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 Responses to the Second Set of IRP Prefiling Period Requests of Information and Request for Confidential Treatment

MOTION SUBMITTING RESPONSES TO THE SECOND SET OF IRP PREFILING PERIOD REQUESTS OF INFORMATION AND REQUEST FOR CONFIDENTIAL TREATMENT

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:

1. On March 11, 2024, the Energy Bureau entered a Resolution and Order in which it instructed LUMA to respond on or before April 1, 2024, by 5:00 p.m., to a *Second Set of IRP Prefiling Period Requests of Information* set forth in Attachment A to the Resolution and Order ("March 11th Order"). The Energy Bureau based its decision to issue these requests on the need to continue ascertaining the adequacy of LUMA's next Integrated Resource Plan ("IRP") proposal.

2. In compliance with the March 11th Order, LUMA hereby submits as Exhibit 1 its responses to the *Second Set of IRP Prefiling Period Requests of Information*. LUMA provides these responses supported by preliminary information. Data, estimates, and other information provided now may change and be revised as LUMA develops the 2024 IRP.

3. Considering that Section 15.10 of Regulation No. 8543 allows for the release to the public of information after an investigation has concluded, LUMA respectfully submits that certain attachments to the responses included in Exhibit 1 should be designated as confidential material that should be protected from disclosure. The attachments to certain responses included in Exhibit 1 are protected from disclosure under Article 6.15 of Act 57-2014 and Act 80-2011, pursuant to the 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.

4. Under separate cover and expediently, within the next ten days, as allowed by Section A.2 of the Energy Bureau's Policy on Management of Confidential Information, LUMA

will submit a memorandum of law in support of this request to file the specific redacted responses in Exhibit 1 under seal of confidentiality.

WHEREFORE, LUMA respectfully requests the Energy Bureau to **take notice** of the foregoing and **deem** that LUMA complied with the Resolution and Order dated March 11, 2024.

RESPECTFULLY SUBMITTED.

I 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.

RESPECTFULLY SUBMITTED.

In San Juan, Puerto Rico, on April 1, 2024

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Exhibit 1

2024 Integrated Resource Plan (2024 IRP)

NEPR-AP-2023-0004

Responses to March 13, 2024 R&O

April 1, 2024

PREFILING PROCESS OF THE 2024 INTEGRATED RESOURCE PLAN (2024 IRP)

NEPR-AP-2023-0004

RESPONSE: RFI-LUMA-AP-2023.0004-20240311-PREB-001-011

The Energy Bureau issued on March 11, 2024, a Resolution and Order (March 11th R&O) ordering LUMA to submit responses to the Second 2024 Integrated Resource Plan (2024 IRP) Prefiling Requests of Information (RFI). LUMA hereby complies and submits its response to Attachment A of the March 11th R&O addressing questions on: 1) how PLEXOS will model and consider Distributed Energy Resources (DER), Battery Energy Storage Systems (BESS); 2) the impact of less agricultural land for solar PV on certain scenarios; 3) resource cost parameters of the marine cable scenario; 4) updates to the LUMA Presentation of October 31, 2023 Technical Conference and questions 6 & 7 of the First 2024 IRP Prefiling RFI of the September 27 R&O. Please note that LUMA is providing the following responses on a preliminary informational basis.

Data, estimates, or other information provided now may change and may be revised as LUMA develops the 2024 IRP.

EXECUTIVE SUMMARY

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 Integrated Resource Plan (IRP) that maps out the transformation of the island's energy resources over the next two decades. LUMA is developing an IRP that best reflects the energy needs and priorities of our customers, while reliably and responsibly progressing towards the clean energy goals that will best serve the interests of Puerto Rico for generations to come.

This comprehensive response by LUMA addresses inquiries from the Energy Bureau regarding various aspects of the 2024 Integrated Resource Plan.

LUMA's approach to energy planning incorporates diverse considerations such as resource constraints, land usage, cost dynamics, and technological integration. 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 energy public policy objectives.

List of Responses and Attachments

Response ID	Document Type	Response Subject
RFI-LUMA-AP-2023.0004-20240311-PREB-001a-c	Response	Resource adequacy constraints used in PLEXOS model
RFI-LUMA-AP-2023.0004-20240311-PREB-002a	Response	DER, PV, BESS, and effects of EE as load modifiers in PLEXOS model.
RFI-LUMA-AP-2023.0004-20240311-PREB-002b	Response	DER, PV, BESS, and effects of EE as load modifiers in PLEXOS model.
RFI-LUMA-AP-2023.0004-20240311-PREB-003a	Response	Energy Storage Resource
RFI-LUMA-AP-2023.0004-20240311-PREB-003b	Response	Energy Storage Resource
RFI-LUMA-AP-2023.0004-20240311-PREB-004-	Response	Expected MW (and MWh, for BESS) trajectories for DER resources
	Attachment* CONFIDENTIAL	RFI-LUMA-AP-2023.0004-20240311-PREB-004_Expected trajectory of MW and MWh values for use in PLEXOS
RFI-LUMA-AP-2023.0004-20240311-PREB-005a	Response	BESS Resources
	Response	BESS Resources
RFI-LUMA-AP-2023.0004-20240311-PREB-006	Response	Agricultural Land for solar PV
RFI-LUMA-AP-2023.0004-20240311-PREB-007	Response	UPV & BESS
RFI-LUMA-AP-2023.0004-20240311-PREB-008a	Response	Generation Legacy Units retirements
RFI-LUMA-AP-2023.0004-20240311-PREB-008b	Response	Generation Legacy Units retirements
RFI-LUMA-AP-2023.0004-20240311-PREB-009	Response	Marine Cable
RFI-LUMA-AP-2023.0004-20240311-PREB-010	Response	Update to RFI # 1 Question no. 6 and slides 12-20 of presentation of the October 31, 2023 Technical Conference
	Attachment* CONFIDENTIAL	Cost trajectory of Fuels
	Attachment* CONFIDENTIAL	Cost trajectory of Onshore- Offshore Wind & UPV DPV
	Attachment* CONFIDENTIAL	Cost trajectory of small combustion turbines or gas turbines, and reciprocating units; Other size CT, GT, or RICE units; Combined cycle units
	Attachment* CONFIDENTIAL	Cost trajectory of UBESS and DBESS

Response ID	Document Type	Response Subject
	Attachment CONFIDENTIAL	Update to Slides 12-20 for presentation of Second 2024 IRP Prefiling Technical Conference Presentation
RFI-LUMA-AP-2023.0004-20240311-PREB-011a	Response	Input assumption that will be used in PLEXOS modeling –DER
RFI-LUMA-AP-2023.0004-20240311-PREB-011b	Response	Input assumption that will be used in PLEXOS modeling –DER
RFI-LUMA-AP-2023.0004-20240311-PREB-011c	Response	Input assumption that will be used in PLEXOS modeling –DER

*Note: *Denotes attachments that have been provided in Microsoft Excel format.*

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-001a-c

SUBJECT

Resource adequacy constraints used in PLEXOS model.

REQUEST

Explain fully how resource adequacy constraints are to be used in the PLEXOS model. Address the following, including provision of any further information required to understand how the PLEXOS model " ... will then add utility resources to provide the remaining energy not served by the distributed scale resources" (LUMA's presentation for Second Technical Conference held on October 31, 2023, Slide 14):

a. Is a deterministic (as opposed to stochastic-driven) planning reserve margin requirement to be used in PLEXOS as a resource adequacy constraint?

b. If so, provide parameters, such as percentage above peak load, or maximum levels of loss-of-load acceptable to the model.

c. If not, provide a description of the resource adequacy constraint to be used in the PLEXOS resource optimization step.

RESPONSE

a. LUMA does not intend to utilize a planning reserve margin (RM) as an input in the PLEXOS modeling. LUMA plans to use Loss of Load Expectation (LOLE) represented as days of unserved energy, which is a probabilistic approach, as the primary indicator of Resource Adequacy (RA).

RM focuses only on the resource adequacy at a single point in time (at peak load) and becomes less useful as a measure of resource sufficiency as the penetration of variable renewable energy resources increases. LOLE on the other hand, assesses the energy resources available to serve demand across all hours in the study period, considering variability of renewable resources, plus planned and unplanned outages of generation resources.

The forecasted date provided in the October 31, 2023 Technical Conference was presented as a preliminary estimates that were subject to change. As anticipated by LUMA, since October 31, 2023, LUMA has performed additional analysis and received additional data from the PR100 team that has resulted in different data and forecast sources being selected for use in the IRP. An updated version of LUMA's presentation for the Second Prefiling Technical Conference of October 31, 2024, slide 14 is included as attachment: RFI-LUMA-AP-2023.0004-20240311-PREB-010-Update of slides 12-20 of presentation of the October 31, 2023 Technical Conference*.pptx_Attachment 5.*

b. The targeted LOLE criterion for the 2024 IRP will be less than or equal to 1 day of loss of load in 10 years. However, due to the current RA shortfall, LUMA does not yet know if the LOLE target is reasonably achievable in the early years of the 2025 to 2044 IRP. The LOLE target is an input into the long-term expansion planning model of PLEXOS (the Long-Term model), which determines an expansion plan that is then run through the short-term production costing model in PLEXOS (the Short-Term model). The Short-Term model performs a more detailed dispatch analysis and produces a more accurate LOLE metric output for the chosen portfolio. LUMA will provide the LOLE results for each portfolio.

c. See the response to RFI-LUMA-AP-2023.0004-20240311-PREB-001b above.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-002a

SUBJECT

DER, PV, BESS, and effects of EE used as load modifiers in PLEXOS model.

REQUEST

Confirm, or explain otherwise:

a. Distributed Energy Resources (DER), solar PV and battery energy storage systems (BESS) and the effects of energy efficiency are to be used as load modifiers (for both energy and peak load) in the forecast used in PLEXOS, all assumed as behind-the-meter (BTM).

RESPONSE

a. LUMA confirms that customer-owned Distributed solar Photovoltaics (DPV), customer-owned Distributed Battery Energy Storage Systems (DBESS), Energy Efficiency (EE) programs, Flexible Demand (FD) programs, Combined Heat and Power (CHP) systems and Electric Vehicle (EV) charging load will be used as load modifiers for the energy and peak load forecasts used in PLEXOS, all assumed as Behind-The-Meter (BTM) resources.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-002b

SUBJECT

DER, PV, BESS, and effects of EE used as load modifiers in PLEXOS model.

REQUEST

Confirm, or explain otherwise:

b. DER resources modeled as BTM will reduce T&D losses (PV, BESS discharging) or increase T&D losses (BESS charging) through their impact on the overall load. Explain if this is not the case, i.e., if distributed resources are to be considered on the supply side, with a form of adjustment for T&D loss savings.

RESPONSE

b. LUMA confirms that Distributed Energy Resources (DER) modeled as BTM resources will be grossed up with T&D losses to calculate their resulting impact on the utility supply resources. The following DER resources will be increased, or grossed-up to account for T&D losses and reflect their equivalent impact on supply-side energy requirements:

- DPV energy production,
- DBESS energy charge or discharge in response to a battery control program request,
- EE savings,
- FD programs,
- CHP generation, and
- EV charging.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-003a

SUBJECT

Energy Storage Resource

REQUEST

With respect to battery energy storage resources:

a. Explain how utility-scale BESS capacity will contribute toward resource adequacy needs and how the BESS parameters will be quantitatively represented in PLEXOS for this attribute.

RESPONSE

a. Utility-scale BESS (UBESS) available capacity will be considered as part of the utility firm capacity resources for the LOLE assessment. The charge and discharge cycle of the UBESS is considered so that only when the UBESS has a charge available it will be considered a firm capacity resource for LOLE calculations.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-003b

SUBJECT

Energy Storage Resource

REQUEST

With respect to battery energy storage resources:

b. Explain how distributed scale BESS resources will contribute toward resource adequacy needs and how the BESS parameters will be quantitatively represented in PLEXOS for this attribute.

RESPONSE

b. For DBESS that is enrolled in a battery control program, available capacity will be considered as part of the utility firm capacity resources for the LOLE assessment. The estimated charge and discharge cycle of the DBESS is considered so that only when the DBESS has a charge available it will be considered a firm capacity resource for LOLE calculations.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-004

SUBJECT

Expected MW (and MWh, for BESS) trajectories for DER resources.

REQUEST

Provide the expected MW (and MWh, for BESS) trajectories for DER resources (solar PV and BESS) and explain how they are similar or are different from the PR100 Study input assumptions for these resources. Provide trajectory of values for use in PLEXOS or confirm that the response to Question No. 10 in this ROI provides that information.

RESPONSE

DER resources are expected to have an upward growth trajectory over the next 20 years. The sources for the DER data are provided below:

- DPV – LUMA is using a forecast of MW and MWh created by LUMA. The LUMA DPV forecast is higher than the 2LMNET forecast from the PR100 for during the first 10 years of the 2024 IRP time period and then aligns closely with the PR100 forecast for the last 10 years of the 2024 IRP. The LUMA DPV forecast is higher than the PR100 forecast in the earlier years since LUMA incorporated the recent high growth rate experienced through January 2024 and the PR100 results were based on data that was approximately 1-year older. The PR100 and LUMA forecasts used different methodologies. The PR100 forecast method uses a benefit-cost analysis that combines the benefits of reduced spending on utility bills and an estimated value associated with resiliency for consumers that include DBESS in their installations. LUMA's method is based on an econometric model that forecasts MW using the DOE's forecast of US small residential PV capacity as an exogenous variable. LUMA's model used for forecasting DPV incorporated historical data from the customers enrolled in the net energy metering program as a proxy to determine the impact of DG in the system. The historical data covered from July 2017 to January 2024.

- DBESS - LUMA is using PR100 DBESS forecasts from Scenario 2LMNET for the MW and MWh.

- Attaching under confidentiality *RFI-LUMA-AP-2023.0004-20240311-PREB-004_Expected trajectory of MW and MWh values for use in PLEXOS.xlsx* Attachment 1. This file responds to RFI #4 and RFI#10 and includes the latest updates to the load modifiers. Note that the PR100 EV forecast assumptions for the LDV portion of the forecast were adjusted by LUMA.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-005a

SUBJECT

BESS Resources

REQUEST

Confirm/provide or explain otherwise concerning distributed BESS resources:

a. The distributed BESS ("DBESS") control percentage defined as a variable in the listed set of scenarios is the percentage of total BESS MW assumed available for its full 4-hour duration, for the purpose of providing resource adequacy value.

RESPONSE

a. The DBESS Control percentages (%) for each scenario reflected in Tables 2 and 3 of Exhibit 1 to LUMA's March 11, 2024 motion, summarized in the Table 1 below, represent the percent of customers with batteries that are assumed to be enrolled in future LUMA customer battery control programs.

Table 1. Percentages in the scenarios under Battery Control Program Characteristics

Scenario	Percentage of DBESS Customers Enrolled in Battery Control Program (%)			
	2025	2030	2035	2040
1	5	10	10	10
2	0	0	0	0
3	5	10	10	10
4	5	15	20	20
5	5	15	20	20
6	10	30	50	60
7	10	30	50	50
8	5	10	10	10
9	5	20	30	40
10	5	10	10	10

Two additional participation assumptions are required to estimate what portion of the customer DBESS energy capacity will be available to LUMA for a battery control program. These two assumptions are: 1) the average percentage of the DBESS installed energy capacity that customers choose to enroll in the program, and 2) the average percentage of enrolled customers who choose to participate in events when LUMA dispatches their DBESS (i.e., the percentage of customers who do not opt-out of events).

The majority of customers that have installed DPV in the last year have also included DBESS in their installation. However, until the very recent implementation of the LUMA Customer Battery Energy Sharing initiative (CBES) there have been no utility rate structures or programs to provide an economic incentive to purchase or use DBESS in Puerto Rico. Therefore, it is reasonable to assume that customers are making a large financial investment to install DBESS strictly for its resiliency benefit, i.e., to provide stored solar energy to the customer premises during periods of unreliability. It also follows that Puerto Rico DBESS owners will not easily be convinced to enroll 100% of their DBESS energy capacity in a battery control program and thus eliminate any resiliency value on days where the battery control program fully drains their battery. LUMA's initial experience with its CBES initiative has indicated that the average customer enrolled has provided only 31% of their battery's total DBESS energy capacity to the program.

There is an additional issue of enrolled customers choosing to opt-out of participation in individual battery control events. For example, the LUMA CBES events to date for which data is available, the program has experienced an average of 80% participation rate from enrolled customers, with the remaining 20% of enrollees choosing to opt-out of participation in the DBESS dispatch events.

Based on LUMA early experience with the CBES program, the resulting product of 31% of DBESS energy capacity enrolled multiplied by the 80% participation rate equates to an average of only 24.8% of enrollee's DBESS installed energy capacity has been available to LUMA for the battery control program events for which data is available.

Given the above information, LUMA plans to use the range of values shown in the following table for the product of the average percent of DBESS energy capacity that individual customers enroll in the program multiplied by average percent of enrollees who opt-in to event participation. The values in Table 2 below will be multiplied by the customer enrollment percentage included in the scenario descriptions to calculate the percentage of total DBESS energy capacity available to LUMA for dispatch.

Table Error! No text of specified style in document.**. Percentages of DBESS Capacity for Dispatch**

Scenario	Percentage of Enrollee's DBESS Installed Energy Production Capacity Available for Dispatch (%)			
	2025	2030	2035	2040
1	30	30	30	30
2	30	30	30	30
3	30	30	30	30
4	30	30	40	45
5	30	30	30	30
6	60	60	60	60
7	60	60	60	60
8	60	60	60	60
9	60	60	60	60
10	30	30	30	30

LUMA believes that battery control programs for DBESS will serve as a valuable contributor to future demand requirements in Puerto Rico. In addition, LUMA plans to work to improve the performance of the CBES program and expand battery control program offerings in the future. The method described above applies actual data from the existing CBES program, combined with prudent utility planning principles, to arrive at a reasonable DBESS control assumption. As the CBES program matures, more detailed data on customer participation trends and characteristics will be available, which, in turn, will help inform the degree to which such programs can contribute to Puerto Rico's energy and capacity needs. Planning on overly aggressive expectations of any battery control programs contributions in the 2024 IRP assumptions, without the benefit of reliable historical Puerto Rico data to support them, would create a risk of producing a resource plan that contains insufficient firm capacity to meet the system needs. LUMA has also looked at demand response programs in other jurisdictions and intends to utilize prudent utility planning principles in forecasting resource availability.

The demand management performance in California, arguably the most mature flexible demand program in the USA has been very disappointing. In a July 10, 2023, report by the California Public Advocates Office, titled "Without critical reforms, demand response programs are not ready to scale[1]," the report indicates:

The California portfolio of demand response "has not performed well by basic measures and has been an unreliable resource for grid operators."

[1] Summary of the report can be found at: https://www.publicadvocates.cpuc.ca.gov/-/media/cal-advocates-website/files/press-room/reports-and-analyses/230710-caladvocates-without-critical-reforms-demand-response-not-ready-to-scale.pdf

- In 2022, during the summer's high electricity use days, "third party demand response only supplied 36% of the reduced demand that they had committed to provide."

- In 2021 -"Only 30% of demand response contracts were able to provide the minimum energy their contracts required throughout the year."

- In 2020 - "Over 33% of the demand response resources counted for resource adequacy requirements did not deliver during the August 2020 extreme heat events. For example, third party demand response provided only 41% of their scheduled reductions during the August 14, 2020 highest-alert grid emergency, according to an interagency California Independent System Operator, California Energy Commission, California Public Utility Commission report."

- In 2019 - "The federal agency in charge of regulating electricity markets investigated and fined two of the largest commercial demand response aggregation companies for grossly overrepresenting what they could deliver to the California grid in 2019."

As discussed above, LUMA's has opted to set reasonable but conservative expectations regarding the availability of the CBES and other demand response programs as a resource in addressing Puerto Rico's energy and capacity needs. This determination is based on LUMA's assessment of data available from existing CBES enrollments, experiences from similar program in other jurisdictions, and prudent utility planning practices. The forecast and assumptions proposed by LUMA for its 2024 IRP are intended to support the successful and incremental deployment of future battery control programs, all the while ensuring the selected resource plan contains sufficient firm capacity to meet system needs.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-005b

SUBJECT

BESS Resources

REQUEST

Confirm/provide or explain otherwise concerning distributed BESS resources:

b. Provide the limitations - in comparison with utility scale BESS - associated with the dispatch or scheduling of BTM BESS in the PLEXOS production cost framework.

RESPONSE

b. LUMA has not yet established any limitations on the dispatch of DBESS batteries in its preliminary modeling for the 2024 IRP. However, to prevent loss of customers in the program, LUMA may choose to limit the number of dispatch events for which the DBESS can be called upon if it finds PLEXOS is dispatching the majority of the available DBESS MW capacity frequently. If only a fraction of the DBESS capacity is frequently needed, the actual dispatch could be cycled through different customer groups to limit customer frustration and the resulting loss of program participants.

LUMA has not yet performed distribution analysis that to determine potential impacts of flexible demand programs. LUMA may find the need to DBESS or other flexible demand programs based upon distribution system impacts of these programs. For example, LUMA may find that it needs to place limits on battery control charge or discharge capability based on the load carrying limitations of the host distribution feeders. LUMA plans to complete assessments of flexible demand program impacts to the distribution system in the years to come as our flexible demand programs mature and the grid hardening / improvements are finalized and implemented.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-006

SUBJECT

Agricultural Land for solar PV

REQUEST

Confirm/provide: How will "less Agricultural land for solar PV", as indicated in certain scenarios, impact input variables? Provide any quantitative data that explains the impact.

RESPONSE

LUMA understands, based on discussion in the PR100 Advisory Group meetings and feedback received by LUMA in the Solutions for the Energy Transformation of Puerto Rico (SETPR) stakeholder meetings, that preservation of agricultural land is an important priority for some stakeholders . The PR100 study defined two variations for land use:

- Less Land – considers only land that was not designated for agricultural purposes for utility-scale projects.
- More Land – considers agriculture land and all land in the Less Land variant for utility-scale projects.

Based on the February 2024 PR100 Summary Report.[2]

- The Less Land variant includes 203 km^2 of developable land with technical potential of 14.22 GW of solar PV.
- The More Land variant, the developable area is 638 km^2, with technical potential of 44.66 GW of solar PV.
- The Less Land variant is anticipated to result in the development of a greater number of smaller solar PV and land-based wind plants.

[2] https://www.nrel.gov/docs/fy24osti/88615.pdf

- Due to the reduced economies of scale and increase in required infrastructure (e.g., access roads, interconnections, etc.) the costs associated with deployment under the Less Land scenario are higher on average than the More Land scenario across all modeled years and technology scenarios.

- The average levelized cost of electricity (LCOE) for cases where More Land is available is $75/MWh, compared to $79/MWh for the cases with Less Land, representing an average of 5% increase in costs when agriculture land is excluded from development.

- LUMA plans to use the PR100 land variants and their respective project costs developed in the PLEXOS modeling for the 2024 IRP.

Based on feedback in the PR100 and the SETPR processes, LUMA considers that in order to reflect stakeholder input, it is important for the 2024 IRP to consider scenarios that include the impacts of differing land use policies on future energy resources.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-007

SUBJECT

Update to response to Question 7 of ROI #1 -Constraints used in PLEXOS modeling of Utility Scale Solar Photovoltaic (UPV) and UBESS.

REQUEST

Provide an update to LUMA's Response to the ROI #1, Question No. 7: State the constraints to be used in the PLEXOS modeling for potential year-over-year provision of utility-scale solar PV and battery energy storage resources, if any, for each of the scenarios modeled.

RESPONSE

There is currently a maximum constraint of 600 MW of utility-scale solar PV that can be added each year in the PLEXOS modeling. This constraint is a preliminary constraint equating to the approximate average of the additions in Tranche 1 and Tranche 2 resource procurements. Adding a constraint to the amount of generation additions serves to reduce the PLEXOS model run times. However, in practice, the 600 MW limit has not impacted actual solar additions in the preliminary results from PLEXOS since the largest utility scale solar PV additions in a single year have been less than 600 MW. Should the PLEXOS results present a portfolio that reaches the 600MW constraint, LUMA will consider an increase to the constraint to a value above the addition being requested by PLEXOS. For utility BESS, there is no constraint currently in the model as to how much can be added each year.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-008a

SUBJECT

Generation Legacy Units retirements

REQUEST

a. Generation Legacy Unit retirements. Confirm, or explain otherwise, that the PLEXOS model will prioritize, first allow, or mandate the retirement of heavy fuel oil legacy steam units at San Juan, Palo Seco, and Aguirre in accordance with any current emission guidelines, including EPA State Implementation Plans (SIP), or other guidance.

RESPONSE

a. LUMA will prioritize in the recommended 2024 IRP portfolio the retirement of heavy fuel oil legacy steam units at San Juan, Palo Seco, and Aguirre.

As LUMA explained during the Third Prefiling 2024 IRP Technical Conference held on January 30, 2024, attaining an acceptable industry standard result for resource adequacy for the Puerto Rico resource portfolio is a planned primary driver for defining LUMA's recommended retirement dates for existing fossil generation units. The indicator for resource adequacy will be the LOLE.

LUMA's preliminary plan is to determine the recommended retirement dates for operational units based first on whether there is sufficient reliable generation available to meet the targeted LOLE performance without the unit targeted for retirement, then allow the PLEXOS model to retire units based on selecting the least cost portfolios of resources. This method is consistent with the System Operation Principles approved by the Energy Bureau. LUMA plans to recommend that the actual retirement of units be delayed until 1-year after both the LOLE and cost data suggest a retirement of a unit is an option. This one-year lag for the retirement date allows a reasonable amount of time to resolve start-up issues with the new units and to demonstrate their ability to reliability operate over multiple months. This one-year lag for the retirement date is a prudent approach for planning the retirement of any generator that is contributing to resource adequacy requirements.

While the 2024 IRP will include a recommended schedule of retirements, LUMA intends to follow Section 3.3 of the System Operation Principles (SOP), when retiring a generation unit.

Unless Genera provides LUMA an alternate retirement schedule that results in superior reliability, LUMA plans to retire the heavy fuel units based on the unit forced outage rates, retiring units with the worst forced outage rate first, as illustrated in Table 3 below.

Only units that are currently in service are considered in the PLEXOS modeling; out of service units are not included in the list below or considered in the PLEXOS modeling.

Table 3. Preliminary order of retirement of Units

Preliminary Order of Retirement	Generator Name	Start of Operation	Fuel	Nameplate Capacity (MW)	Available Capacity (MW)	Forced Outage Rate (%)
1	Palo Seco 4	1968	LSFO*	216	160	60
2	San Juan 7	1965	LSFO*	100	70	40
3	Aguirre Steam 1	1971	LSFO*	450	300	25
4	Aguirre Steam 2	1971	LSFO*	450	350	15
5	Palo Seco 3	1968	LSFO*	216	190	15
6	San Juan 9	1968	LSFO*	100	90	8

The retirement logic described above will be based on PLEXOS results but cannot be set to be an automated decision endogenous to PLEXOS.

See response RFI-LUMA-AP-2023.0004-20240311-PREB-008b below regarding LUMA's System Operation Principles (SOP).

* LSFO= Low Sulfur Fuel Oil = Heavy Fuel Oil

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-008b

SUBJECT

Generation Legacy Units

REQUEST

Generation Legacy Unit retirements.

b. Confirm, or explain otherwise, that all other non-peaking legacy fossil fuel unit retirements (i.e., Aguirre diesel units, Costa Sur steam units, and the San Juan combined cycle units) are allowed as endogenous to the model, if economic.

RESPONSE

b. LUMA confirms that all other non-peaking legacy fossil fuel unit retirements are allowed as endogenous to the PLEXOS model, if economic. However, the PLEXOS model will also allow fuel switching from fossil diesel to a biodiesel or renewable diesel fuel if economic.

LUMA has established a general process for evaluating the retirement of a unit which is consistent with the System Operations Principles (SOP) and defined in the SOP Procedures. The process starts with receiving pertinent information from the Facility requesting the unit retirement. After receiving information on the unit to be retired, LUMA evaluates how the retirement of this unit will impact the system, customers, regulatory policies, among others, and submits a motion with recommendations to the Energy Bureau for review. The Energy Bureau, based on its evaluation, will determine if the unit is approved to be retired. If the unit is not approved to be retired, the unit will be designated as a Reliability-Must-Run ("RMR") unit. A retirement request can be resubmitted after the identified impact of the unit retirement has been addressed.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-009

SUBJECT

Marine Cable

REQUEST

Provide all Marine Cable resource cost parameters (initial, and ongoing costs including fuel, maintenance, and/or purchased power agreement costs) if used as resource option offered to the model, and/or if used to represent a "fixed decision" resource in a scenario.

RESPONSE

The cost parameters for the Marine Cable scenario will be completed as part of the four (4) Supplemental Scenarios that will be filed on August 1, 2024, as ordered by the Energy Bureau on the March 13 R&O. For the analysis, LUMA will use best available market data.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-010

SUBJECT

Update to response to Question No. 6 of ROI#1 & Slides 12-20 of LUMA's presentation for Second Technical Conference held on October 31, 2023.

REQUEST

Provide an update to LUMA's Response to ROI #1, Question No. 6, and as necessary confirm or modify the information provided on LUMA's presentation for Second Technical Conference held on October 31, 2023, slides numbers 12-20. Provide the information in Excel file format.

For easy reference, Question No. 6 from the ROI #1 is reproduced below.

Provide current planned capital costs and fixed O&M cost trajectories for all years across the planning horizon of 2025-2044 for supply resources to be used as options in the IRP modeling. These cost trajectories should capture any changes in capital and O&M costs across the planning horizon. Provide estimated cost trajectories for resources including [but not limited to the following:

a. Wind - onshore.
b. Wind - offshore.
c. Solar PV utility scale.
d. Solar PV distributed scale.
e. Battery energy storage utility scale - 4-hour duration
f. Battery energy storage utility scale - 2-hour duration
g. Battery energy storage utility scale - 6-hour duration
h. Battery energy storage - distributed scale.
i. Small combustion turbines or gas turbines.
j. Small reciprocating engines (RICE units).
k. Other size CT, GT, or RICE units.
l. Combined cycle units.

For all cost estimates including sources and the vintage of the estimate.

RESPONSE

In alignment with the previously provided response to Question #6 of the First 2024 IRP Prefiling ROI, , LUMA has adopted all thePR100 utility-scale wind and solar resource cost estimates for use in the 2024 IRP. For simple cycle combustion turbines, combined cycle units, the reciprocating internal combustion units and the UBESS units, LUMA is using a cost estimate developed by the 2024 IRP Technical Consultant. The IRP Technical consultant was asked by LUMA to review all of the resource cost estimates provided by PR100 and either confirm the estimates are reasonable or propose alternative cost estimates based on their industry experience.

The PR100 resource cost estimate was primarily drawn from the National Renewable Energy Laboratory (NREL) 2023 Annual Technology Baseline (ATB) with a geographic adjustment for Puerto Rico. The cost data found in the 2023 ATB were escalated to account for the PR100 estimated cost differential between resource projects constructed in the mainland U.S., on which the 2023 ATB costs are based, versus the higher costs seen in the bid responses received to the Tranche 1 and 2 solicitations. The cost differential seen in the pricing for the Tranche 1 and 2 bids is expected to decline to much lower levels in future years but remain higher than the mainland US costs. PR100 concluded that the pricing of the resources is assumed to decline from the mainland USA to Puerto Rico cost differential seen in Tranche 1 and 2 to a much lower premium that would then persist to the end of the 2024 IRP time horizon. The cost trajectory for the mid to later years of the 2024 IRP would then follow the ATB cost trajectories with a steady cost premium to reflect the continuing higher costs in Puerto Rico.

LUMA is also providing the requested data update to Question #6 of the First 2024 IRP Prefiling RFI and slides 12-20 of LUMA's presentation of the Second Technical Conference held on October 31, 2023, in the following documents attached under confidentiality:

1. RFI-LUMA-AP-2023.0004-20240311-PREB-010_*Cost trajectory of Onshore - Offshore Wind & UPV – DPV.*xlsx_ Attachment 1 *(*Question # 6 of First 2024 Prefiling RFI items a, b, c, & d / Slide 12, 13, 14, 15). The Vintage period is as of December 2023.
2. RFI-LUMA-AP-2023.0004-20240311-PREB-010_*Cost trajectory of UBESS and DBESS.*xlsx_ *Attachment 2 (Question # 6 of First 2024 Prefiling RFI items e, f, g, & h / Slide 13). The Vintage period is as of January 2023.*
3. RFI-LUMA-AP-2023.0004-20240311-PREB-010_*Cost trajectory of small combustion turbines or gas turbines, and reciprocating units; Other size CT, GT, or RICE units; Combined cycle unit.*xlsx_ *Attachment 3 (Question # 6 of First 2024 Prefiling RFI items i, j & l). The Vintage period is as of January 2023.*
4. RFI-LUMA-AP-2023.0004-20240311-PREB-010_*Cost trajectory of Fuels.*xlsx_ *Attachment 4* (Question # 6 of First 2024 Prefiling RFI items i, j & l). The Vintage period is as of November 2023.

The information provided on slides 12 - 20 of LUMA's presentation for the Second 2024 IRP Prefiling Technical Conference held on October 31, 2023, is updated in attachment *RFI-LUMA-AP-2023.0004-20240311-PREB-010-Update of slides 12-20 of presentation of the October 31, 2023 Technical Conference.pptx_Attachment 5.*

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-011a

SUBJECT

Input assumption that will be used in PLEXOS modeling.

REQUEST

For all resource types, provide the input assumptions across all planning years to be directly used in the PLEXOS modeling, or to be considered in any form of post-processing of PLEXOS results.

a. For all distributed energy resources ("DER", solar PV, and battery resources) used as load modifiers, provide the trajectory of MW (PV), and of MW and MWh (BESS) quantities to be used across scenarios, and differentiate between solar PV and battery resources.

RESPONSE

a. See attachment *RFI-LUMA-AP-2023.0004-20240311-PREB-004_Expected trajectory of MW and MWh values for use in PLEXOS.*xlsx _Attachment 1.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-011b

SUBJECT

Input assumption that will be used in PLEXOS modeling –DER.

REQUEST

For all resource types, provide the input assumptions across all planning years to be directly used in the PLEXOS modeling, or to be considered in any form of postprocessing of PLEXOS results.

b. Explain how the costs associated with load-modifying DER resources are to be used in the PLEXOS modeling, or to be used in post-processing modeling of PLEXOS modeling results.

RESPONSE

b. Costs associated with load-modifying DER resources will be integrated into the PLEXOS modeling framework to accurately reflect their impact on the overall system. These costs will be utilized during post-processing modeling of PLEXOS results to evaluate the economic feasibility and effectiveness of integrating DER resources into the energy system. The incorporation of these input assumptions and cost considerations is expected to provide robust and insightful analysis that facilitates informed decision-making regarding energy resource planning and management.

Attachment A

NEPR-AP-2023-0004

Response: RFI-LUMA-AP-2023.0004-20240311-PREB-011c

SUBJECT

Input assumption that will be used in PLEXOS modeling – DBESS

REQUEST

For all resource types, provide the input assumptions across all planning years to be directly used in the PLEXOS modeling, or to be considered in any form of postprocessing of PLEXOS results.

c. Explain how the functionality of the distributed BESS resources will be represented in PLEXOS.

RESPONSE

c. DBESS forecasted to be under a battery control program will be used in PLEXOS for:

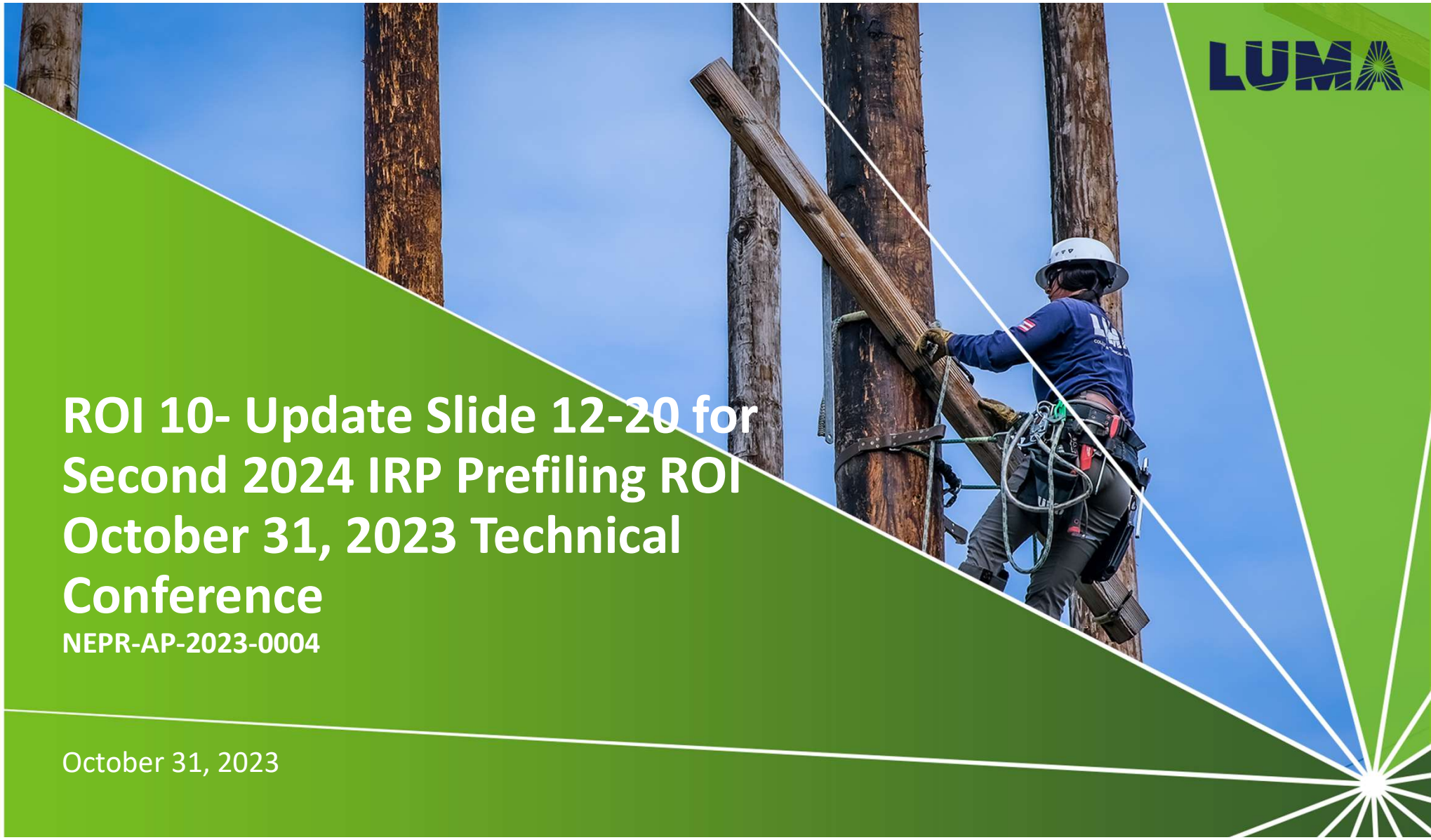
   a. Firm capacity, including RA.

   b. To increase load through charging and to decrease load through discharging.

   c. To address transmission or energy resource constraints

   d. To contribute to economic dispatch

DBESS that is not enrolled in battery control program will not be considered in the PLEXOS modeling or in the RA assessment since LUMA would have no control over when or how these DBESS resources are used.



ROI 10- Update Slide 12-20 for Second 2024 IRP Prefiling ROI October 31, 2023 Technical Conference

NEPR-AP-2023-0004

October 31, 2023

2. PR100 / DOE Information to Inform Assumptions in the IRP

c. Distributed scale vs. Utility-scale resource scenarios

No update

- PR100 assessed three (3) scenarios based primarily on the differences in the amount of Distributed Photovoltaic (DPV) and Distributed Battery Energy Storage Systems (DBESS) installed:
  1. Lowest - DPV forecasted based on economically justified DPV, including a savings of a reduced electric bill, and an estimate of the value of resiliency from the solar+storage
  2. Highest - DPV were based on DPV installations on every rooftop
  3. A third scenario that adds additional customer to the lower forecast

- PR100 bill savings portion of the assessment assumed net energy metering (NEM) remains the same, providing a full retail rate credit through 2050

- PR100 then added utility-scale resources to provide the remaining energy not served by DPV

2. PR100 / DOE Information to Inform Assumptions in the IRP

c. Distributed scale vs. Utility scale resource scenarios (Cont.)

LUMA is using an internally generated forecast for DPV and the PR100 2LMNET forecast for DBESS

~~LUMA DPV and DBESS forecasts will be based on economically justified projects, including savings of a reduced electric bill, and an estimate of the value of resiliency from the solar + storage installations~~

~~UMA will create two (2) foundational DPV and DBESS forecasts differentiated by the EM credit value for excess generation flowing to the grid~~

1. ~~Existing NEM - assumes NEM remains the same, providing a full retail rate credit~~
2. ~~Modified NEM - assumes the NEM credit reflects only the value of time-based avoided costs, which could go to zero $/kWh value at times when system generation from combined utility-scale and distributed solar exceeds system demand~~

LUMA is only using a single version of the forecasts for DPV and DBESS.

The forecast assumes the existing NEM for the DBESS forecast. The LUMA DPV forecast does not include elements that would be impacted by the NEM.

No modified NEM variations are now planned for the 2024 IRP.

2. PR100 / DOE Information to Inform Assumptions in the IRP

Clean version
Updated Slide

c. Distributed scale vs. Utility scale resource scenarios (Cont.)

- LUMA is using an internally generated forecast for DPV and the PR100 2LMNET forecast for DBESS
- LUMA is only using a single version of the forecasts for DPV and DBESS.
- The forecast assumes the existing NEM for the DBESS forecast. The LUMA DPV forecast does not include elements that would be impacted by the NEM.
- No modified NEM variations are now planned for the 2024 IRP.

2. PR100 / DOE Information to Inform Assumptions in the IRP

c. Distributed scale vs. Utility-scale resource scenarios (Cont.)

LUMA is only using a single DPV forecast.

- ~~LUMA will then create two (2) or more DPV forecasts for modeling that vary the date of the transition from growth rates with the current NEM structure to those growth rates that occur with the transition of NEM customer credits to the actual avoided costs~~
- LUMA will also take into consideration technical limits of the grid to host the forecasted DPV
- LUMA will then add utility resources to provide the remaining energy not served by the distributed scale solar resources

2. PR100 / DOE Information to Inform Assumptions in the IRP

Clean version
Updated Slide

c. Distributed scale vs. Utility-scale resource scenarios (Cont.)

- LUMA is using a single DPV forecast.
- LUMA will also take into consideration the technical limits of the grid to host the forecasted DPV
- LUMA will then add utility resources to provide the remaining energy not served by the distributed scale solar resources

2. PR100 / DOE Information to Inform Assumptions in the IRP

d. Transmission and/or distribution analysis

- PR100 found that even for the scenario with their lowest distributed solar forecast, scenario 1LMNet, most of the existing distribution feeders would require upgrades to accommodate the distributed solar.
- LUMA looks forward to reviewing the conclusions and recommendations of the PR100 T&D analysis for potential insights that could enhance the 2024 IRP
- LUMA plans to utilize the results from its own transmission and distribution analyses as input to 2024 IRP

The LUMA forecast of DPV planned for use in the 2024 IRP (similar to the PR100 2LMNET forecast) has an even higher DPV growth rates than those in the in the 1LMNET forecast.

2. PR100 / DOE Information to Inform Assumptions in the IRP

d. Transmission and/or distribution analysis

Clean version
Updated Slide

- PR100 found that even for the scenario with their lowest distributed solar forecast, scenario 1LMNet, most of the existing distribution feeders would require upgrades to accommodate the distributed solar.
- The LUMA forecast of DPV planned for use in the 2024 IRP (similar to the PR100 2LMNET forecast) has an even higher DPV growth rates than those in the in the 1LMNET forecast.
- LUMA looks forward to reviewing the conclusions and recommendations of the PR100 T&D analysis for potential insights that could enhance the 2024 IRP
- LUMA plans to utilize the results from its own transmission and distribution analyses as input to 2024 IRP

No update

3. Core Modeling Assumptions

a. Load forecast - components for IRP modeling

i. Base forecast (peak load and annual energy)
ii. Energy efficiency effects on base forecast (energy and peak load modification)
iii. Distributed generation (solar PV) behind-the-meter (BTM) effects on base forecast (energy load modification)
iv. Distributed battery storage behind the meter (BTM) effects on base forecast, if any (energy and peak load modification)

No update

3. Core Modeling Assumptions

a. Load forecast - components for IRP modeling

i. Base forecast (peak load and annual energy)

- LUMA and Guidehouse have made considerable progress in a forecasting improvement initiative
  - Historical data from both system metering and customer metering was thoroughly reviewed to address errors and missing data and to identify anomalies in customer or system data that were not reflective of normal usage
  - Historical and recent weather impacts on the system were refined
  - New econometric forecasting model was created by assessing the forecasting accuracy using alternative sets of econometric drivers
  - Once the econometric model was determined, alternate forecasts were created using upper and lower probabilistic projections of the selected econometric drivers in addition to changing temperature expectations

3. Core Modeling Assumptions

a. Load forecast - components for IRP modeling Energy Forecast (GWh)

Preliminary Draft Forecast

	FY 2025	FY 2030	FY 2035	FY 2040	FY 2044	Source
Base (before consideration of the next four rows)	[redacted]					
Energy Efficiency*						
~~Distributed PV+BESS**~~						
Distributed PV with rebound effect***						
Combined Heat and Power						
Electric Vehicle Charging						
Total (Net Energy Requirements)						

3. Core Modeling Assumptions

Clean version
Updated Slide

a. Load forecast - components for IRP modeling Energy Forecast (GWh)

Preliminary Draft Forecast

	FY 2025	FY 2030	FY 2035	FY 2040	FY 2044	Source
Base (before consideration of the next four rows)	[redacted]					
Energy Efficiency*						
Distributed PV with rebound effect**						
Combined Heat and Power						
Electric Vehicle Charging						
Total (Net Energy Requirements)						
Cumulative Distributed PV***						

[redacted]

3. Core Modeling Assumptions

a. Load forecast - components for IRP modeling Peak Load Forecast (MW)

	FY 2025	FY 2030	FY 2035	FY 2040	FY 2044	Source
Base Peak Load	[redacted]					
Energy Efficiency*						
Distributed ~~PV+~~BESS ~~with full retail rate NEM credit~~						
Combined Heat and Power						
~~DR (Flexible Demand)~~						
Electric Vehicle Charging						
Total						

[redacted]

Clean version
Updated Slide

3. Core Modeling Assumptions

a. Load forecast - components for IRP modeling Peak Load Forecast (MW)

	FY 2025	FY 2030	FY 2035	FY 2040	FY 2044	Source
Base Peak Load	[redacted]					
Energy Efficiency*						
Distributed BESS						
Combined Heat and Power						
DR (Flexible Demand)						
Electric Vehicle Charging						
Total						

[redacted]

3. Core Modeling Assumptions (Cont.)

b. New resource options - attributes, cost trajectories and implementation constraints for IRP modeling

Technology	2025 CapEx ($/kW)	2030 CapEx ($/kW)	2035 CapEx ($/kW)	2040 CapEx ($/kW)	2044 CapEx ($/kW)	Source
vii. Demand response including BTM BESS	[redacted]					

[redacted]

Clean version
Updated Slide

3. Core Modeling Assumptions (Cont.)

b. New resource options - attributes, cost trajectories and implementation constraints for IRP modeling

Technology	2025 CapEx ($/kW)	2030 CapEx ($/kW)	2035 CapEx ($/kW)	2040 CapEx ($/kW)	2044 CapEx ($/kW)	Source
vii. Demand response including BTM BESS	[redacted]					