

**COMMONWEALTH OF PUERTO RICO  
PUBLIC SERVICE REGULATORY BOARD  
PUERTO RICO ENERGY BUREAU**

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**IN RE:**

ENERGY EFFICIENCY AND DEMAND  
RESPONSE TRANSITION PERIOD PLAN

**CASE NO.:** NEPR-MI-2022-0001

**SUBJECT:** Submittal of Permanent Customer  
Battery Energy Sharing Program Proposal in  
Compliance with Resolutions and Orders of  
October 23, 2024 and December 5, 2024

**MOTION TO SUBMIT PERMANENT CUSTOMER BATTERY ENERGY SHARING  
PROGRAM PROPOSAL IN COMPLIANCE WITH RESOLUTIONS AND ORDERS OF  
OCTOBER 23, 2024 AND DECEMBER 5, 2024**

**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**

As the Transmission and Distribution system operator, LUMA is responsible for facilitating the implementation of Puerto Rico’s public energy policy, including key customer initiatives such as Energy Efficiency (“EE”) and Demand Response (“DR”) Programs, which are required by law and mandated by the Puerto Rico Energy Bureau (“Energy Bureau”). Accordingly, LUMA has been implementing a Transition Period Plan (“TPP”) containing various quick-start or pilot EE and DR programs, which will be setting the stage for the design and implementation of

larger scale, more permanent programs that would form part of a Three-Year Plan submitted by LUMA and approved by the Energy Bureau.

Among the DR Programs proposed in the TPP is a Pilot Battery DR Program (now called “Customer Battery Energy Sharing” (“CBES”)) Pilot which provides incentives to residential customers for sharing stored energy from their batteries during DR events, contributing to grid stability and supporting energy demand during peak demand periods. This pilot program operates under the aggregator model, where the customers enroll in the program through a qualified third-party aggregator, who is responsible for enrolling customers, dispatching battery resources for participating customers during grid events, reporting performance, and compensating customers based on participation.

LUMA successfully launched the CBES Pilot in November 2023 and the program has seen steady growth since, reaching 7,602 customer enrollments by December 2024, with an average of 135 new customers approved per week. As previously informed to this Energy Bureau, during the course of this pilot, LUMA has observed a trend where the total battery capacity utilized per event has not increased proportionately to the rising number of customers enrolled and understands this behavior could be addressed through program design adjustments.

Noting the CBES Pilot’s success and the need to grow customer participation and customer provided capacity, in a Resolution and Order issued on October 23, 2024, modified by Resolution and Order issued on December 5, 2024, the Energy Bureau directed LUMA to propose a form of permanent CBES program to further grow and scale this resource before summer 2025. In compliance with these Resolutions and Orders, LUMA is submitting with this Motion, as *Exhibit 1*, its proposal for the permanent CBES Program.

As discussed in the attached proposal, LUMA proposes achieving a 40 MW/Hour target from dispatching the program for 2.5 hours. To achieve this, LUMA recommends, based on available information at this time, to target enrollment of 19,500 participants with a yearly incentive budget of \$6.1 Million. It is also important to recognize that there are additional costs associated with implementing the program. LUMA does not propose modifying the aggregator compensation of \$1.25 kWh at this time. LUMA recommends transitioning the CBES Pilot into a full program by emphasizing increasing participation and reliability of the resource provided by DR events while minimizing the impact on participating customers during this transition. Moving forward, LUMA recommends a bi-annual review of the recommended enrollment target and budget to best suit the needs of the grid.

LUMA has several ongoing improvements in progress, described in the attached proposal, that LUMA anticipates will spur additional recommendations for the long-term structure of the permanent program. These ongoing improvements include a system operation impact research (to determine what impact the CBES program has on safe management of LUMA's distribution system and to determine the feasibility and impacts of incorporating large commercial and industrial sites into the program); a formal Test Event Plan (involving LUMA calling a range of test events to better understand the expected level of battery discharge for different event characteristics and help forecast operating impacts); a Consumer Research Survey (to gain more information about customer experience and participation drivers, the results of which will be used to develop targeted marketing aimed at increasing participation); and Distributed Energy Resource Management System ("DERMS") integration (a process to implement a device level DERMS for initial use in the CBES program to enable automated dispatch and reporting and create operational efficiencies in enrolling customers). LUMA proposes to strategically and methodically migrate

existing batteries to the DERMS platform in coordination with aggregators, with minimal impact on customers.

More information will be shared with the Energy Bureau and stakeholders as the results of the efforts described above become available. LUMA anticipates that these findings will spur evolving or additional recommendations for the long-term structure of the permanent CBES program.

## **II. Relevant Background and Procedural History**

1. On June 21, 2022, LUMA filed with the Energy Bureau, in Case No. NEPR-MI-2021-0006, *In Re: Demand Response Plan Review, Implementation and Monitoring*, LUMA's proposed Energy Efficiency and Demand Response Transition Period Plan ("Proposed TPP") containing the description and associated budgets of various quick-start EE and DR Programs to be implemented by LUMA during a two (2)-year Transition Period, which included a Battery DR Program. *See Motion Submitting Proposed EE/DR Transition Period Plan* in Case No. NEPR-MI-2021-0006, *In Re: Demand Response Plan Review, Implementation and Monitoring* and its *Exhibit 1*. The Battery DR Program was described as a program targeting residential customers with behind the meter (BTM) batteries and providing incentives to these customers for load shifting to batteries during DR event periods. *See id.* Exhibit 1, Section 4.3.2.

2. On February 16, 2023, the Energy Bureau issued a Resolution and Order ("February 16<sup>th</sup> Order") considering, amending, and approving the Proposed TPP (the Proposed TPP, as approved by the Energy Bureau, the "TPP"). In the February 16<sup>th</sup> Resolution and Order, the Energy Bureau established deadlines for quarterly and annual reports, program milestones and other filings, including the filing by December 2, 2023, of a draft EE and DR Three-Year Plan for fiscal years ("FY") 2025 to 2027.

3. Regarding the TPP's DR Programs, the Energy Bureau indicated that "LUMA's top priority shall be to work with third-party battery aggregators to develop and launch an emergency battery DR Program in FY2023, as part of or paired with its proposed emergency DR program that utilizes backup generators and other load flexibility". See February 16<sup>th</sup> Order, p. 15. The February 16<sup>th</sup> Order included milestones to implement the Battery DR Program. See *id.*, pp. 21-23, 29.

4. On August 29, 2023, LUMA submitted the quarterly report on the TPP for the fourth quarter ("Q4") of Fiscal Year 2022-2023 in which it informed, among others, regarding the various TPP programs, including the Battery DR Program (as mentioned, now called "Customer Battery Energy Sharing" ("CBES")) Pilot. Regarding the CBES Pilot, LUMA informed that it had finalized the design and development of this program, and the program would be launched in late fall 2023. See *id.* Exhibit 1, pp. 4 and 8.

5. On October 30, 2023, LUMA submitted the annual report on the TPP for Fiscal Year 2023 in which informed, among others, regarding the various TPP programs, including the CBES Pilot. Regarding the CBES Pilot, LUMA informed that it had launched the program's website, published the guidelines for the program, and executed three Master Aggregation Agreements. See *Motion to Submit TPP FY2023 Annual Report*, Exhibit 1, p. 5.

6. Also on October 30, 2023, LUMA filed a motion requesting the Energy Bureau to extend for an additional fiscal year the TPP and postponing the deadlines for filing of the Three-Year plan accordingly. See *Request to Extend by One Additional Year the Deadline to File the Three-Year Plan, Concomitant Deadlines and Extend the Term of the Transition Period Plan for An Additional Fiscal Year*.

7. On November 29, 2023, LUMA filed its first quarterly report for FY 2024 on the TPP in which it informed in connection with the CBES Pilot that by November 2023 it had launched the CBES Pilot and completed a successful test dispatch, and those 953 customers had been enrolled and 4.6 MW in battery capacity was available for a DR event. *See Motion to Submit FY 2024 Q1 TPP Report*, Exhibit 1.

8. On November 29, 2023, the Energy Bureau issued a Resolution and Order (“November 29<sup>th</sup> Order”) granting LUMA’s request to extend the TPP by one year (until June 30, 2025) and to delay the filing of the EE and DR Three-Year Plan by one year and ordered LUMA to file a revised TPP. *See id.*

9. On December 4, 2023, LUMA informed the Energy Bureau that, among others, it had executed additional Master Aggregation Agreements for the CBES Pilot and had successfully conducted a test of the capability to call emergency DR events for the CBES Pilot. *See Motion to File Proof of Customer Enrollment and Additional Executed Master Aggregation Agreements and Evidence of Capability to Call Emergency DR Events and Request for Confidentiality*, pp. 4-5.

10. On December 20, 2023, LUMA submitted to the Energy Bureau the revised version of the TPP, extending the TPP until June 2025. *See Motion to Submit Revised TPP and Other Information Requested Under the Resolution and Order of November 29, 2023, filed on December 20, 2023*, and its Exhibit 1.

11. After other procedural events<sup>1</sup>, On August 13, 2024, LUMA submitted its FY2024 Q4 TPP report, in which, among other things, it described the progress of the TPP programs,

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<sup>1</sup> LUMA continued to inform on the progress of the implementation of the CBES in the TPP reports for the second and third quarter of FY 2024. *See Motion to Submit FY Q[2] TPP Quarterly Report*, Exhibit 1, filed on February 29, 2024, and *Motion to Submit FY2024 Q3 Consolidated Transition Period Plan and Demand Response Administrative Cost Quarterly Report, Inform on Processing of Energy Efficiency Rebates, and Request Confidential Treatment*, Exhibit 1, filed on May 15, 2024 .

including the CBES Pilot. *See Motion to Submit FY2024 Q4 Consolidated Transition Period Plan and Demand Response Administrative Cost Quarterly Report and Request for Approval of Template for these Quarterly Reports*, Exhibit 1. In it, LUMA described the significant progress made in expanding customer participation and enhancing the capacity of the CBES Pilot, informing, among other things, that 5,726 customers enrolled for FY2024, and the program had an enrolled capacity of 38 MW, of which the program saw 18 MW consistently available for emergency DR events, and had dispatched 53 events in the Fiscal Year. *See id.* Exhibit 1, pp. 36 and 38.

12. LUMA also informed it had observed a trend where the actual capacity realized per event did not increase proportionately to the rising number of customers enrolled; that this behavior could be addressed through program design adjustments; and that to address this barrier and further the programs objectives, it intended to exceed the original enrollment target, given that the then current base alone could not drive growth in battery capacity deployment. *See id.* LUMA also noted that the CBES Pilot had shown potential in enhancing grid stability and optimizing energy consumption through effective DR strategies. *See id.*

13. On September 16, 2024, LUMA submitted a motion requesting clarification on the timeline for completion of the Market Baseline and Potential Studies<sup>2</sup> and an extension of the deadline to submit the Draft Three-Year Plan (then scheduled for December 2, 2024 as per the

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<sup>2</sup> The Energy Bureau's EE Regulation mandates two key studies to assess and guide energy efficiency efforts on the island: the Market Baseline Study and the Potential Study. *See* Regulation for Energy Efficiency, Regulation 9367 ("EE Regulation"), Sections 1.09(B)(29) and (38) and 3.02(A) and (B). Among others, the EE Regulation provides that, prior to the end of the TPP, and informed by the first Potential Study, the Energy Bureau shall estimate the energy efficiency savings achieved during that period for certain specified actions and that the Energy Bureau "shall use the results of the initial Market Baseline Study and the Potential Study, along with the estimated impacts of actions during the Transition Period Plan, to develop, in collaboration with the [the Public Energy Policy Program], estimated annual savings expected to be achieved by PREPA's efficiency programs", among others, "for each Program Year through 2040". *See id.* Section 3.02(D) and (E).

November 29<sup>th</sup> Order) given the delay in the completion of these studies which are to be used to develop the Three-Year Plan, and a concomitant extension of the TPP. *See Informative Motion, Request for Clarification Regarding Delayed Timeline for Completion of Market Baseline and Potential Studies, And Request for Extension to Submit Draft Three-Year Plan and Associated Tasks and Deadlines.*

14. On October 28, 2024, LUMA submitted its annual report on the TPP, providing with respect to the CBES Pilot some of the information discussed above in the fourth quarterly report and further indicating that LUMA was investigating participation rates and conducting surveys to better understand the factors influencing customer behavior and improve future program design, given the divergence found between customer growth and capacity growth. *See Motion to Submit FY2024 Consolidated Transition Period Plan and Demand Response Administrative Cost Annual Report*, Exhibit 1, p.8, 16, 17 and 25.

15. On October 23, 2024, the Energy Bureau issued a Resolution and Order (“October 23<sup>rd</sup> Order”) in which, among other determinations, it determined to: (a) extend the TPP by six months until December 31, 2025, while ordering LUMA to submit a revised TPP by December 2, 2024 and (2) defer the requirement to submit the draft EE and DR Three-Year Plan in December 2024, while ordering LUMA to begin stakeholder engagement on this draft plan on or before April 15, 2025. *See* October 23<sup>rd</sup> Order, pp. 4-6. In addition, the Energy Bureau issued directives regarding the CBES Pilot, among others. *See id.* pp. 3-4.

16. Regarding the CBES Pilot, the Energy Bureau indicated it was pleased to see the continued growth and success of the program and recognized that it had almost 6,000 participants, while noting that the capacity could be improved if more customers participated, or existing customers made more capacity available. *See id.*, p. 3. The Energy Bureau also

determined that LUMA should “transition this program from a pilot to a permanent program” and noted that it was interested in “enabling LUMA to further grow and scale this resource before summer 2025”. *See id.* The Energy Bureau then directed LUMA to:

1. File a motion proposing the form of its permanent customer battery sharing program no later than December 2, 2024. The Energy Bureau anticipates that it will host a technical conference on LUMA’s proposed program in January 2025. LUMA and the Energy Bureau will retain the ability to make program changes within the permanent program, to increase program cost-effectiveness and scale, and to manage overall program costs as needed.
2. Design a permanent program based on successful elements of the CBES pilot, to build on these successes and reduce customer transition costs, shocks, or loss of participation between the CBES pilot and the permanent program.
3. Design the program with the expectation that the participating resources will be regularly dispatched during high -load periods on the grid (such as the summer months), as well as in other times of grid stress.
- [4]. Design the program with the intention to not only increase the number of participants in the program but also to optimize the available energy and capacity from each participant so the grid resources can grow faster than the number of participants.

*See id.*, pp. 3-4.

17. On November 25, 2024, LUMA submitted a Motion in which, among others, it requested the Energy Bureau to extend the deadlines to submit the revised TPP and proposed CBES permanent program form until January 31, 2025. *See Motion for Extension of Deadlines and Modification of a Reporting Requirement in Resolution and Order of October 23, 2024.*

18. On December 5, 2024, the Energy Bureau issued a Resolution and Order (“December 5<sup>th</sup> Order”) granting the extensions to the filing of the revised TPP and CBES permanent program form until January 31, 2025.

### **III. Submittal of Report on Permanent CBES Program Proposal**

19. In compliance with the October 23<sup>rd</sup> Order, LUMA submits with this Motion its proposal for the permanent CBES Program (“Permanent CBES Program Proposal”). *See Exhibit*

1. This proposal provides as summary of data and insights from the first year of the CBES Pilot operations, the preliminary general form of the proposed permanent program, and the recommendations for transitioning the pilot into a permanent program. This proposal will evolve based on the information obtained as part of ongoing research and other initiatives described in the proposal, resulting in the long-term structure for the program. LUMA looks forward to discussing this proposal with the Energy Bureau during the upcoming technical conference.

**WHEREFORE**, LUMA respectfully requests that the Energy Bureau **take notice** of the aforementioned and **accept** the Permanent CBES Program Proposal in *Exhibit 1* in compliance with the October 23<sup>rd</sup> Order, as modified by the December 5<sup>th</sup> Order, with respect to the submittal of this program proposal.

**RESPECTFULLY SUBMITTED.**

In San Juan, Puerto Rico, this 31<sup>st</sup> day of January 2025.

We hereby certify that we filed this Motion using the electronic filing system of this Energy Bureau and that we will send an electronic copy of this Motion the Independent Office for Consumer Protection at [hrivera@jrsp.pr.gov](mailto:hrivera@jrsp.pr.gov); PREPA at [arivera@gmlex.net](mailto:arivera@gmlex.net); and [mvalle@gmlex.net](mailto:mvalle@gmlex.net); and [agraitfe@agraitlawpr.com](mailto:agraitfe@agraitlawpr.com), [info@sesapr.org](mailto:info@sesapr.org), [bfrench@veic.org](mailto:bfrench@veic.org), [shanson@veic.org](mailto:shanson@veic.org), [evand@sunrun.com](mailto:evand@sunrun.com), [jordgraham@tesla.com](mailto:jordgraham@tesla.com), [forest@cleanenergy.org](mailto:forest@cleanenergy.org), [customerservice@sunnova.com](mailto:customerservice@sunnova.com), [javrua@sesapr.org](mailto:javruea@sesapr.org), [pjcleanenergy@gmail.com](mailto:pjcleanenergy@gmail.com), and [mrios@arroyorioslaw.com](mailto:mrios@arroyorioslaw.com).



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*Exhibit 1*

*Proposal for Permanent Customer Battery Energy Sharing Program*

# Permanent Customer Battery Energy Sharing Program Proposal

January 31, 2025

NEPR-MI-2022-0001





## Executive Summary

As the operator of Puerto Rico's transmission and distribution (T&D) system, LUMA is committed to doing everything it can to work with its partners to address the island's generation capacity deficit. Much like the T&D system, Puerto Rico's generation assets have suffered from decades of neglect resulting in a significant lack of generation capacity that leads to frustrating outages for customers.

Among the positive steps LUMA is taking to improve grid reliability is partnering with renewable energy service companies (ESCOs) on the Customer Battery Energy Sharing (CBES or CBES Pilot) program. CBES was launched as a pilot program to increase the supply of energy available during peak demand periods, by drawing from participating solar customers' battery systems to improve day-to-day service reliability and minimize the impact of generation load shedding.

In Fiscal Year 2024, LUMA established strong partnerships with various renewable ESCOs. These collaborations have supported the expansion of the CBES Pilot. As LUMA prepares to transition the CBES Pilot to a permanent program, valuable lessons learned during the pilot program phase will inform the design of the permanent program.

LUMA is committed to building on the successful elements of the CBES Pilot to create a seamless transition that minimizes customer costs and maximizes participation. This includes enabling regular dispatching of participating resources during high-load periods and other critical times of grid stress. The goal is to not only increase the number of participants, but also to optimize the energy output and capacity from each participant, ensuring that grid resources grow effectively and sustainably. It is also essential to highlight the need for new resources within LUMA as the program looks to grow. This expansion will entail associated costs, which may include additional administrative support, increased communication efforts, and enhanced outreach initiatives. These investments are crucial for ensuring the program's success and effectiveness moving forward.

To comply with the Puerto Rico Energy Bureau's (Energy Bureau) directive issued on October 23, 2024, LUMA is submitting proposal for the permanent CBES Program ("Permanent CBES Program Proposal"), outlining the structure of the permanent CBES program. This will be informed by the lessons learned from the pilot program phase and will aim to improve the effectiveness of the program while addressing any challenges encountered. The transition of the CBES program into a permanent fixture represents a significant opportunity for the energy landscape of Puerto Rico. By leveraging customer battery systems, LUMA aims to bolster grid stability and reliability.

# Permanent CBES Program Proposal

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# Permanent CBES Program Proposal

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# Permanent CBES Program Proposal

## List of Acronyms

ACRONYM	DEFINITION
ADR	Automated Demand Response
ADMS	Advanced Distribution Management Systems
API	Application Programming Interface
BTM	Behind the Meter
CBES	Customer Battery Energy Sharing
C&I	Commercial and Industrial
DERMS	Distributed Energy Resource Management System
DR	Demand Response
ESCO	Energy Service Companies
EE	Energy Efficiency
EMS	Energy Management Systems
M&V	Measurement and Verification
NEM	Net Energy Metering
OEM	Original Equipment Managers
T&D	Transmission and Distribution
TPP	Transition Period Plan
SCADA	Supervisory Control and Data Acquisition

# Permanent CBES Program Proposal

## 1.0 Introduction

### 1.1 Purpose and Objectives

On October 23, 2024, the Energy Bureau issued a Resolution and Order determining that the CBES Pilot should be transitioned into a permanent program. The Energy Bureau expressed interest in “enabling LUMA to further grow and scale this resource before summer 2025<sup>1</sup>.” To support the transition from pilot program to permanent program, the Energy Bureau ordered that LUMA:

- File a motion proposing its plan for the transition of the CBES Pilot by December 2, 2024. The referenced deadline was extended to January 31, 2025, per the Energy Bureau’s December 5, 2024, Resolution and Order on Case No. NEPR-MI-2022-0001.
- Design the permanent program to incorporate successes found during the CBES Pilot and minimize transition pains felt by program participants,
- Design the program to incorporate regular dispatching of participating resources during high-load periods on the grid (such as the summer months), and
- Include design considerations to increase both the number of program participants and the efficiency with which participants’ energy and capacity is used.

This report is intended to support the ordered motion by providing a summary of data and insights from the first year of the CBES Pilot operations, the general preliminary form of the proposed permanent program, as well as recommendations for transitioning the pilot program into a permanent program. The proposed permanent program will be further developed based on the additional information obtained during implementation as a result of the ongoing research, stakeholder and Energy Bureau collaboration and other initiatives described in this report.

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<sup>1</sup> October 23 Order, NEPR-MI-2022-0001, Pg. 3.

# Permanent CBES Program Proposal

## 2.0 CBES Pilot Overview

### 2.1 Procedural Background and CBES Pilot Overview

On June 21, 2022, LUMA filed a proposed Energy Efficiency (EE) and Demand Response (DR) Transition Period Plan (TPP) outlining several quick launch programs, including a battery demand response program (implemented as CBES Pilot). On February 16, 2023, the Energy Bureau modified and approved the proposed TPP with amendments. On November 29, 2023, the Energy Bureau granted a one-year extension of the TPP and ordered LUMA to submit a revised TPP, which was filed on December 20, 2023.

The CBES Pilot was designed to develop and test operational procedures for leveraging distributed batteries as a DR resource during emergency events. The CBES Pilot is directed at residential and small commercial LUMA Customers with behind-the-meter (BTM) batteries who are registered in LUMA's Net Energy Metering (NEM) Program. Participants receive financial compensation for operating their BTM batteries during CBES program Events or Demand Response Events (DR event) as part of the CBES Pilot stage.

The CBES Pilot operates under an Aggregator<sup>2</sup> model, where customers enroll in the program through a qualified third-party Aggregator. At the time of this report, the CBES Pilot has five active Aggregator partners who regularly participate in dispatch events. Aggregators are responsible for enrolling customers, dispatching battery resources for participating customers during grid events, reporting performance, and compensating customers based on participation.

In the context of the TPP, a DR event is a situation triggered when a significant and immediate threat to the stability and reliability of the electrical grid occurs. This includes conditions where the grid's ability to supply power is compromised, potentially leading to outages or service disruptions. DR events are dispatched as a critical resource to avoid system reliability issues. DR events are called when the forecasted demand for the day is equal to or less than 100 MW of the operating peak reserve. In 2023, there were 47 days with at least one hour during which the peak operating reserve fell to 100 MW or less. DR events are not called during severe weather events, including storm warnings and storm advisories. Participation in these events is voluntary, and customers can opt out of events at any time before or during the event. LUMA provides a standard non-negotiable performance payment of \$1.25/kWh (as approved by the Energy Bureau in Resolution and Order of August 29, 2023, in Docket NEPR-MI- 2022-0001) to Aggregators for their aggregation services, who, in turn, must provide compensation to participating customers for operating their batteries during DR events according to the Aggregators' unique business model and customer value proposition. LUMA does not propose modifying the Aggregator compensation of \$1.25 kWh at this time. LUMA validates incentive payments to Aggregators by examining participant level discharge for each event as provided by the Aggregator.

The CBES Pilot was designed to develop and test the operational procedures for leveraging distributed batteries as an energy resource to the electric grid in Puerto Rico and its customers. A key benefit of the program is the reduced likelihood of outages, as the batteries discharge to support on-site usage or

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<sup>2</sup> An Aggregator is a specialized company that combines multiple customer energy resources to provide grid services, enabling small-scale energy assets to collectively participate in electricity markets and grid management.

# Permanent CBES Program Proposal

export energy to the grid. The additional energy dispatched enhances electric service stability and helps mitigate the effects of load shedding.

## 2.2 CBES Pilot Objective and Goals

The objective of the CBES Pilot has been and continues to be to acquire the necessary experience and insights to verify the reliability of BTM battery resources, determine program optimization strategies, and assess both system-wide impacts and customer responses. By leveraging BTM batteries, the program aims to provide significant grid benefits, test battery adoption potential, and help customers reduce bills while maintaining grid reliability during emergency conditions. This objective is broken down into four concrete goals derived directly from the TPP<sup>3</sup>:

- 1) Test and refine programs
- 2) Understand market readiness and customer preferences
- 3) Build market readiness and customer awareness
- 4) Understand organizational and operational requirements

The description for each of these four goals can be found below in *Table 1: CBES Pilot Goals*. *Section 4.0* of this report details the efforts that have been made to date to achieve these goals, and *Section 0* of this report highlights the continued developments to achieve these goals.

**Table 1: CBES Pilot Goals**

CBES PILOT GOAL	GOAL DESCRIPTION
<b>Test and refine programs</b>	Quickly launch the CBES Pilot to assess its effectiveness, gather participant feedback, and implement improvements, ensuring the program is fully optimized.
<b>Understand market readiness and customer preferences</b>	Develop a robust understanding of current market infrastructure and capture customer preferences and feedback during the initial CBES Pilot stages to inform future modifications and recommendations.
<b>Build market readiness and customer awareness</b>	Enable the CBES Pilot by developing market infrastructure and increasing customer awareness to expand participation beyond initial customers and vendors. This continues to be achieved by leveraging insights into customer preferences and engaging new local contractors and equipment.
<b>Understand organizational and operational requirements</b>	Establish a comprehensive structure for the effective administration of the CBES Pilot by identifying and addressing internal organizational and operational requirements.

<sup>3</sup> See *Section 2.1, Overview of "Transition Period Plan"* of the EE/DR Transition Period Plan Revised December 2023, NEPR-MI-2022-0001.

# Permanent CBES Program Proposal

## 3.0 CBES Pilot Summary

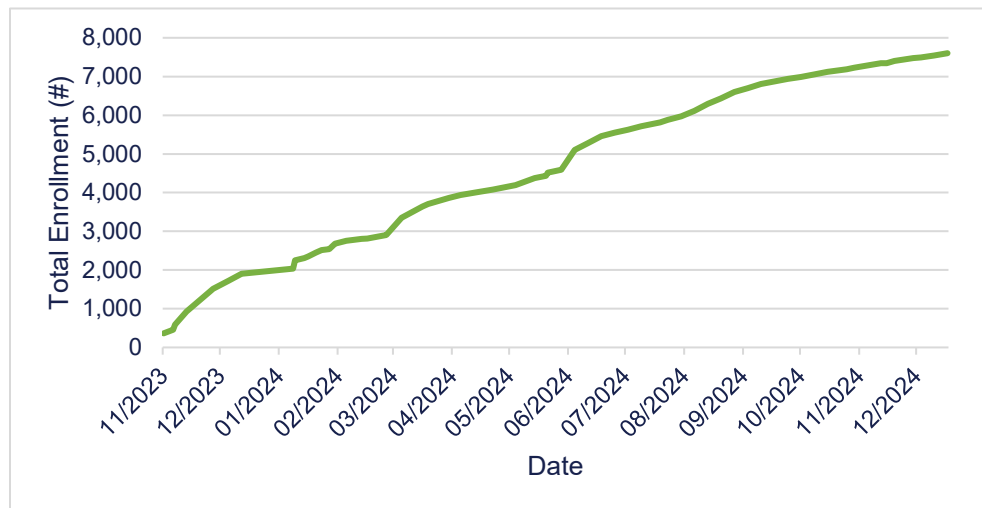
### 3.1 Introduction

This section covers the number of customers enrolled in the CBES Pilot, the number of events since its inception, and the average battery discharge metrics. Aggregators are required to provide LUMA a quarterly report of battery discharge (kWh) values by customer for each event. The data provided by the Aggregators is the basis for the battery metrics shown in this section. LUMA also has its own internal system to keep track and validate the number of customers enrolled in the CBES Pilot, which is used to produce the enrollment figures in *Section 3.2*.

### 3.2 Enrollment

The CBES Pilot has grown consistently since the first customer joined in early November 2023. Approval by LUMA is a key step in the customer's CBES participation journey, as it ensures that each participant meets the program requirements before being enrolled. Eligible customers are enrolled in the CBES Pilot through an approved Aggregator, who is responsible for enrolling customers, when eligibility is validated by LUMA, dispatching battery resources of participating customers during CBES program Events called by LUMA and compensating these customers for the energy provided. At the end of December 2024, the CBES Pilot had approved 7,602 different customers for participation. On average, 121 customers have been approved per week since the beginning of the CBES Pilot. *Figure 1: CBES Pilot Enrollment* displays the cumulative enrollment over time.

**Figure 1: CBES Pilot Enrollment**



At the time of this report, five Aggregators are actively enrolling customers in the CBES Pilot and participating in events. In addition to enrolling customers, each Aggregator is primarily responsible for maintaining the customer relationship, which includes informing participants about program updates, event notifications and processing payments. *Table 2: CBES Pilot Enrollment by Aggregator* shows the number of approved customers for each Aggregator. Aggregators #2 and #3 have enrolled the most customers, with a combined total of 82% of the CBES Pilot program population enrolled.

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**Table 2: CBES Pilot Enrollment by Aggregator**

AGGREGATOR	TOTAL ENROLLED CUSTOMERS	
	COUNT	PERCENT
1	102	1%
2	2,563	34%
3	3,656	48%
4	1,254	16%
5	27	<1%
<b>Total</b>	<b>7,602</b>	<b>100%</b>

With LUMA's recommendation of a full-scale program and greater customer engagement as outlined in *Section 6.0*, enrollment numbers and enrollment growth rates remain critical factors for the program's success. LUMA expects that enrollment rates can be further improved with additional coordination across existing and potential new Aggregators in relation to marketing and recruitment activities and a heightened focus on customer experience. However, to achieve greater customer engagement of the full-scale program with expedited timelines as described in *Section 6.0*, an accelerated enrollment growth rate is necessary.

To achieve greater customer engagement will require a strategic approach and coordinated effort between LUMA and the Aggregators to optimize and modify some of the existing characteristics of the CBES Pilot, including examining the customer incentive model and key performance indicators (KPIs), and minimizing other constraints to achieve the goals at scale. This increased growth rate is unlikely to happen instantaneously and will need to be appropriately scaled over the recommended program term as outlined in *Section 6.0* of this report.

## 3.3 Event Summary

*Table 3: CBES Event Summary* presents the total number of CBES events by duration that were called through the end of September 2024. The most common event length was two hours, representing 76% of all events called. All events took place in the evening, with the earliest start time being 5:00 p.m. AST and the latest being 7:00 p.m. AST. The most common event start time was 7:00 p.m. AST, which accounted for 72% of the events. At the end of September 2024, the CBES Pilot had not called a one-hour event. However, one-hour test events will be called in the future. For a detailed event-by-event summary, please refer to *Section 8.0*.

**Table 3: CBES Event Summary**

TOTAL EVENTS BY DURATION			TOTAL NUMBER OF EVENTS	TOTAL EVENT HOURS
2-HOUR	3-HOUR	4-HOUR		
58	3	15	76	185

*Table 4: Mean Battery Discharge per Participant by Event Duration* shows the mean battery energy (kWh) and power (kW) discharge values by each event duration and all DR events as a whole up until September 2024. The mean battery metrics are weighted by the number of participants in each event. A

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participant is a customer with greater than 0 kWh battery discharge during the event hours. Additionally, the 10<sup>th</sup> and 90<sup>th</sup> discharge percentiles are displayed.

**Table 4: Mean Battery Discharge per Participant by Event Duration**

EVENT DURATION	MEAN PARTICIPANT DISCHARGE					
	KWH/EVENT	DISCHARGE PERCENTILES (KWH)		KW	DISCHARGE PERCENTILES (KW)	
		10TH	90TH		10TH	90TH
2 Hours	6.6	5.7	7.7	3.3	2.9	3.9
3 Hours	7.2	6.3	8.9	2.4	2.1	3.0
4 Hours	5.6	5.3	6.5	1.4	1.3	1.6
<b>Average of All Events</b>	<b>6.4</b>	<b>5.4</b>	<b>7.7</b>	<b>2.8</b>	<b>1.4</b>	<b>3.8</b>

From the event dispatch data, four-hour events have the lowest average kWh discharge values and three-hour events have the highest. However, it should not be concluded that future events will necessarily follow a similar trend.

There are numerous reasons why total battery energy (kWh) could vary across events. Possible sources of variation include event duration, event start time, on-peak or off-peak, seasonality, weather, customers adjusting their battery reserve level or opting out of events, battery health, dispatch communication issues, limitations of the battery inverter, and battery charge level.

Over the course of the CBES Pilot, LUMA has seen a range of battery discharge values. The average participant discharge ranges from 5.4 kWh to 7.7 kWh across all events based on the 10<sup>th</sup> and 90<sup>th</sup> percentiles. These events were called across multiple seasons, from November 2023 to September 2024, and under a variety of different conditions that could influence the discharge in order to understand what the reliability and firmness of the resource would be given any number of potential factors that would influence performance.

Generally, the mean discharge power (kW) per participant decreases as the event length increases. Most batteries are discharged at a consistent rate throughout the event duration, and the rate varies to account for the total energy (kWh) available in the battery before the event. For example, if the total available energy in a battery is 8 kWh, then a two-hour event provides 4 kW of power hourly. However, the hourly power would be approximately 2 kW for a four-hour event.

Given the design of the CBES Pilot, LUMA cannot guarantee a precise discharge level before an event. In addition to the sources of variability noted above, the role of customer choice in the current CBES Pilot model, both in terms of the Aggregators and individual customers, should be considered. Customer choice is a key benefit of this pilot program, allowing participants a level of control and comfort over when their batteries are being discharged. This element of choice and, therefore, variability must be carefully balanced to operate the current state of the electric grid. This balance exists in the current CBES Pilot construct; however, as the CBES Pilot grows and transitions into a permanent program, this balance will need to be considered and incorporated into additional testing.

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LUMA calls events through notifications to all eligible Aggregators. In turn, the Aggregators dispatch their fleet of batteries. Each Aggregator determines its own dispatch strategy, including when to charge batteries before the event and how much energy to discharge per battery. Once the Aggregators schedule an event, each customer can opt out of the event or adjust their battery reserve level. For example, if a customer's battery reserve level is 60%, the CBES Pilot can only utilize up to 40% of the battery for a dispatch. Customers can also set their reserve level to 100%, where the battery would not discharge during an event.

This level of variability and customer choice leads to many unknowns regarding the reliability of this resource. With additional testing and data-gathering, LUMA seeks to shed light on these unknown elements and determine optimal and reliable conditions for dispatch events to help balance the grid.

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## 4.0 Progress to Date

### 4.1 Introduction

During the first year of the CBES Pilot's operations, LUMA has achieved measured progress toward each CBES Pilot goal as outlined in *Section 2.0*. That progress is detailed by goal in the sections below.

### 4.2 Test and Refine Programs

To launch the CBES Pilot quickly, the team developed and implemented a comprehensive project plan outlining key milestones, timelines, issues, and risks. Over the past year of the CBES Pilot, LUMA has monitored and analyzed several key performance indicators, including:

- Enrollment
- Enrollment growth
- Participation rate
- Battery energy capacity
- Battery reserve
- Energy per event
- Capacity per event
- Cost per event hour

Several of these indicators have already been discussed in *Section 3.0* of this report, and the team has and will continue to use the insights provided to iterate and refine components of the CBES Pilot. In addition, in September 2024, LUMA launched a formal Test Event Plan to capture more data on optimal event conditions. That Test Event Plan is detailed in *Section 5.0* of this report.

### 4.3 Understand Market Readiness and Customer Preferences

To properly scale the CBES Pilot to a permanent program, specific attention must be given to understanding the market readiness for expansion. LUMA is examining existing eligible sites, market trends for future installation, and the availability of equipment and qualified installers. Moving forward, the team will plan to address any potential gaps in scaling to more widespread participation.

LUMA has also developed a Consumer Research Study to gain more information about customer experience and what drives customers to participate in the program. More information on this ongoing effort can be found in *Section 5.0* of this report.

### 4.4 Build Market Readiness and Customer Awareness

Building on the research that will be obtained from the Consumer Research Survey, LUMA plans to continue to build market readiness and customer awareness of the program offering. The survey results will be used to develop targeted marketing collateral aimed at increasing participation. One of the main elements of LUMA's recommendation for transforming the CBES Pilot into a permanent program is expanding participation. More information on LUMA's recommendation is found in *Section 6.0* of this report.

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## 4.5 Understand Organizational and Operational Requirements

As with any pilot program, time and consideration must be given to understand and optimize the unique organizational and operational requirements to establish an effective administrative protocol. LUMA has put effort into understanding best practices in the industry amongst DR programs as well as aligning those best practices with the optimal solution for LUMA's specific needs. The team has developed an internal Operations Manual that details all relevant methods, processes, and protocols for effective pilot program management. In addition, an outward facing Aggregator Handbook has been developed to improve the onboarding process for new Aggregators and clearly lay out operational requirements and protocols.

An additional component of this goal involves implementing DR technology solutions. LUMA is currently working to integrate a device level Distributed Energy Resource Management System to enhance and automate certain elements of the CBES Pilot's operations. This ongoing development is described further in *Section 5.0* of this report.

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## 5.0 Continued Development

### 5.1 Introduction

In addition to the progress detailed in *Section 4.0* above, the CBES Pilot, has several ongoing efforts designed to further improve its performance and inform recommendations as it transitions to a permanent program. Areas of continued development include operation system impacts, test events, consumer research, and device level Distributed Energy Resource Management System (DERMS) implementation. More information on each of these development areas is detailed below.

### 5.2 Operations Systems Impacts

With any utility pilot program, it is critical to understand the broader impacts the initiative will have on the utility's operation systems, both in its current state and as the pilot program scales to a wider audience and impact. One critical safeguard built into this pilot program is the eligibility requirement that sites must be registered as part of LUMA's NEM program. As the CBES scales from pilot to permanent program, research is currently underway with the support of the U.S. Department of Energy and supporting National Labs to determine the impact the CBES Pilot will have on the safe management of LUMA's distribution system. As the permanent program participation develops further, and the number of enrolled customers continue to grow, this research would lay the groundwork for safe export of energy back into the grid. The research will also help determine what effect does battery energy exports into the grid has over current or volt/var violations at feeder or transformer level. Additional assessment is also being conducted within LUMA to determine the feasibility and impacts of incorporating large commercial and industrial sites into the program, including system impacts. The methodical approach to scaling enrollment with enhanced situational awareness and understanding of distribution system impacts will help ensure that the bulk system and local distribution system remain in sync.

### 5.3 Test Events

To better understand how the CBES Pilot performs under a variety of conditions, LUMA will call a range of test events. The test events are strategically planned and will be called throughout the pilot program. In total, LUMA aims to call approximately 34 test events. *Table 5: CBES Test Events* displays the test categories in which LUMA hopes to gain additional information.

**Table 5: CBES Test Events**

TEST TYPE	NOTES	NUMBER OF TESTS
Duration	Event duration varies from 1 to 4 hours. All events start at 19:00	8
Time of day	Event start times range from 6:00 to 21:00. All events are two hours long	10
Seasonal impacts	2-hour events from 19:00 - 21:00 in Sept., Nov., Dec., Jan., and Mar.	5
Event notification timing	2-hour events from 15:00 - 17:00 with 1 hour to 2-day notification times	8
Post-storm	Events called after storms or weather events, as needed	3

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Calling test events will allow LUMA to gain valuable insights into how the pilot program functions as conditions vary. The test events will provide LUMA with data that can be used to better understand the expected level of battery discharge for different event characteristics and help forecast operating impacts. For example, LUMA can determine the expected discharge for a 1-hour versus a 4-hour event by testing different event lengths. Overall, LUMA will use the lessons learned from the test events to help scale the pilot program into a permanent program.

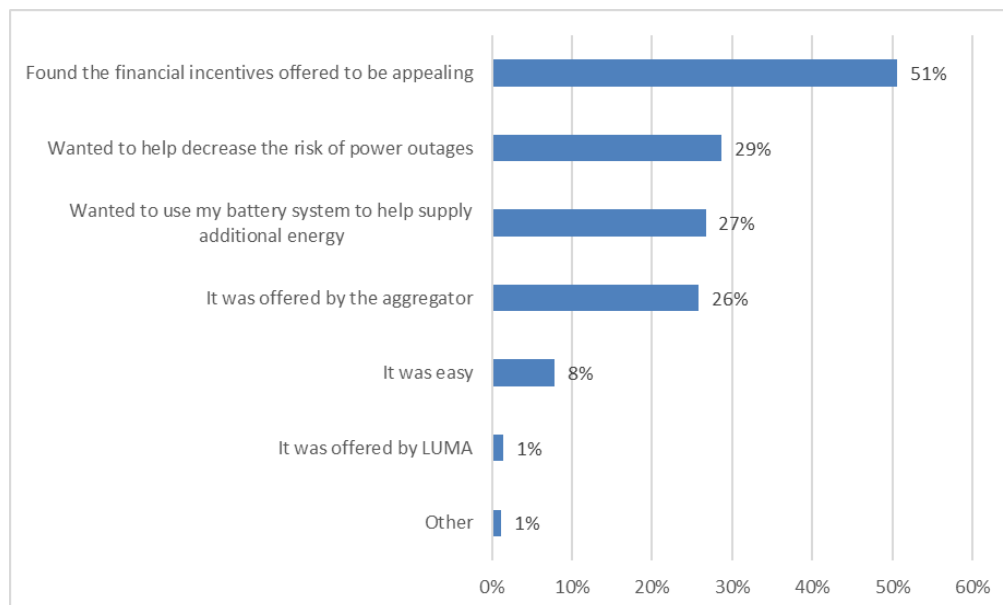
## 5.4 Consumer Research

In October and November of 2024, LUMA fielded a survey of CBES participants and obtained 381 responses. Of these 381 respondents, 93% reported either sharing their battery power regularly or occasionally. Survey responses are being analyzed and initial analysis provided insights that will be helpful in transitioning the CBES Pilot into a permanent program.

The primary purpose of the survey was to understand customer participation drivers and perception about the CBES Pilot. These insights will be used in future marketing to drive new enrollments and continued participation as well as testimonials that communicate participants' perception can become material for future marketing to support program growth.

Survey respondents identified financial incentives as their primary motivation to enroll in the CBES Pilot. Many participants also expressed a strong desire to help reduce the risk of power outages and help supply additional energy were also ranked highly by participants. Additionally, 60% of participants strongly agreed that they felt good about their extra battery power going to good use during an event. Over 80% of respondents identified Aggregators as their primary sources of CBES Pilot awareness. Continuing to leverage both financial and altruistic motives through Aggregator outreach will serve to expand the CBES Pilot.

**Figure 2: CBES Pilot Enrollment Motivation**



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The secondary purpose of the survey was to track customer satisfaction and experiences. Customer satisfaction results will help the CBES program address any pain points, reduce event opt outs and promote participant retention. Customer experience questions provide context about the way participants manage their battery sharing and the degree to which they are optimizing their otherwise unused battery storage.

Customer satisfaction with the CBES Pilot is high. Over 67% of participants strongly agreed that they would recommend the CBES program to eligible fellow Puerto Ricans, and 70% of participants did not identify sharing battery power as an inconvenience. However, participants generally want to understand the CBES program better. Over 80% would like a deeper understanding of the calculation of financial incentives. Additionally, almost 50% would like to understand their contribution to their community better. Approximately 31% of survey respondents also said they would like to know how their contribution compares to other CBES Pilot participants. These responses indicate an opportunity for distinct levels of participation, in which participants are further incentivized either altruistically, competitively, or through rewards to increase their own participation in the CBES program.

In addition to the survey mentioned above, concurrent research is being conducted by the National Laboratories. These efforts will survey both customers enrolled in the CBES Pilot and those who are not, as well as individuals with and without an eligible battery system. The results of these efforts will provide a more holistic understanding of the market's potential and willingness to participate, creating an even wider lens to view future program recommendations from the customers' perspective.

## 5.5 DERMS Implementation

Since its launch in November 2023, the CBES Pilot has enrolled over 7,000 customers through qualified Aggregators. The Aggregators are responsible for recruiting customers, controlling and managing the dispatch of batteries, and securely collecting battery telemetry data and reporting metrics, among other responsibilities.

In the current pilot program configuration, LUMA System Operations determines the need for a DR event based on system constraints. To call an event, the LUMA DR team sends an event notice via email to Aggregators, who in turn confirm participation and expected dispatchable capacity via email before dispatching the event.

As the CBES Pilot continues to scale steadily, it is critical to ensure and enhance the reliability of this process and resources when called during emergency conditions for LUMA and the customers it serves. It is also increasingly important to support the seamless dispatch of DR events and ensure robust reporting of event indicators to promptly respond to grid needs through automation. As such, LUMA is in the process of implementing a device level DERMS or a grid-edge DERMS for initial use in the CBES Pilot.

- **Automated Dispatch:** In the current scope, the grid-edge DERMS will enable Automated Demand Response (ADR) to manage most enrolled batteries in the CBES Pilot through participating Aggregators. Through existing Application Programming Interface (API) integrations with these Aggregators and other future battery Original Equipment Managers (OEMs), DERMS will be able to schedule and dispatch events and exchange data in near real-time and more effectively than the existing process.

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- **Near Real-time Reporting:** Optimal data points and timely reporting are indispensable to the success of DR programs, including comprehensive post-event analysis, cost-effectiveness tracking, and accurate measurement and verification for planning and forecasting. The DERMS will enable streamlined access to historical data, post-event data, and metrics such as enrollment rates, participation rates, event opt-out rates, and more, in near real-time.
- **Operational Efficiencies:** In addition to automated dispatch and reporting, DERMS will also benefit the enrollment and reconciliation processes, reducing manual intervention, operational burdens, and delays for LUMA and Aggregators. The benefits of DERMS implementation will extend beyond the CBES program and ultimately be used in other DR programs as LUMA's DR offerings diversify.
- **DER Strategy:** The DERMS platform will also enable LUMA to extend those same use cases and value to additional demand response technologies, approaches and validations. Using the CBES program as a starting point to a holistic and balanced DR strategy over longer horizons and unique system need scenarios.

**Next Steps:** DERMS implementation began in December 2024 which includes strategically and methodically migrating existing batteries to the DERMS platform in coordination between LUMA and Aggregators. After initially launching with existing Aggregators, LUMA plans to explore onboarding additional Aggregators with DERMS in an effort to improve enrollment rates and streamline processes across Aggregators per approved onboarding requirements and guidelines. In the future, LUMA plans to explore locational dispatch and telemetry-based dispatch capabilities with DERMS. These capabilities are expected to bring further sophistication with a targeted approach to the battery control strategy and, in turn, enhance the overall customer experience. In the long run, investments in these capabilities will provide benefits beyond CBES and will extend to eventual system-level investments for grid management technologies such as Energy Management Systems (EMS) and Advanced Distribution Management Systems (ADMS).

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## 6.0 Program Recommendations

### 6.1 Introduction

As of this report, LUMA's recommendations for transitioning the CBES Pilot into a permanent program are organized in two main areas:

- 1) Program design and term, and
- 2) Program enrollment and budget.

LUMA's main objectives for scaling this pilot program to a permanent program include expanding participation to obtain a greater and more reliable impact from the aggregate CBES resource for DR events. In addition, LUMA wants to enable a smooth transition for participating customers.

LUMA recognizes that multiple approaches and models exist for purchasing power from residential customers to balance the electrical system. LUMA will continue to explore various program structures with distinct pricing mechanisms as part of its engagement with stakeholders and Aggregators. These alternative models may offer different incentive structures, technological platforms, and engagement strategies to optimize demand response effectiveness.

### 6.2 Program Design and Term

In this initial transition from a pilot program to a permanent program, LUMA recommends a conservative approach that maintains the existing look and feel of the CBES Pilot. One main goal shared by both the Energy Bureau and LUMA is to minimize the impact of this transition on customers. An additional priority is minimizing potential risks to the grid due to scaling the program too quickly.

LUMA recommends a three-year term for the full-scale program, beginning on July 1, 2025. This term length aligns not only with the start of the fiscal year, but also with the concurrent three-year planning process. The three-year term is expected to provide a higher level of certainty and credibility for both Aggregators and customers about the longevity of their enrollment and investment in CBES. Additionally, the three-year timeframe may enable LUMA to scale enrollments at a steady rate, qualifying the CBES program as a resilient and reliable resource for LUMA system operations and Puerto Rico's power grid. This recommendation is also in line with various behind-the-meter DR programs in the United States.

At the culmination of each three-year period, LUMA will review the needs of the grid with respect to the services and value provided by the CBES program and ultimately recommend either to continue the program as is, to modify the program to fit an adapted set of grid and customer needs, or to discontinue the program due to lack of cost effectiveness or other inherent reasons.

The design of the CBES Pilot encourages participation from both the Aggregators and customers. There is currently no defined limit on the number of customers the CBES Pilot can enroll, as long as the budget can support additional customers.<sup>4</sup> Customers are also given the freedom to decide if they want to participate in the CBES Pilot and select which events they wish to participate in. The option to opt out of events lets customers know they have full control over when and how their battery is utilized, allowing

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<sup>4</sup> The Energy Bureau R&O March 21, 2024, on Case No. NEPR-MI-2022-0001.

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them to join the program with minimal risk. For LUMA, this pilot program design means that the administrative burden of enrolling customers and maintaining a battery fleet is shifted to the Aggregators. Overall, LUMA recommends keeping the CBES Pilot design the same in the near future with minor modifications.

### 6.3 Program Enrollment and Budget

*Table 6: CBES Projected Program Enrollment and the \$1.25/kWh Incentive Budget* displays projected CBES program enrollment and incentive cost associated with each fiscal year through 2028. Currently, the CBES aims to achieve a 40 MW target from dispatching the program with a 73% participation rate for 2.5 hours by the end of 2028. The 40 MW target is derived from examining 2023 system load data. There were 47 hours in 2023 where system reserves were negative. From these hours, the 90<sup>th</sup> percentile of the reserve shortfall was 40 MW. This value was chosen so the CBES Program can provide relief in most situations when system reserves are negative. The projected total yearly incentive budget for a 40 MW capacity is approximately \$6.1 million, which corresponds to an enrollment of 19,500 customers.

LUMA recommends expanding the CBES Program to include 19,500 customers to help with future generation shortfalls. In addition to incentives, the approval for administration, technology and operation of the program must also proportionally match the expansion in customer participants, Aggregators, and optimization and reporting of the program's performance.

*Table 6: CBES Projected Program Enrollment and the \$1.25/kWh Incentive Budget* also shows the targeted MW discharge value for the end of each fiscal year along with the corresponding enrollment and incentive cost as the program ramps up to the 40 MW target. From the current enrollment of over 8,000 customers, the CBES program hopes to steadily increase the rate of enrollment over the next one to two years. In line with what was requested by the Energy Bureau, By the end of fiscal year 2025 (i.e. Summer of 2025), the CBES program aims to have 18 MW discharge capacity per event while enrolling 8,500 customers. The target capacity increases to 28 MW and 36 MW by the end of fiscal years 2026 and 2027, respectively. These projections assume an accelerated enrollment growth rate in fiscal years 2026 and 2027.

As noted in *Section 3.2*, the pace of enrollment in the current pilot program structure can be a limiting factor to achieve the greater customer engagement and performance. To promote the best interests of CBES participants as well as Puerto Rico's energy grid, the enrollments will need to ramp up at a higher rate over the duration of the first year of the program and continue to increase steadily in the second and third years. LUMA plans to implement enrollment strategies in collaboration with existing and potential Aggregators to reach these enrollment growth goals.

As such, LUMA will strengthen its partnership with Aggregators and DERMS to invest in program marketing and recruitment tactics, along with optimizing dispatch and control strategies. By improving event participation and performance, and minimizing unenrollment and event opt outs, the program can more expediently achieve its capacity targets and effectively support Puerto Rico's grid needs.

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**Table 6: CBES Projected Program Enrollment and the \$1.25/kWh Incentive Budget**

YEAR (FISCAL)	TARGETED DISCHARGE (MW/EVENT)	CUSTOMERS ENROLLED (END OF FISCAL YEAR)	TOTAL PROGRAM PERFORMANCE INCENTIVE COSTS
2025	18	8,500	\$2,662,285
2026	28	13,500	\$4,228,334
2027	36	17,500	\$5,481,174
2028	40	19,500	\$6,107,594

It should be noted that the indicators above assume there are no grid management issues when large amounts of energy exports are sent to the grid. LUMA is researching if there is an export threshold level that could limit the enrollment cap for the program. It is important to consider that the outcome of supplementary studies and the effective deployment of necessary upgrades could have an effect on the figures above.

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## 7.0 Program Optimization, Testing & Evaluation

### 7.1 CBES Pilot Performance & Baseline

The Consumer Research Survey (*Section 5.4*) conducted by LUMA during the CBES Pilot outlined customer preferences, including motivations for enrollment, and household battery usage, including battery reserve preferences, providing a better baseline understanding of customer behavior. In the future state of the program, LUMA recommends assessing the overall impact of the aggregate resource to the grid. This would entail standardizing and collecting additional indicators and data required for measurement and evaluation to further optimize the interaction between the battery, solar, and grid, when injecting energy back into the grid.

As an example, there can be considerable variation in the amount of battery energy discharge on an event-by-event basis, as noted in *Section 3.3*. One part of this variability comes from each Aggregator implementing their own dispatch strategy. To help control for this variation, LUMA recommends additional guidelines for participating Aggregators. This includes potentially asking Aggregators to:

- Discharge the batteries at a constant rate throughout the event.
- Discharge each battery up to the customer-set battery reserve level, exporting back to the grid where possible.
- If given enough notification, charge the batteries before the event begins using available excess solar energy.
- Explore locational dispatch and ramping capabilities

### 7.2 Future Program Improvements & Evaluation

LUMA will explore implementing the guidelines mentioned above while gathering feedback from the Aggregators about changes to dispatch strategy. Incorporating these guidelines will help LUMA better predict future dispatches and help control variability in the dispatches based on the Aggregator.

To further optimize the dispatch strategy and event design, LUMA plans to explore and automate the selection and activation of groups of batteries during DR events, based on grid conditions. The objective is to dispatch these groups in a systematic approach based on system needs and then steadily ramp up to 40MW, preserving the customer experience and grid stability. To address the dispatch variability and obtain a higher discharge capacity as well as participation from each battery, LUMA may assess additional customer incentive structures. Besides pay-for-performance model, LUMA may explore incentive models such as an upfront enrollment incentive or customized payment based on shared battery capacity to enhance customer participation in DR events and improve overall customer satisfaction.

Additionally, LUMA will explore the feasibility of incorporating and utilizing large Commercial & Industrial (C&I) batteries enrolled in the NEM program to respond with grid constraints and emergencies. Based on the battery size, location, customer type, rate classification, NEM and interconnection status, LUMA may define the eligibility criteria, program design, and dispatch strategy for Large C&I batteries, within a separate pilot or program structure from CBES. This will require a well-coordinated effort and detailed

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assessment with LUMA System Operations and Planning teams to fully understand and evaluate the impacts to LUMA's distribution system, including potential risks, compliance requirements, key assumptions, and alignment with standard operating procedures for dispatch. In the future, LUMA's team plans to investigate use cases and approaches to enable energy from batteries to be safely injected back into the grid without causing distribution system violations, and to integrate these resources with enterprise systems such as Supervisory Control and Data Acquisition (SCADA) and ADMS, along with grid edge technologies and programs.

LUMA will also continue to explore process evaluations to support continuous program optimization. The goal is to identify successful components of the program as well as opportunities to improve operations and services for LUMA and its customers, including considerations about other planned utility scale battery programs. These improvements may include additional data collection and standardization of measurement and verification (M&V) metrics, avoided costs analysis for cost effectiveness, in-depth customer interviews to understand and predict behavior, optimization of grid edge DERMS processes and consideration of distribution operations, dispatch strategy testing including locational dispatch, payment structure and reconciliation enhancements and testing, among others.

The historical participation rate, average battery energy per participant (kWh/event) and other metrics established by the CBES Pilot can be used to estimate expected response for the aggregate resource in the full-scale program for ongoing planning and forecasting. These performance indicators along with the learnings from consumer research surveys from the pilot program should serve as a baseline for future program evaluation and continued optimization.

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## 8.0 Conclusion

### 8.1 Summary of Enrollment and Event Findings

The main conclusions from the enrollment and event data are as follows:

- CBES Pilot growth has been steadily increasing, with an average of 121 new customers approved each week
- The concentration of the CBES Pilot population is currently distributed between two main Aggregators, totaling approximately 82% of the total population
- Variation exists in the event-by-event discharge levels, and the source of that variation could be due to a wide range of reasons. In general, the mean participant energy discharge ranges from 5.4 kWh to 7.7 kWh across all event durations
- The mean participant power (kW) per hour decreases as the event length increases, which represents that calling an event with a longer duration does not guarantee more power per event

### 8.2 Summary of Current Progress and Future Developments

Over the past year of the CBES Pilot's operations, LUMA has made considerable progress towards its four goals, as detailed in *Section 4.0* of this report. Notable improvements include an Operations Manual documenting proper protocol and operating procedures, an Aggregator Handbook to enhance the process of onboarding new Aggregators to the pilot program, and a Consumer Research Survey to understand customer participation drivers.

LUMA has several ongoing improvements in progress, including system operations impact research, a formal Test Event Plan, and DERMS integration. More information will be shared with regulatory and stakeholder bodies as the results of these efforts become available. LUMA anticipates that these findings will spur additional recommendations for the long-term structure of the permanent program. Furthermore, supplementary studies and upgrades may facilitate more rapid implementation and reduce potential negative impacts on the grid, ensuring enhanced reliability and resilience during critical periods.

### 8.3 Summary of Recommendations

LUMA's recommendations for transitioning the CBES Pilot into a permanent program emphasize increasing participation and reliability of the resource provided by DR events while minimizing the impact on participating customers during this transition. Based on the best available information at the time of this report, LUMA's recommendation is that, alongside its partners, a target for enrollment of up to 19,500 participants should be established with a yearly program budget of \$6.1 Million. As LUMA and its partners, including the National Laboratories, uncover more information and findings on the optimal state of this program, we anticipate that this recommendation will evolve. Moving forward, LUMA recommends a bi-annual review of the recommended enrollment target and budget to best suit the needs of the grid.

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## 9.0 Appendix A: CBES Individual Event Summary

### 9.1 CBES Individual Event Summary

*Table 7: CBES Event-by-Event Summary* displays a summary of all the CBES events through the end of September 2024. Participating customers in the table are those who had a battery discharge greater than 0 kWh during the event hours. The total battery energy discharged per event is the total kWh summed from the quarterly energy reports each Aggregator submits to LUMA. The total battery power dispatched is the average hourly value calculated by dividing the total energy by the event duration. Lastly, the total cost per event represents the \$1.25 per kWh paid to the Aggregators. The total program incentive cost through the end of September 2024 was approximately \$2.1 million.

**Table 7: CBES Event-by-Event Summary**

EVENT INFORMATION			PARTICIPANTS		EVENT STATISTICS				
DATE	DURATION (HOURS)	START TIME	PARTICIPATING CUSTOMERS	# OF PARTICIPATING AGGREGATORS	TOTAL BATTERY ENERGY DISPATCHED (KWH/EVENT)	AVERAGE ENERGY PER PARTICIPANT (KWH/EVENT)	TOTAL BATTERY POWER DISPATCHED (KW)	AVERAGE POWER PER PARTICIPANT (KW)	TOTAL EVENT COST
11/17/2023	2	17:00	506	3	4,115	8.1	2,057	4.1	\$5,144
11/21/2023*	2	17:00	5	1	29	5.8	14	2.9	\$36
12/7/2023	2	18:00	1,459	4	12,938	8.9	6,469	4.4	\$16,173
1/11/2024	3	18:00	1,749	4	15,848	9.1	5,283	3.0	\$19,810
2/1/2024	2	18:00	2,264	5	18,203	8.0	9,101	4.0	\$22,753
2/21/2024	3	18:30	2,440	5	20,476	8.4	6,825	2.8	\$25,595
3/20/2024	2	18:30	3,067	5	23,653	7.7	11,827	3.9	\$29,567
4/1/2024	2	19:00	3,018	5	23,597	7.8	11,799	3.9	\$29,497
4/3/2024	2	19:00	3,134	5	24,493	7.8	12,246	3.9	\$30,616
4/5/2024	2	19:00	3,285	5	25,298	7.7	12,649	3.9	\$31,623
4/22/2024	2	19:00	3,459	4	26,450	7.6	13,225	3.8	\$33,062

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EVENT INFORMATION			PARTICIPANTS		EVENT STATISTICS				
DATE	DURATION (HOURS)	START TIME	PARTICIPATING CUSTOMERS	# OF PARTICIPATING AGGREGATORS	TOTAL BATTERY ENERGY DISPATCHED (KWH/EVENT)	AVERAGE ENERGY PER PARTICIPANT (KWH/EVENT)	TOTAL BATTERY POWER DISPATCHED (KW)	AVERAGE POWER PER PARTICIPANT (KW)	TOTAL EVENT COST
4/29/2024	2	19:00	3,477	4	27,025	7.8	13,512	3.9	\$33,781
4/30/2024	2	19:00	3,421	4	25,697	7.5	12,849	3.8	\$32,121
5/1/2024	2	19:00	3,425	4	25,342	7.4	12,671	3.7	\$31,677
5/2/2024	2	19:00	3,412	4	24,022	7.0	12,011	3.5	\$30,028
5/3/2024	2	19:00	3,171	4	21,136	6.7	10,568	3.3	\$26,420
5/6/2024	2	19:00	3,318	4	23,450	7.1	11,725	3.5	\$29,312
5/7/2024	2	19:00	3,162	4	20,464	6.5	10,232	3.2	\$25,579
5/8/2024	2	19:00	3,339	4	23,453	7.0	11,726	3.5	\$29,316
5/9/2024	2	19:00	3,331	4	23,710	7.1	11,855	3.6	\$29,637
5/10/2024	2	19:00	3,389	4	24,443	7.2	12,221	3.6	\$30,554
5/15/2024	2	19:00	3,421	4	25,080	7.3	12,540	3.7	\$31,350
5/16/2024	2	19:00	3,402	4	24,936	7.3	12,468	3.7	\$31,170
5/17/2024	2	19:00	3,405	4	24,530	7.2	12,265	3.6	\$30,662
5/20/2024	2	19:00	3,421	4	24,236	7.1	12,118	3.5	\$30,294
5/21/2024	2	19:00	3,449	4	24,411	7.1	12,205	3.5	\$30,513
5/22/2024	2	19:00	3,307	4	20,144	6.1	10,072	3.0	\$25,180
5/23/2024	2	19:00	3,402	4	23,953	7.0	11,976	3.5	\$29,941
5/24/2024	2	19:00	3,407	4	23,878	7.0	11,939	3.5	\$29,848
5/28/2024	2	19:00	3,500	4	25,380	7.3	12,690	3.6	\$31,725

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EVENT INFORMATION			PARTICIPANTS		EVENT STATISTICS				
DATE	DURATION (HOURS)	START TIME	PARTICIPATING CUSTOMERS	# OF PARTICIPATING AGGREGATORS	TOTAL BATTERY ENERGY DISPATCHED (KWH/EVENT)	AVERAGE ENERGY PER PARTICIPANT (KWH/EVENT)	TOTAL BATTERY POWER DISPATCHED (KW)	AVERAGE POWER PER PARTICIPANT (KW)	TOTAL EVENT COST
5/29/2024	2	19:00	3,647	4	24,843	6.8	12,421	3.4	\$31,053
5/30/2024	2	19:00	3,486	4	24,428	7.0	12,214	3.5	\$30,535
5/31/2024	2	19:00	3,508	4	24,950	7.1	12,475	3.6	\$31,188
6/3/2024	2	19:00	3,426	4	22,728	6.6	11,364	3.3	\$28,410
6/4/2024	2	19:00	3,487	4	23,844	6.8	11,922	3.4	\$29,805
6/5/2024	2	19:00	3,490	4	22,292	6.4	11,146	3.2	\$27,865
6/6/2024	2	19:00	3,470	4	23,483	6.8	11,742	3.4	\$29,354
6/7/2024	2	19:00	3,641	4	23,833	6.5	11,917	3.3	\$29,792
6/10/2024	2	19:00	3,746	4	23,861	6.4	11,931	3.2	\$29,827
6/11/2024	2	19:00	3,970	4	26,886	6.8	13,443	3.4	\$33,607
6/12/2024	2	19:00	3,785	4	23,653	6.2	11,827	3.1	\$29,567
6/13/2024	2	19:00	2,236	3	12,994	5.8	6,497	2.9	\$16,243
6/14/2024	2	19:00	3,657	4	21,587	5.9	10,794	3.0	\$26,984
6/17/2024	2	19:00	3,667	4	20,950	5.7	10,475	2.9	\$26,187
6/18/2024	2	19:00	3,743	4	21,449	5.7	10,725	2.9	\$26,812
6/19/2024	2	19:00	3,685	4	21,073	5.7	10,536	2.9	\$26,341
6/20/2024	2	19:00	3,703	4	21,129	5.7	10,564	2.9	\$26,411
6/21/2024	2	19:00	3,763	4	21,778	5.8	10,889	2.9	\$27,223
6/24/2024	2	19:00	3,904	4	23,376	6.0	11,688	3.0	\$29,220

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EVENT INFORMATION			PARTICIPANTS		EVENT STATISTICS				
DATE	DURATION (HOURS)	START TIME	PARTICIPATING CUSTOMERS	# OF PARTICIPATING AGGREGATORS	TOTAL BATTERY ENERGY DISPATCHED (KWH/EVENT)	AVERAGE ENERGY PER PARTICIPANT (KWH/EVENT)	TOTAL BATTERY POWER DISPATCHED (KW)	AVERAGE POWER PER PARTICIPANT (KW)	TOTAL EVENT COST
6/25/2024	2	19:00	3,979	4	24,067	6.0	12,034	3.0	\$30,084
6/26/2024	2	19:00	3,922	4	23,798	6.1	11,899	3.0	\$29,748
6/27/2024	2	19:00	3,915	4	23,191	5.9	11,596	3.0	\$28,989
6/28/2024	2	19:00	3,910	4	23,192	5.9	11,596	3.0	\$28,990
7/11/2024	2	19:00	3,680	4	22,566	6.1	11,283	3.1	\$28,208
7/18/2024	2	19:00	3,787	4	23,582	6.2	11,791	3.1	\$29,478
7/19/2024	2	19:00	3,602	4	20,301	5.6	10,151	2.8	\$25,376
8/9/2024	2	19:00	4,176	4	25,175	6.0	12,588	3.0	\$31,469
8/16/2024	2	19:00	4,076	4	21,406	5.3	10,703	2.6	\$26,758
8/19/2024	2	19:00	4,222	4	22,584	5.3	11,292	2.7	\$28,230
8/20/2024	4	18:00	4,609	4	26,599	5.8	6,650	1.4	\$33,249
8/21/2024	4	18:00	2,083	3	13,891	6.7	3,473	1.7	\$17,364
8/22/2024	4	18:00	4,622	4	25,218	5.5	6,305	1.4	\$31,523
8/23/2024	4	18:00	4,750	4	24,657	5.2	6,164	1.3	\$30,821
8/26/2024	4	18:00	4,515	4	25,116	5.6	6,279	1.4	\$31,395
8/27/2024	4	18:00	4,570	4	25,827	5.7	6,457	1.4	\$32,284
8/28/2024	4	18:00	4,625	4	26,092	5.6	6,523	1.4	\$32,615
8/29/2024	4	18:00	4,595	4	25,229	5.5	6,307	1.4	\$31,536
9/3/2024	4	18:00	4,827	4	25,565	5.3	6,391	1.3	\$31,956

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EVENT INFORMATION			PARTICIPANTS		EVENT STATISTICS				
DATE	DURATION (HOURS)	START TIME	PARTICIPATING CUSTOMERS	# OF PARTICIPATING AGGREGATORS	TOTAL BATTERY ENERGY DISPATCHED (KWH/EVENT)	AVERAGE ENERGY PER PARTICIPANT (KWH/EVENT)	TOTAL BATTERY POWER DISPATCHED (KW)	AVERAGE POWER PER PARTICIPANT (KW)	TOTAL EVENT COST
9/4/2024	4	18:00	4,751	4	24,947	5.3	6,237	1.3	\$31,184
9/5/2024	4	18:00	2,129	3	13,952	6.6	3,488	1.6	\$17,440
9/6/2024	4	18:00	2,125	3	13,771	6.5	3,443	1.6	\$17,214
9/9/2024	4	18:00	4,648	4	24,994	5.4	6,249	1.3	\$31,243
9/10/2024	4	18:30	4,765	4	25,682	5.4	6,421	1.3	\$32,103
9/11/2024**	2	19:00	4,567	4	22,363	4.9	11,182	2.4	\$27,954
9/17/2024**	3	19:00	4,605	4	26,572	5.8	8,857	1.9	\$33,215
9/23/2024**	4	19:00	4,831	4	28,011	5.8	7,003	1.4	\$35,014
<b>Total</b>									<b>\$2,134,812</b>

\*The event on 11/21/2023 was an onboarding test event for one Aggregator.

\*\*The final three events on 9/11, 9/17, and 9/23 were test events that varied event duration.

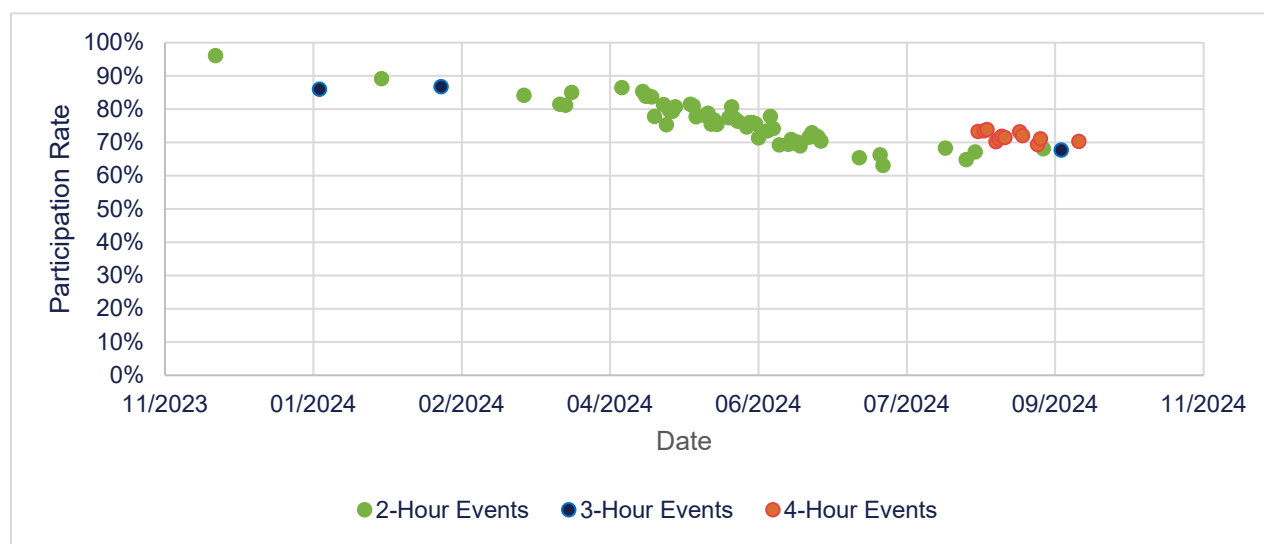
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The average power per participant column in *Table 7: CBES Event-by-Event Summary* shows several trends. First, as stated previously, the average power per participant is lower for longer events and higher for shorter events. Second, the average battery power per participant slightly decreases over time for the series of two-hour events from April 29 to June 28. During this period, there were 42 two-hour events from 7:00 p.m. to 9:00 p.m. AST (19:00 – 21:00), including many events on back-to-back weekdays. Over this series, the average power per participant decreases from 3.9 kW on April 29 to 3.0 kW on June 28. Since participants with zero discharge are removed from the participant count for each event in *Table 7: CBES Event-by-Event Summary*, the decrease is not simply due to participants opting out of events.

There are at least three likely causes for the decrease in average power per participant. First, customers can change their battery reserve level at any time. It is possible that some customers raised their reserve level during the series of events. For example, if a customer changes their battery reserve level from 50% to 80%, then only the remaining 20% of the battery capacity is available for discharge. In the customer research survey, about 28% of respondents indicated they had adjusted their reserve level since joining the program. Secondly, the batteries potentially were unable to recharge fully after the series of back-to-back events. Typically, the batteries should be charged with solar availability the day after an event. However, it is possible that after many consecutive events, the batteries did not have enough time or solar availability to recharge fully. Finally, the Aggregators may have changed their dispatch strategy over the event series to decrease the discharge level. Currently, LUMA has limited visibility into customer-level battery reserve settings, charging profiles, and Aggregator dispatch strategies.

Lastly, *Figure 3: CBES Pilot Participation Rate* displays the participation rate for CBES events through September. The participant rate for each event is calculated as the number of participants who had greater than zero kWh discharge divided by the number of customers enrolled by LUMA. The participation rate steadily declined during May and June, which corresponds with the series of back-to-back events during that period. However, the participation rate has remained relatively stable after June, including during the series of four-hour events called in August. The decline in participation rate in May and June is likely due to customers opting out of events or changing their battery reserve level to 100%.

**Figure 3: CBES Pilot Participation Rate**



\*The figure excludes test events and the events that did not include all participating Aggregators.

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## 9.2 CBES Projected Incentive Budget

*Table 6: CBES Projected Program Enrollment and the \$1.25/kWh Incentive Budget* displays the projected enrollment and cost associated with achieving the 40 MW target from dispatching the program for 2.5 hours with a 73% participation rate. The table also shows the predicted mean kW discharge per participant for one-hour to four-hour events. The mean kW discharge values for two-hour, three-hour, and four-hour events come from *Table 4: Mean Battery Discharge per Participant by Event Duration*. The remaining mean kW values are calculated using a simple linear regression model to predict the discharge values for durations that did not have event data.

The budget calculation in *Table 8: Projected Event Discharge and Yearly Incentive Budget at Scale* uses a mean participation rate (73%) based on the number of approved customers enrolled versus the number of participants in each event, defined as customers with a greater than 0 kWh discharge. The number of event hours assumes that each event duration will have eight different instances, which means the total number of events per year is 56. The total program incentive cost is calculated by adding the predicted cost for each event's duration. The cost for each duration is determined by multiplying the total predicted kWh for each participant by \$1.25.

Under these assumptions, the permanent CBES program will aim to steadily scale participation to **19,500 customers** with a yearly incentive budget of approximately \$6.1 million. LUMA's goal is to reach these targets as soon as possible while minimizing the risk of any potential adverse impacts on system safety and reliability.

**Table 8: Projected Event Discharge and Yearly Incentive Budget at Scale**

EVENT DURATION (HOURS)	MEAN DISCHARGE PER PARTICIPANT (KW)	TOTAL EVENT DISCHARGE (MW/EVENT)	NUMBER OF EVENT HOURS	TOTAL PROGRAM PERFORMANCE INCENTIVES COST
1.0	4.3	61	8	\$605,275
1.5	3.8	54	12	\$806,477
2.0	3.3	47	16	\$939,850
2.5	2.8	40	20	\$1,006,010
3.0	2.4	34	24	\$1,018,095
3.5	1.9	27	28	\$935,048
4.0	1.4	20	32	\$796,839
<b>Total</b>				<b>\$6,107,594</b>