate of 29% implies frequent thermal unit trips and restarts across the legacy thermal fleet. Each restart event involves startup fuel expenditures that are distinct from normal operating fuel costs. The petitioner respectfully submits that the Commission should direct LUMA to confirm whether unit startup costs associated with forced outage recovery events were fully captured in the PLEXOS production cost modeling, as their omission would result in an understatement of fuel costs within the IRP's own modeling framework, independent of any outage cost quantification methodology.

The petitioner respectfully requests that all electronic communications, including emails and telephone contact, be directed to the contact information provided below. The petitioner further requests that all notices, correspondence, copies of orders, and any other physical documentation regarding this docket be sent to the undersigned at the mailing address on file with the Bureau.

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WHEREFORE, the petitioner respectfully requests that this Honorable Energy Bureau grant this Petition to appear as amicus curiae in Case No. NEPR-AP-2023-0004 and accept the accompanying brief for inclusion in the record of this proceeding.

Respectfully submitted,

In San Juan, Puerto Rico, on March 30, 2026.

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