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# Connecticut Energy Storage Solutions – Final Evaluation Report

## Final Evaluation Report of the 2022 – 2024 Program Cycle

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# Executive Summary

This report provides Guidehouse's final evaluation of the Energy Storage Solutions (ESS) program for its first three-year program cycle, which includes program years 2022 through 2024. It includes an update on the ESS program tracking metrics, evaluation metrics, benefit-cost metrics from the program's inception through March 31, 2024, as well as evaluation findings and recommendations for the next program cycle. In addition, this report provides an overview of the findings from Guidehouse's research on barriers to participation in the residential program.

The program tracking metrics show that as of March 31, 2024, 169 projects have been completed (167 residential projects and 2 commercial and industrial [C&I] systems) totaling 1.72 MW of storage capacity. An additional 327 projects have been approved into the program but are not completed (292 residential and 35 C&I), adding an additional 81.88 MW of capacity, for a total of 83.61 MW of approved capacity. Completed projects fall short of the 50 MW capacity goals for both residential and C&I sectors, however, when accounting for approved projects, C&I projects exceed its first program cycle capacity target.

As of March 31, 2024, interval energy data was available for 125 completed residential systems and 1 C&I system that had been verified in Distributed Energy Resource Management System (DERMS). For the analysis period, both summer and winter season average active event participation were 74% and 79%, respectively, for residential systems[1], and 100% active event participation for both summer 2023 and winter 2023-2024 seasons for the single C&I system.

This report includes all active events called during the summer 2022, winter 2022-2023, summer 2023, and winter 2023-2024[2]. The evaluation metrics show that 39 active events occurred during the evaluation period:

- Three events during the summer 2022 season (all in September),
- Three during the winter 2023 season (in February and March),
- Thirty during the summer 2023 season (in July through September, concentrated in July), and
- Three during the winter 2024 season (in January and March).

Active event participation increased steadily as more systems enrolled in the program, and an average of 36 systems responded to active events throughout the evaluation period. Event participation for the summer 2023 season was 71% for participating residential systems per event, and 79% for the winter 2023-2024 season. Average maximum expected power dispatched per event for residential systems was 47% for the summer 2023 season and 41% for the winter 2023-2024 season. This single C&I system, which enrolled late in the summer 2023 season, dispatched only 2% of its expected power. In the winter 2023-2024 season, it dispatched 40% of its maximum expected power.

[1] Event participation is defined as a battery system having an average negative power value for the event period. For this analysis period, Guidehouse has assumed 100% participation except for some technical circumstances (e.g., a system malfunction)

[2] Due to reporting timelines, this report excludes any events called after March 31, 2024.

This report also describes performance for passive dispatch events called during the summer 2023 season[3]. Participation in passive events fluctuated throughout the summer season, ranging from 40% to 95%, with an average event participation of 75%. Average maximum expected power dispatched was higher for passive events than active events at 53% but missed program targets of 80% of maximum available power dispatched. As summer 2023 was the first season for passive dispatch, these findings may not be representative of expected performance in future years.

Table ES-1 shows the count of projects by application status, customer type, and utility, and Table ES-2 shows ESS progress toward the program capacity goals by sector.

[3] Passive event performance for the summer 2023 season only includes residential systems as the C&I system enrolled late in the summer 2023 season.

## Table ES-1. Count of Projects by Project Status, Customer Type, and Utility

| Utility | Customer Type | Project Status as of March 31, 2024 | | | |
|---|---|---|---|---|---|
| | | Submitted[1] | Approved[2] | Complete[3] | Total[4] |
| Eversource | Residential Standard | 13 | 103 | 142 | 258 |
| | Residential Underserved | 0 | 12 | 7 | 19 |
| | Residential Low-income | 2 | 0 | 3 | 5 |
| | *Residential Subtotal* | *15* | *115* | *152* | *282* |
| | Small C&I | 1 | 6 | 1 | 8 |
| | Medium C&I | 0 | 8 | 0 | 8 |
| | Large C&I | 0 | 15 | 1 | 16 |
| | *C&I Subtotal* | 1 | 29 | 2 | 32 |
| | ***Eversource Subtotal*** | ***16*** | ***144*** | ***154*** | ***314*** |
| United Illuminating | Residential Standard | 1 | 13 | 10 | 24 |
| | Residential Underserved | 0 | 164 | 5 | 169 |
| | Residential Low-income | 0 | 0 | 0 | 0 |
| | *Residential Subtotal* | *1* | *177* | *15* | *193* |
| | Small C&I | 0 | 0 | 0 | 0 |
| | Medium C&I | 2 | 2 | 0 | 4 |
| | Large C&I | 0 | 4 | 0 | 4 |
| | *C&I Subtotal* | *2* | *6* | *0* | *8* |
| | ***United Illuminating Subtotal*** | ***3*** | ***183*** | ***15*** | ***201*** |
| **Total Number of Residential Participants** | | **16** | **292** | **167** | **475** |
| **Total Number of C&I Participants** | | **3** | **35** | **2** | **40** |
| **Total Number of Participants** | | **19** | **327** | **169** | **515** |

Note: Within the ESS program, there is a system enrolled at a mixed-use multifamily apartment building, with both residential occupants and commercial space. The project is considered a "hybrid" and classified as both residential and C&I within the program. The hybrid housing project is made up of 161 residential underserved participants and one large C&I participant benefitting from a single energy storage system. In order to accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I). More detail on the hybrid housing project can be found in Section 3.1.5.
Note: Application review process may include back and forth communications with project developers to ensure their applications are complete and error-free, which may impact project approval timelines. Also, depending on the estimated upfront incentive amounts, C&I projects may need to be approved by the Green Bank Board of Directors, and this is subject to pre-established board meeting schedules.
1. "Submitted" projects have documentation turned in to the Green Bank but have yet to be approved.
2. "Approved" projects have been reviewed by the Green Bank, and documentation has either been confirmed or in some cases is being inspected.
3. "Completed" projects are approved, installed, and energized, and are either being verified or already verified within DERMS.
4. Totals given are the sum of submitted, approved, or complete projects, and do not include any cancelled projects.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

## Table ES-2. Total Power Capacity (MW) by Project Status

| Utility | Customer Type | Project Status as of March 31, 2024 | | | |
|---|---|---|---|---|---|
| | | Submitted[1] | Approved[2] | Complete[3] | Total[4] |
| Eversource | Residential Standard | 0.15 | 0.98 | 1.17 | 2.30 |
| | Residential Underserved | 0.00 | 0.11 | 0.06 | 0.17 |
| | Residential Low-income | 7.68 | 0.00 | 0.03 | 0.03 |
| | *Residential Subtotal* | *0.16* | *1.09* | *1.26* | *2.50* |
| | Small C&I | 0.00 | 3.96 | 0.13 | 4.59 |
| | Medium C&I | 0.00 | 11.32 | 0.00 | 11.32 |
| | Large C&I | 0.00 | 53.88 | 0.25 | 54.13 |
| | *C&I Subtotal* | *0.50* | *69.16* | *0.38* | *70.03* |
| | ***Eversource Subtotal*** | ***0.66*** | ***70.25*** | ***1.63*** | ***72.53*** |
| United Illuminating | Residential Standard | 0.00 | 0.10 | 0.06 | 0.16 |
| | Residential Underserved | 0.00 | 0.92 | 0.03 | 0.95 |
| | Residential Low-income | 0.00 | 0.00 | 0.00 | 0.00 |
| | *Residential Subtotal* | *0.00* | *1.02* | *0.09* | *1.11* |
| | Small C&I | 0.00 | 0.00 | 0.00 | 0.00 |
| | Medium C&I | 0.63 | 6.17 | 0.00 | 6.79 |
| | Large C&I | 0.00 | 4.45 | 0.00 | 4.45 |
| | *C&I Subtotal* | *0.63* | *10.62* | *0.00* | *11.24* |
| | ***United Illuminating Subtotal*** | ***0.63*** | ***11.63*** | ***0.09*** | ***12.35*** |
| **Total Power Capacity: Residential (MW)** | | **0.16** | **2.11** | **1.35** | **3.61** |
| **Total Power Capacity: C&I (MW)** | | **1.13** | **79.77** | **0.38** | **81.27** |
| **Total Power Capacity (MW)** | | **1.28** | **81.88** | **1.72** | **84.89** |

Note: Within the ESS program, there is a system enrolled at a mixed-use multifamily apartment building, with both residential occupants and commercial space. The project is considered a "hybrid" and classified as both residential and C&I within the program. The hybrid housing project is made up of 161 residential underserved participants and one large C&I participant benefitting from a single energy storage system. In order to accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I). Capacity for the hybrid housing project has been fractionalized with 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant. More detail on the hybrid housing project can be found in Section 3.1.5.

1. "Submitted" projects have documentation turned in to the Green Bank but have yet to be approved.
2. "Approved" projects have been reviewed by the Green Bank, and documentation has either been confirmed or is being inspected.
3. "Completed" projects are approved, installed, and energized, and are either being verified or already verified within DERMS.
4. Totals given are the sum of submitted, approved, or complete projects, and do not include any cancelled projects.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table ES-3 displays the total power capacity in MW of submitted, approved, and complete projects as of March 31, 2024. Additionally, a total is provided, summing across these three stages. Only the energy capacity of complete projects was used (i.e., 1.3 MW of Residential capacity and 0.4 MW C&I capacity) in calculating the percentage of complete capacity relative to goal as of March 31, 2024. Although the capacity of approved projects for C&I is 80 MW, exceeding the 2024 C&I program goals, these projects were not completed within the 2022-2024 cycle.

**Table ES-3. Progress Made Toward Program Capacity Goals**

| Customer Type | Project Submitted (MW) | Project Approved (MW) | Project Complete (MW) | Total (MW) | Program Goals (2022-2024) (MW) | Percentage of Complete Capacity Relative to Goal as of March 31, 2024[1] |
|---|---|---|---|---|---|---|
| **Residential** | 0.2 | 2.1 | 1.3 | 3.6 | 50.0 | 2.7% |
| **C&I** | 1.1 | 79.8 | 0.4 | 81.3 | 50.0 | 0.8% |

Note: Within the ESS program, there is a system enrolled at a mixed-use multifamily apartment building, with both residential occupants and commercial space. The project is considered a "hybrid" and classified as both residential and C&I within the program. The hybrid housing project is made up of 161 residential underserved participants and one large C&I participant benefitting from a single energy storage system. In order to accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I). Capacity for the hybrid housing project has been fractionalized with 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant. As of March 31, 2024, the hybrid housing project is "Approved" but not yet "Complete." More detail on the hybrid housing project can be found in Section 3.1.5

1. In aggregate, the cumulative capacity of submitted, approved, and complete projects accounts for 7.2% and 162.5% of program goals for Residential and C&I capacity respectively.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

# 1. Introduction

## 1.1 Program Background and Objectives

In 2021, Public Act 21-53 established statewide energy storage goals of 1,000 MW by 2030, with interim goals of 300 MW by 2024 and 650 MW by 2027. In Docket No. 17-12-03RE03, based on stakeholder feedback, the Public Utility Regulatory Authority (PURA) established the statewide ESS with a 2030 goal of 580 MW of behind the meter storage capacity and an interim goal of 100 MW by 2024 to be divided evenly between residential and C&I sectors.

The goals of the program, as stated in Docket No. 17-12-03RE03, are to:

- Produce positive net benefits to all ratepayers,
- Provide electrical grid benefits including resilience, peak shaving and ancillary services,
- Foster the sustained, orderly development of a state-based electric energy storage industry,
- Provide resilience benefits to customers in environmental justice communities or experiencing economic hardships,
- Reduce barriers to entry for storage deployment in Connecticut,
- Maximize the long-term environmental benefits with respect to emissions reductions, and
- Maximize benefits to ratepayers derived from the wholesale capacity market.

The program is collectively implemented by the Connecticut Green Bank (Green Bank) and the state's electric distribution companies (EDCs), Eversource Energy (Eversource) and United Illuminating (UI) (collectively, the Program Administrators) and provides upfront and performance-based incentives for residential and C&I storage systems for customers in Connecticut.

The upfront incentive is administered by the Connecticut Green Bank and is structured as a declining block incentive, which may be adjusted at the beginning of each three-year program cycle through 2030.[4] [5] The upfront incentive is passed onto the customer as a reduction in total system cost. Within the residential incentive block, residential low-income customers[6], which includes multifamily affordable housing, and customers in underserved communities[7] are eligible for higher upfront incentives for systems.

To qualify for this incentive, participants must enroll in the passive dispatch program, which requires energy storage systems to provide dispatch during non-holiday weekdays, between the hours of 3 p.m. and 8 p.m. during the summer months of June, July, and August.

[4] Public Utilities Regulatory Authority Final Decision under Docket 17-12-03RE03, July 28, 2021, available at: https://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/6991ef77ba07bae185258752007994f7?OpenDocument

[5] Incentives were adjusted prior to the end of the first three-year phase in the Year 3 Final Decision in Docket No. 23-08-05

[6] Defined as those with income below 60% of State Median Income (SMI).

[7] Defined as communities in distressed municipalities, as defined by CT Department of Economic Community Development (DECD), and multifamily affordable housing.

The performance-based incentive is based on the average kW dispatched during active events, which provides a rate of $200 per kW during the summer season[8] and $25 per kW during the winter season[9] for the first 5 years of a customer's participation in the program, and $115 per kW during the summer season and $15 per kW during the winter season, from years 6-10 of their participation in the program. Participants receive the performance incentive payments after each performance incentive season, based on the battery system's average power contribution to the grid during active dispatches. Eversource and UI administer the performance-based incentives.

For applications submitted prior to 2023, customers on the grid edge[10], critical facilities[11], C&I customers replacing existing fossil fuel generators, and small businesses were eligible to retain and monetize their capacity rights as an additional effective incentive. However, in the Final Decision under Docket No. 22-08-05, PURA authorized the program to prohibit projects that were submitted prior to January 1, 2023 from participating in the forward capacity market (FCM) .[12] In exchange, effective January 1, 2023, PURA authorized a new 50% upfront incentive adder for residential projects and a 25% upfront incentive adder for C&I projects for eligible customers located on the grid edge, eligible critical facilities, eligible small businesses, and eligible customers replacing a fossil fuel generator.[13]

In the Final Decision under Docket No. 23-08-05, PURA increased the Tranche 1 residential upfront incentive levels for all customer types to address low residential participation in the program. The Decision raised upfront incentives for residential standard incentive by 1.25 times and by 1.5 times for underserved and low-income customers. PURA also authorized an increase in the upfront incentive level cap for residential projects from $7,500 to $16,000. All changes were effective immediately as of the date of the Final Decision of November 29, 2023. PURA chose not to raise commercial incentives at the time of the Final Decision.

## 1.2 Program Metrics Overview

The Program Administrators submitted program metrics to PURA for approval in December 2021,[14] including program tracking metrics, evaluation metrics, and benefit-cost analysis (BCA). Guidehouse will report progress on the program metrics as part of annual and program cycle reporting.

[8] Defined as June-September during the hours of 12 pm to 9 pm.

[9] Defined as November-March during the hours of 12 pm to 9 pm.

[10] Defined as (1) the top ten percentage of circuits with the highest number of outages per customer during major storms since July 1, 2012, and (2) the top ten percentage of circuits with the longest outages due to major storms since July 1, 2012.

[11] Defined according to Conn. Gen. Stat. § 16-243y(a)(2), as well as known facilities that were designated essential by the DECD pursuant to Governor Lamont's Executive Order 7H.

[12] Public Utilities Regulatory Commission Final decision under Docket No. 22-08-05, December 21, 2022, available at: https://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/5494c093c39b7f308525891f00571bba?OpenDocument

[13] Public Utilities Regulatory Commission Final decision under Docket No. 22-08-05, December 21, 2022, available at: https://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/5494c093c39b7f308525891f00571bba?OpenDocument

[14] Evaluation Metrics, Methodology, and Data Requirements for Energy Storage Solutions. December 15, 2021, available at: http://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/f0dcf43648974eb8852587ac00776b07/$FILE/21-08-05%20Attachment%201%20-%20ESS%20Evaluation%20Metrics_20211215.pptx

Table 1-1 describes the program tracking metrics, Table 1-2 provides the evaluation metrics, and Table 1-3 provides the BCA metrics.[15] The program tracking metrics that Guidehouse used for this program cycle evaluation are presented in Section 3, evaluation metrics are presented in Section 4, and BCA metrics are presented in Section 5. Table A-1 provides the original data fields from the Green Bank that Guidehouse used to compile and segment the data tables.

**Table 1-1. ESS Program Metrics**

| Program Tracking Metric | Original Metric Name December 2021 PURA Submission, or New | Description | Table # |
|---|---|---|---|
| ESS Participants | Number of Program Participants | Total number of energy storage system participants, and percentage of the total, segmented by utility and customer type. | Table 3-2 |
| Share of Low-Income & Underserved Residential Participants | Incentive Adder Receipt | Percentage of customers receiving either underserved or low-income incentive adders, both by number of participants and nameplate capacity. Customers are considered underserved if located in a municipality listed on the Connecticut Department of Community Development as distressed. Customers are considered low-income if they are at or below 60% of the State Median Income. | Table 3-3 |
| Indication of Participation in the ISO-NE FCM for C&I Participants | FCM Participation | Percentage of customers participating in FCM, both by number of participants and nameplate capacity. Results are segmented by Not Qualified, Qualifies for FCM but not bidding, and Qualified for FCM and bidding. | Table 3-4 |
| Project Approval Rates | Program Approval Rates | Percentage of unique applications that apply for the program that are advanced through Approved enrollment status, still in Submitted status, or have been cancelled, all divided by total unique applicants. | Table 3-5 |
| Average Days to Approve Project Application | Average Time to Approval | Average difference in days from Application Date to Approval Date by application. | Table 3-6 |
| Share of Energy Storage Paired with PV | *Added since 2021 submission* | Count and percentage of participants, systems, and kWh paired with PV segmented by utility and customer type. | Table 3-7 |
| Total Allocated Power / Energy Capacity by Project Status (by kW and kWh) | Installed Capacity (number of units, kW and kWh) | Total nameplate storage system capacity (kW) and rated energy (kWh), based on manufacturer specifications, segmented by utility, customer type, and application status. | Table 3-8<br>Table 3-9 |
| Average Project Size | Average System Size | Average electric storage system nameplate capacity (kW) and rated energy (kWh) per participant. | Table 3-10 |

[15] In April 2022, CT DEEP published Updates to Connecticut Conservation and Load Management Cost Effectiveness Testing which introduces the Connecticut Efficiency Test (CTET) as a screening tool that aligns with state policy priorities. In response, Guidehouse added the CTET as a benefit-cost metric for 2023.

| Program Tracking Metric | Original Metric Name December 2021 PURA Submission, or New | Description | Table # |
|---|---|---|---|
| Number of Systems and Batteries by Storage Type | Number of Systems per Storage Type | Number of storage systems by unique model (manufacturer + model). Note that that one customer may have multiple storage systems, and each of these systems will be counted individually. | Table 3-11 |
| Number of Approved or Completed Application by Contractor | *Added since 2021 submission* | Count of applications either approved or completed, segments by residential or C&I, and contractor. | Table 3-12 |
| Program Administrative Costs ($) | Program Administrative Costs ($) | Costs incurred by the Program Administrators to manage the program. Includes cost for both EDCs and the Green Bank. Segmented by program administrator, and additionally sub-segmented into IT, marketing, personnel, and EM&V | Table 3-13 |
| Total Upfront Incentive Encumbered ($) | Incentives Encumbered and/or Disbursed | Total upfront incentives to all program participants. | Table 3-14 |
| Average Total Project Incentive ($/participant) | Average Project Incentive | Average of upfront and performance-based incentives per program participant. | Table 3-15 |
| Average Project Cost ($/participant) | Average Installed System Cost | Total storage system installed costs ($) divided by total participants. For customers with PV-paired systems, costs will be reported for whole system cost as provided data allows. | Table 3-16 |
| Total System Costs by System Size ($/kWh and $/kW) | Installed Storage System Cost per System Size | Total storage system installed costs ($) divided by total nameplate system capacity (kW) and by total system rated energy (kWh), separately. For customers with newly-installed PV-paired systems, costs will be reported for whole system cost as provided data allows. | Table 3-18 |
| Battery Costs by System Size ($/kWh, $/kW) | *Added since 2021 submission* | Battery and storage installed costs ($) divided by total nameplate system capacity (kW) and total system rated energy (kWh), separately. | Table 3-19 |

*Source: Guidehouse summary of Energy Storage Systems Evaluation Metrics Submitted to PURA on December 15, 2021*

**Table 1-2. Evaluation Metrics**

| Evaluation Metrics | Original Metric Name December 2021 PURA Submission, or New | Description | Units |
|---|---|---|---|
| Average Power per Event | Average Power per Event | Average storage system power output for each dispatch event, both per participant and in aggregate | kW/participant<br>MW/program |
| Active Event Participation | Active Event Participation | Number of participants in each active event divided by the participants in Active or Active+Passive programs at the time of the event, as a percentage, averaged over the course of a season (weighted by number of participants at the time of the event) | % |
| Battery Energy Availability | Battery Energy Availability | Average available storage system energy during the first telemetry interval of active events or backup power events, as weighted average % state of charge, per participant, and in aggregate | %<br>kWh/participant<br>MWh/event |
| Seasonal Average Power | Seasonal Average Power | Average storage system power output for all dispatch events over all event hours over the course of a season, both per participant and in aggregate | kW/participant<br>MW/event |
| Coincident Peak Power per Event | Peak Power per Event | Average storage system power output during the peak hour(s) identified by ISO-NE,[1] both per participant and in aggregate | kW/participant<br>MW/program |
| Coincident Peak Seasonal Average Power | Peak Seasonal Average Power | Average storage system power output during the on peak demand resource hours identified by ISO-NE,[2] both per participant and in aggregate | kW/participant<br>MW/program |
| Peak Targeting Percentages | Peak Targeting | Percentage of active events that are aligned with the ISO-NE daily peak, the seasonal peak, and the annual peak. Note that Eversource and UI may call events at different times, so this metric is EDC-specific | % |
| Battery Availability (Uptime) | Battery Availability (Uptime) | Percentage of telemetry intervals where storage systems are available based on status during the first interval of dispatch events or backup power events | % |
| Solar Energy Used | Solar Energy Used | Sum of solar energy produced during times when storage systems are charging, in aggregate, divided by total solar output | % |
| Estimated Bill Savings | Estimated Bill Savings | Product of Impact Load shape and average energy rates by hour | $<br>$/participant |
| Avoided Emissions ($CO_2$, NOx, SOx) | Avoided Emissions ($CO_2$, NOx, SOx) | Total net emissions reduction of $CO_2$, NOx, and SOx based on the EPA AVERT model[3] and AESC 2021[4] marginal emissions | Tons $CO_2$<br>Tons NOx<br>Tons SOx |
| Instances Battery Provided Backup Power | Instances Battery Provided Backup Power | Count of outage events when the storage remained operating | # |
| Energy Discharged during Outage | Energy Discharged during Outage | Sum of each participant's difference of storage system energy at the start and end of backup power events | kWh/outage |

1. As identified at: https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/ann-sys-peak-day-hr-load
2. As identified at: https://www.iso-ne.com/markets-operations/markets/demand-resources/about
3. EPA's Avoided Emissions and Generation Tool (AVERT), available at: https://www.epa.gov/avert
4. Avoided Energy Supply Costs in New England 2021, published May 2021, available at: https://www.synapse-energy.com/project/aesc-2021-materials

*Source: Guidehouse summary of Energy Storage Systems Evaluation Metrics Submitted to PURA on December 15, 2021*

**Table 1-3: BCA Metrics**

| Benefit-Cost Analysis Metrics[1] | Benefits | Costs |
|---|---|---|
| Ratepayer Impact Measure (RIM) Test | Utility System Impacts[2] | Participant Bill Savings<br>Program Incentives<br>Program Administration |
| Participant Cost Test (PCT) | Non-Energy Impacts[3]<br>Avoided Backup Generator<br>Participant Bill Savings<br>Program Incentives | Incremental DER Costs |
| Program Administrator Cost Test (PACT) | Utility System Impacts[2] | Program Incentives<br>Program Administration |
| Societal Cost Test (SCT) | Utility System Impacts[2]<br>Societal Impacts[4]<br>Non-Energy Impacts[3] | Program Administration<br>Incremental DER Costs |
| Total Resource Cost (TRC) Test | Utility System Impacts[2] | Program Administration<br>Incremental DER Costs |
| Connecticut Efficiency Test (CTET)[5] | Utility System Impacts[2]<br>Societal Impacts (Non-Embedded Emissions Only)<br>Non-Energy Impacts (Reduced Arrearages Only) | Program Incentives<br>Program Administration |

1. Ratios and associated benefits and costs, for total program and by customer class (Residential, C&I)
2. Includes: Avoided Energy; Avoided Generation, Transmission, and Distribution Capacity; Reliability; DRIPE Energy and DRIPE Capacity; Cross-DRIPE; Market Revenue; Avoided Ancillary Services
3. Impacts applied to participant and/or society as appropriate
4. Includes: Non-Embedded Emissions; Job Creation
5. Guidehouse added the CTET in this report. In April 2022, CT DEEP published Updates to Connecticut Conservation and Load Management Cost-Effectiveness Testing which introduces the CTET as a screening tool that aligns with state policy priorities. This metric was not included in the metrics submitted to PURA in December 2021. The CTET is equivalent to the PACT with non-embedded emissions and reduced arrearages added as benefits.

*Source: Guidehouse summary of Energy Storage Systems Evaluation Metrics Submitted to PURA on December 15, 2021, and the new CTET metric*

## 1.3 Final Report Requirements and Objectives

In accordance with Docket 17-12-03RE03, the goal of this report is to summarize the results of the first three-year cycle of the ESS program, including updates on program tracking metrics, evaluation metrics, and the BCA. This report will also provide information on research conducted regarding barriers to participation in the residential program. Using insights from the program metrics and the research findings, the final section will provide key findings of this first program cycle and program recommendations for the next three-year cycle.

# 2. Data Sources and Data Review

This section describes the data sources used for this evaluation and the steps taken to prepare the data for analysis. The data sources used include: program tracking data, event data, outage data, and program cost data from the PAs, and interval energy data from the DERMs provider. All data, unless otherwise noted, is through March 31, 2024.

## 2.1 Data from Program Administrators

- **Program Tracking Data**: Encompasses project identification, customer characteristics, system characteristics, system cost details, and updates. Provided by Connecticut Green Bank. Further detail can be found in Table A-2.

- **Event Data**: Information on all active events such as date, start time, stop time, and OEMs called, that Eversource and UI called throughout the event season.

- **Outage Data**: One row for each instance of a participant enrolled in the program being affected by an outage. The data fields included the geographic zone of the outage[16], the outage ID, the duration of the outage, and the start and end time.

- **Program Cost Data**: Included "actual" non-incentive program costs identified as of Q1 2024, as well as projected non-incentive program costs associated with ESS, aligned with previous filings with PURA. Provided by each PA.

## 2.2 Data from OEMs

- **Interval Energy Data**: One row per time, date, and unique device ID indicating cumulative energy (dis)charging, average power (dis)charging, and the stored energy both in kWh and as a percentage of total for the battery storage system and cumulative energy (dis)charging, average power (dis)charging, and the stored energy both in kWh and as a percentage of total for the site.

## 2.3 Data Review

Guidehouse addressed several discrepancies in the data to prepare it for analysis including: correcting OEM- specific variations in time zone, removing rows with exact duplicate readings correcting OEM – specific variations in sign conventions for battery power, aggregating rows with sub-15 minute interval energy readings, removing rows that do not align with enrollment data, removing rows outside of the enrollment range, either before the accepted date or after the unenrolled date, removing conflicting energy interval data observations for the same period, removing outliers (i.e. , rows with a reading greater than 105% of nameplate capacity).

In total, completion of the QC steps outlined above reduced the raw data set by 36% through converting data from 5-minute to 15-minute intervals, 20% through removing exact duplicates, 15% through removing data outside of the device's enrollment period, 5% through removing values with differing readings, and >1% through removing dispatch outliers. Utilizing a mapping file provided by the DERMs provider to bridge different identification conventions across the energy interval data and program tracking data, Guidehouse was able to pair all cleaned energy interval data with its relevant program tracking data by battery UUID apart from a single

[16] Geographic information includes the state, region (e.g., eastern/western), area work center, and town.

Generac device present in the program tracking data[17]. This system was excluded from the program evaluation metrics[18].

## 2.4 Findings and Recommendations

This section presents key findings and recommendations based on Guidehouse's review of the program tracking data, interval energy data, event data, and program cost data.

**Table 2-1. Data Availability and QA/QC Findings and Recommendations**

| Finding | Recommendation |
|---|---|
| Residential interval energy data was provided in the same format for both the year two and current evaluation period. This consistency allowed for swifter data cleaning of interval energy as issues in the current evaluation period were already known and resolved in the year two evaluation (e.g., specific battery partners with different time zones were known to have this issue).<br>Conversely, Guidehouse did not receive C&I energy interval data until the Summer 2023 season, at which point, QA/QC was more time-intensive due to the differences in data availability between the residential and C&I DERMS. | Guidehouse recommends the Green Bank share findings of the program tracking data review with the C&I DERMS provider, as was done previously for the residential DERMS provider, to a facilitate a more consistent data deliverable between both DERMS providers (i.e., a data deliverable with fields aligned with the needs of the evaluation and across residential and C&I sectors). |
| Guidehouse found that program tracking data was mostly complete and accurate, with some discrepancy due to third-party data entry error. These discrepancies were limited almost entirely to the model number and record type fields. | Guidehouse recommends continued efforts from the Green Bank in maintaining program tracking data quality, and continued reminders to third parties on data entry best practices. |
| As the program continues to grow and more battery partners are added, data QA/QC has increased in its complexity as different partners may have different conventions. | Guidehouse recommends that the Program Administrators consider a more frequent data transfer schedule, which would allow for early QA/QC to potentially identify any issues before an entire season has passed. |
| During the summer 2023 and winter 2023-2024 data request processes, oftentimes there was uncertainty regarding who was responsible for providing different data sources to Guidehouse for evaluation. Considerable time was spent reconciling data from different sources and ensuring all systems were present across different data sets, sometimes unsuccessfully. For example, the single Generac system was included in the program tracking data but not in energy interval data, which precluded its inclusion in the program evaluation metrics analysis. | Guidehouse recommends in the next three-year cycle that the DERMS provider, Program Administrators, and the evaluator discuss roles and responsibilities to ensure an efficient and quick data request process. Additionally, all parties should consider centralizing data transfer as much as possible, with as much data coming from one source as is feasible to minimize the need for mapping files which maximizes the amount of data included in the analysis. |

*Source: Guidehouse analysis*

[17] Although some UUIDs appearing in the program tracking data did not appear in the telemetry data, conditions such as unenrollment or late enrollment in the winter 2023-2024 season explained the discrepancy between these two data sources.

[18] This Generac system was included in program evaluation metrics presented in Section 3 of this report but was excluded from the program evaluation metrics (Section 4) and the lack of performance data does not affect any of those metrics (i.e. – if a value of 0 had been included for those metrics for this system, performance metrics would have decreased).

# 3. Program Tracking Metrics

This section describes the program tracking metrics that Guidehouse reviewed for this annual evaluation, beginning with a description of the project status categories and residential income categories. The section then presents the program tracking metrics to date and concludes with findings and recommendations.

## 3.1 Program Tracking Data Categories

This section defines select program tracking data categories, including project application stages and units, residential income categories, C&I categories, and the hybrid project.

### 3.1.1 Project Stage Categories

The program tracking data contains a "Stage" field that indicates the application and project completion stage for each project. The relevant stages for tracking project status are listed below.

**Table 3-1. Project Stage Categories**

| Project Stage | Definition |
|---|---|
| **Application Submitted** | Project has submitted all required documentation but is not yet approved. |
| **Under BOD Review** | The C&I project's estimated upfront incentive is above $500,000 and requires Green Bank's Board approval.[19] |
| **Approved** | Project has been reviewed by the Green Bank and all project information and documentation is correct or has been sent back for additional information/edits. |
| **Completed** | Project has been approved, installed, energized, and has either been verified in the DERMS platform, or is in the process of doing so. |
| **Cancelled** | Project has been cancelled and removed from the submitted, approved, or completed stage, by the contractor and/or Green Bank. |

*Source: Connecticut Green Bank.*

### 3.1.2 Project Unit Definitions

The program tracking metrics are provided across several nuanced units to best reflect the data being presented. These units are defined as:

- **Application:** Defined as a single project application in the program for an upfront incentive in return for the installation and participation of a "System."

[19] Guidehouse has included "Under BOD Review" under "Application Submitted" for the purposes of the program tracking metrics.

- **System:** Defined as a collection of energy storage devices and other necessary balance of plant (e.g., inverter) at a single installation location. Note that a "Project" includes a single "System", but may contain multiple "Battery Units", in addition to other balance of plant.
- **Battery Unit:** Defined as a single energy storage device, as manufactured and sold to customers. Note that a "System" may contain multiple "Battery Units," in addition to other balance of plant.
- **Participant**: Defined as a single customer that either applied to the program or is part of a hybrid application, as described in Section 3.1.5.

### 3.1.3 Residential Categories

PURA categorizes residential customers in three groups: standard, underserved communities, and low-income (which includes multifamily affordable housing). Underserved customers include those living in environmental justice communities (as defined in Conn. Gen. Stat. § 22a-20a) distressed municipalities, as defined by Conn. Gen. Stat. § 32-9p, public housing authorities, and multifamily affordable housing as contemplated by Conn. Gen. Stat. § 16-244z. Customers fall into the low-income category if their annual income is below 60% of the State Median Income.

The low-income and underserved categories are not mutually exclusive, a household can be both low-income and located in an underserved community. The incentive adder for low-income households is higher than it is for underserved households, so if a household is classified as both, it will receive the higher low-income incentive.

PURA, in its Final Decision in Docket 17-12-03RE03, directed the Program Administrators to aim to deploy 40% of residential storage installations in underserved communities and low-income households.

### 3.1.4 C&I Categories

C&I participants qualify for different incentive tiers based on their annual peak demand, according to the categories below:

- **Small C&I**: Defined as customers with annual peak demand less than 200 kW
- **Medium C&I**: Defined as customers with annual peak demand between 200 and 500 kW
- **Large C&I:** Defined as customers with annual peak demand greater than 500 kW

### 3.1.5 Hybrid Project

Within this report, there is a unique project that serves a building that, in part, includes multifamily affordable housing. This project is classified as a hybrid project that includes both residential and C&I participants. Specifically, this hybrid project is classified as 1 large C&I project, serving 1 large C&I participant, in addition to 161 underserved residential participants.

The Green Bank determined that 47% of the system will be considered as underserved residential and 53% as large C&I based on the proportion of site demand which will serve residential (e.g., apartments) and commercial (e.g., community rooms and the charter school)

purposes. In Section 3.2 Guidehouse uses the same 47% and 53% split in determining the energy storage capacity and costs to be allocated to residential and C&I categories. The relative share of upfront incentives for residential and C&I components, 75% and 25%, respectively, was calculated by applying the residential underserved and large C&I upfront incentive formulas to the 47% and 53% split of capacity, respectively. For all metrics, including where the entirety of the project may be consolidated under either of the two categories, a description of its handling is noted beneath the table.

While this hybrid project is the only of its kind thus far, multifamily affordable housing is an additional avenue through which low-income participation and capacity targets can be reached due to the larger scale of these systems and centralized incentive structure. Because the upfront incentive is paid to the multifamily property owner rather than the individual resident, residents can access the advantages of the battery backup, such as resilience, without paying the upfront cost that is an often-cited barrier to enrollment, especially for low-income and underserved participants.

## 3.2 Program Tracking Metrics

This section summarizes the final ESS program tracking metrics for the 2022-2024 program cycle using data available through March 31, 2024.

Table 3-2 displays the number of ESS participants, and percentage of the total, segmented by utility and customer type. The majority of participants are residential and in either the approved or complete stage. The majority of C&I participants are in the approved stage.

**Table 3-2. ESS Participants (Number and Percentage of Total)**

| Utility | Customer Type | Project Status as of March 31, 2024 | | | |
|---|---|---|---|---|---|
| | | Submitted (Participants) | Approved (Participants) | Complete (Participants) | Total (Participants) |
| Eversource | Residential Standard | 13 (2.5%) | 103 (20%) | 142 (28%) | 258 (50%) |
| | Residential Underserved | 0 (0%) | 12 (2.3%) | 7 (1.4%) | 19 (3.7%) |
| | Residential Low-income | 2 (0.4%) | 0 (0%) | 3 (0.6%) | 5 (1%) |
| | *Residential Subtotal* | *15 (2.9%)* | *115 (22%)* | *152 (30%)* | *282 (55%)* |
| | Small C&I | 1 (0.2%) | 6 (1.2%) | 1 (0.2%) | 8 (1.6%) |
| | Medium C&I | 0 (0%) | 8 (1.6%) | 0 (0%) | 8 (1.6%) |
| | Large C&I | 0 (0%) | 15 (2.9%) | 1 (0.2%) | 16 (3.1%) |
| | *C&I Subtotal* | *1 (0.2%)* | *29 (5.6%)* | *2 (0.4%)* | *32 (6.2%)* |
| | ***Eversource Subtotal*** | ***16 (3.1%)*** | ***144 (28%)*** | ***154 (30%)*** | ***314 (61%)*** |
| UI | Residential Standard | 1 (0.2%) | 13 (2.5%) | 10 (1.9%) | 24 (4.7%) |
| | Residential Underserved | 0 (0%) | 164 (32%) | 5 (1%) | 169 (33%) |
| | Residential Low-income | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| | *Residential Subtotal* | *1 (0.2%)* | *177 (34%)* | *15 (2.9%)* | *193 (37%)* |
| | Small C&I | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| | Medium C&I | 2 (0.4%) | 2 (0.4%) | 0 (0%) | 4 (0.8%) |
| | Large C&I | 0 (0%) | 4 (0.8%) | 0 (0%) | 4 (0.8%) |
| | *C&I Subtotal* | *2 (0.4%)* | *6 (1.2%)* | *0 (0%)* | *8 (1.6%)* |
| | ***UI Subtotal*** | ***3 (0.6%)*** | ***183 (36%)*** | ***15 (2.9%)*** | ***201 (39%)*** |
| **Total Number of Residential Participants** | | **16 (3.1%)** | **292 (57%)** | **167 (32%)** | **475 (92%)** |
| **Total Number of C&I Participants** | | **3 (0.6%)** | **35 (6.8%)** | **2 (0.4%)** | **40 (7.8%)** |
| **Total Number of Participants** | | **19 (3.7%)** | **327 (63%)** | **169 (33%)** | **515 (100%)** |

Note: All percentages above are given as a percentage of the total sum of submitted, approved, and completed projects.
Note: The hybrid housing project is made up of 161 residential underserved participants and one large C&I participant benefitting from a single energy storage system. In order to accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I).
Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024 in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-3 displays the percentage of residential participants receiving upfront incentives by expected installed capacity and by number of participants. This table is intended to show the program's progress toward the goal defined in the Final Decision of Docket 17-12-03RE03 that 40% of residential participants be classified as low-income or underserved customers. Table 3-3

shows that the program is currently below target with 32% falling into either the underserved or low-income residential categories.

Within the 40% targets for low-income or underserved customers, goals were set for 30% being underserved and 10% being low-income. Within these targets, the program is achieving its underserved target but below target for its share of low-income installed capacity.

**Table 3-3. Share of Low-Income & Underserved Residential Participants**

| Upfront Incentive Received | Percentage by Expected Installed Capacity (MW) | Percentage by Number of Participants |
|---|---|---|
| **Standard** | 68% | 59% |
| **Underserved** | 31% | 40% |
| **Low-income** | 1.0% | 1.1% |
| *Underserved or Low-Income* | 32% | 41% |

Note: Table includes approved and completed residential systems.
Note: Table values may not sum to 100% due to rounding.
Note: The hybrid housing project is made up of 161 residential underserved participants and one large C&I participant benefitting from a single energy storage system. In order to accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I). Capacity for the hybrid housing project has been fractionalized with 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant.
Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024 in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-4 displays the percentage of participants and installed capacity by plans for participation in the ISO-NE forward capacity market (FCM) for C&I systems. C&I customers who qualify and are expected to bid make up the majority of installed capacity (48%), with the smallest share of capacity being systems that are not qualified (16%).

**Table 3-4. Indication of Participation in the ISO-NE FCM for C&I Participants**

| Participation Status | Percentage of Participants (%) | Percentage of Expected Installed Capacity (% of MW) |
|---|---|---|
| **Qualified & Expected to Bid** | 35% | 48% |
| **Qualified & Not Bidding** | 45% | 36% |
| **Not Qualified**[1] | 20% | 16% |

1. Participants & Capacity listed as “Not Qualified” could be either those systems that did not meet the criteria for eligibility to retain capacity rights if enrolled prior to 2023 or those systems that enrolled in 2023 or later. The analysis considers all projects in the approved, completed, or cancelled stages that are not qualified.
Note: The hybrid housing project is made up of 161 residential underserved participants and 1 large C&I participant benefitting from a single energy storage system. In order to accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I). Capacity for the hybrid housing project has been fractionalized with 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant. The hybrid housing project was submitted in 2023 and is therefore not qualified to bid into the FCM.
Note: Table values may not sum to 100% due to rounding.
Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-5 displays the percentage of applications that have successfully moved through the pipeline to the approval phase. The smallest share of application statuses is in the submitted stage (4%), with 71% of applications either approved or complete. 25% of applications have been cancelled and removed from the program, for reasons such as having applied with an ineligible energy storage model and have not been resubmitted.

**Table 3-5. Project Approval Rates**

| Utility | Customer Type | Application Status as of March 31, 2024 | | |
|---|---|---|---|---|
| | | Submitted (Applications) | Approved or Complete (Applications) | Cancelled (Applications) |
| Eversource | Residential Standard | 4% (13/344) | 71% (245/344) | 25% (86/344) |
| | Residential Underserved | 0% (0/25) | 76% (19/25) | 24% (6/25) |
| | Residential Low-income | 29% (2/7) | 43% (3/7) | 29% (2/7) |
| | *Residential Overall* | *4% (15/376)* | *71% (267/376)* | *25% (94/376)* |
| | Small C&I | 11% (1/9) | 78% (7/9) | 11% (1/9) |
| | Medium C&I | 0% (0/13) | 62% (8/13) | 38% (5/13) |
| | Large C&I | 0% (0/20) | 80% (16/20) | 20% (4/20) |
| | *C&I Overall* | *2% (1/42)* | *74% (31/42)* | *24% (10/42)* |
| | ***Eversource Overall*** | ***4% (16/418)*** | ***71% (298/418)*** | ***25% (104/418)*** |
| UI | Residential Standard | 3% (1/36) | 64% (23/36) | 33% (12/36) |
| | Residential Underserved | 0% (0/8) | 100% (8/8) | 0% (0/8) |
| | Residential Low-income | 0% (0/1) | 0% (0/1) | 100% (1/1) |
| | *Residential Overall* | *2% (1/45)* | *69% (31/45)* | *29% (13/45)* |
| | Small C&I | 0% (0/1) | 0% (0/1) | 100% (1/1) |
| | Medium C&I | 50% (2/4) | 50% (2/4) | 0% (0/4) |
| | Large C&I | 0% (0/5) | 80% (4/5) | 20% (1/5) |
| | *C&I Overall* | *20% (2/10)* | *60% (6/10)* | *20% (2/10)* |
| | ***UI Overall*** | ***5% (3/55)*** | ***67% (37/55)*** | ***27% (15/55)*** |
| **Percentage of Residential Applications** | | **4% (16/421)** | **71% (298/421)** | **25% (107/421)** |
| **Percentage of C&I Applications** | | **6% (3/52)** | **71% (37/52)** | **23% (12/52)** |
| **Percentage of Total Applications** | | **4% (19/473)** | **71% (335/473)** | **25% (119/473)** |

Note. Percentages above consider only the number of applications, and not necessarily the number participants associated with the application. Therefore, the hybrid housing project, despite having 162 associated participants, is considered as a single Large C&I application for this table.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-6 displays the average number of days to approve applications from the date submitted to approval, as well as the average number of days from the date submitted to the completion date. Note that these averages are over the duration of the program so far, and therefore do not account for previous changes in the classification of stages or potential changes in time to approval as the program matures.

Averages are bifurcated between those submitted through 2022 and after 2022 to show an increase in the average days to approve an application for both residential and C&I applications, and an increase in the average days to completion for residential systems. C&I systems both through 2022 and after 2022 have an average duration to approve applications approximately 6-7 times longer than residential applications.

**Table 3-6. Average Days to Approve Project Application**

| Customer Type | Average Days to Approve Application | Average Days to Completion |
|---|---|---|
| Residential Submitted through 2022 | 43 | 281 |
| Residential Submitted after 2022 | 12 | 142 |
| ***Residential Overall*** | ***28*** | ***229*** |
| C&I Submitted through 2022 | 277 | 594 |
| C&I Submitted after 2022 | 94 | N/A |
| ***C&I Overall*** | ***257*** | ***594*** |
| **Total Program Average Days** | **49** | **233** |

Note**:** Estimates for average days to approve application and average days to completion may vary from prior estimates, potentially due to changes in program enrollment (e.g., unenrollments).
Note: Averages above consider only the number of days associated with an application, and not necessarily the number of days associated with the number of participants. Therefore, the hybrid housing project, despite having 162 associated participants, is considered as a single Large C&I application for this table.
Note: Application review process may include back and forth communications with project developers to ensure their applications and complete and error-free, which may impact project approval timelines. Also, depending on the estimated upfront incentive amounts, C&I projects may need to be approved by the Green Bank Board of Directors, and this is subject to pre-established board meeting schedules.
Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.
*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-7 displays the share of energy storage paired with PV for approved projects by system, participant, and capacity (kWh).

Residential systems are almost entirely (99%) paired with PV; however, residential participants are less often paired with PV due to the hybrid project's large share of residential underserved participants. A similar trend is observed when estimating by capacity (kWh); however, the overall average is far lower due to C&I systems making up a larger share of program capacity and having a much lower rate of PV pairing.

**Table 3-7. Share of Energy Storage Paired with PV**

| Customer Type | By Number of Systems[1] | By Number of Participants[2] | By System's kWh[1] | By Participant's kWh[2] |
|---|---|---|---|---|
| Residential Standard | 99% | 99% | 99% | 99% |
| Residential Underserved | 100% | 14% | 100% | 24% |
| Residential Low-income | 100% | 100% | 100% | 100% |
| *Residential Average* | *99%* | *64%* | *99%* | *77%* |
| Small C&I | 14% | 14% | 5.2% | 5.2% |
| Medium C&I | 0% | 0% | 0% | 0% |
| Large C&I | 20% | 20% | 5.9% | 4.4% |
| *C&I Average* | 14% | 14% | 4.3% | 3.4% |
| **Overall Average** | *93%* | *60%* | *9.8%* | *6%* |

1. Percentages by system or system's kWh above consider only systems and their energy storage capacity (kWh), and as such, the hybrid housing project has been classified exclusively as "Large C&I."
2. Percentages by participant or participant's kWh, fractionalizes the hybrid project's capacity onto the 161 residential underserved participants and single C&I participant. Capacity for the hybrid housing project has been distributed as 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant.
Note: Share of energy storage w/ PV pairing analysis includes only projects in the "approved" or "completed" stages.
Note: Table values may not sum to 100% due to rounding.
Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.
*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-8 shows nameplate storage system power capacity segmented by utility, customer type, and project status. Currently, the C&I program accounts for a much larger share of program enrolled capacity, due to their larger average system size, despite making up a smaller share of program participants. The vast majority of enrolled capacity is in the approved stage.

**Table 3-8. Total Allocated Power Capacity (kW) by Project Status**

| Utility | Customer Type | Project Status as of March 31, 2024 | | | |
|---|---|---|---|---|---|
| | | Submitted (kW) | Approved (kW) | Complete (kW) | Total (kW)[1] |
| Eversource | Residential Standard | 147 | 976 | 1,172 | 2,295 |
| | Residential Underserved | 0 | 111 | 59 | 170 |
| | Residential Low-income | 8 | 0 | 27 | 35 |
| | *Residential Subtotal* | *155* | *1,087* | *1,258* | *2,500* |
| | Small C&I | 500 | 3,961 | 125 | 4,586 |
| | Medium C&I | 0 | 11,321 | 0 | 11,321 |
| | Large C&I | 0 | 53,877 | 250 | 54,127 |
| | *C&I Subtotal* | *500* | *69,159* | *375* | *70,034* |
| | ***Eversource Subtotal*** | **655** | **70,246** | **1,633** | **72,535** |
| UI | Residential Standard | 0 | 104 | 58 | 162 |
| | Residential Underserved | 0 | 916 | 34 | 949 |
| | Residential Low-income | 0 | 0 | 0 | 0 |
| | *Residential Subtotal* | 0 | 1,020 | 91 | 1,111 |
| | Small C&I | 0 | 0 | 0 | 0 |
| | Medium C&I | 625 | 6,167 | 0 | 6,792 |
| | Large C&I | 0 | 4,448 | 0 | 4,448 |
| | *C&I Subtotal* | *625* | *10,615* | *0* | *11,240* |
| | ***UI Subtotal*** | ***625*** | ***11,635*** | ***91*** | ***12,351*** |
| **Total Power Capacity: Residential (kW)** | | **155** | **2,107** | **1,349** | **3,611** |
| **Total Power Capacity: C&I (kW)** | | **1,125** | **79,775** | **375** | **81,275** |
| **Total Power Capacity (kW)** | | **1,280** | **81,881** | **1,724** | **84,886** |

1. Totals shown above are the sum of submitted, approved, and complete, without any projects listed as "cancelled."

Note**:** The hybrid housing project has been distributed above to the 161 residential underserved and single large C&I participants benefitting from a single energy storage system. Capacity for the hybrid housing project has been fractionalized with 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-9 shows capacity (rated energy) in kWh segmented by utility, customer type, and project status. As with Table 3-8, the C&I program makes up the majority of submitted and

approved energy capacity to date, although so far, primarily residential projects have been completed, with residential completed capacity almost three times greater than C&I.

**Table 3-9. Total Allocated Energy Capacity (kWh) by Project Status**

| Utility | Customer Type | Project Status as of March 31, 2024 | | | |
|---|---|---|---|---|---|
| | | Submitted (kWh) | Approved (kWh) | Complete (kWh) | Total (kWh)[1] |
| Eversource | Residential Standard | 327 | 2,528 | 2,604 | 5,459 |
| | Residential Underserved | 0 | 301 | 143 | 443 |
| | Residential Low-income | 20 | 0 | 57 | 77 |
| | *Residential Subtotal* | *347* | *2,828* | *2,804* | *5,979* |
| | Small C&I | 1,000 | 16,230 | 660 | 17,890 |
| | Medium C&I | 0 | 34,278 | 0 | 34,278 |
| | Large C&I | 0 | 132,226 | 558 | 132,784 |
| | *C&I Subtotal* | *1,000* | *182,734* | *1,218* | *184,952* |
| | **Eversource Subtotal** | ***1,347*** | ***185,562*** | ***4,022*** | ***190,931*** |
| UI | Residential Standard | 54 | 301 | 169 | 525 |
| | Residential Underserved | 0 | 1,862 | 77 | 1,939 |
| | Residential Low-income | 0 | 0 | 0 | 0 |
| | *Residential Subtotal* | *54* | *2,163* | *246* | *2,463* |
| | Small C&I | 0 | 0 | 0 | 0 |
| | Medium C&I | 1,112 | 19,270 | 0 | 20,382 |
| | Large C&I | 0 | 9,513 | 0 | 9,513 |
| | *C&I Subtotal* | *1,112* | *28,783* | *0* | *29,895* |
| | ***UI Subtotal*** | ***1,166*** | ***30,945*** | ***246*** | ***32,358*** |
| **Total Energy Capacity: Residential (kWh)** | | **401** | **4,991** | **3,050** | **8,443** |
| **Total Energy Capacity: C&I (kWh)** | | **2,112** | **211,516** | **1,218** | **214,846** |
| **Total Energy Capacity (kWh)** | | **2,513** | **216,508** | **4,268** | **223,289** |

Note**:** Capacity for the hybrid housing project has been fractionalized with 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

1. Totals shown above are the sum of submitted, approved, and complete, without any projects listed as “cancelled.”

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-10 displays the average system size (in kW and kWh) per participant for approved systems, segmented by utility and customer type. To date, the average system size for Medium C&I is greater than the average system size for Large C&I in UI's service territory. Notably, there is still limited enrollment to date on which to calculate average system size, leading the potential for greater variance. Additionally, as C&I components are classified by peak demand, it is not guaranteed that the average system size for Large C&I to be larger than Medium C&I, but instead just expected.

**Table 3-10. Average Project Size**

| Utility | Customer Type | Average System Size[1] | |
|---|---|---|---|
| | | (kW/participant) | (kWh/participant) |
| Eversource | Residential Standard | 8.8 | 21 |
| | Residential Underserved | 9 | 23 |
| | Residential Low-income | 9 | 19 |
| | *Residential Average* | *9* | *21* |
| | Small C&I | 584 | 2,413 |
| | Medium C&I | 1,415 | 4,285 |
| | Large C&I | 3,383 | 8,299 |
| | *C&I Average* | *2,243* | *5,934* |
| | ***Eversource Average*** | ***241*** | ***636*** |
| UI | Residential Standard | 7 | 20 |
| | Residential Underserved | 5.6 | 11 |
| | Residential Low-income | N/A | N/A |
| | *Residential Average* | *6* | *13* |
| | Small C&I | N/A | N/A |
| | Medium C&I | 3,084 | 9,635 |
| | Large C&I | 1,112 | 2,378 |
| | *C&I Average* | *1,769* | *4,797* |
| | ***UI Average*** | ***59*** | ***158*** |
| **Average System Size for Residential Systems** | | **7.5** | **18** |
| **Average System Size for C&I Systems** | | **2,166** | **5,750** |
| **Average System Size[2]** | | **169** | **445** |

1. Average system size analysis includes only projects in the "approved" or "completed" stages.
2. Guidehouse used an average of each project size of kW per participant

Note**:** Capacity for the hybrid housing project has been fractionalized with 47% of capacity classified under the 161 residential underserved participants and 53% of capacity classified under the single large C&I participant.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-11 shows the number of participants and number of storage systems by make and model. Sunpower is the most popular residential manufacturer, accounting for 33% of

residential systems. Tesla is the most popular C&I manufacturer, accounting for 76% of C&I systems.

**Table 3-11. Number of Systems and Batteries by Storage Type**

| Type | Make and Model | Number of Systems[1] | Number of Battery Units[1] |
|---|---|---|---|
| Residential | SunPower - SunVault | 98 | 127 |
| | Enphase Energy - IQ Battery 10T | 78 | 123 |
| | Enphase Energy - IQ Battery 5P | 15 | 46 |
| | Enphase Energy - IQ Battery 3T | 2 | 4 |
| | FranklinWH - aPower X | 59 | 131 |
| | Generac PWRcell - PWRcell M6[3] | 25 | 30 |
| | Generac PWRcell - PWRcell M5 | 2 | 2 |
| | Generac PWRcell - PWRcell M4 | 2 | 2 |
| | Generac PWRcell - PWRcell M3 | 1 | 1 |
| | EndurEnergy Systems - ESP-5100 | 5 | 31 |
| | EndurEnergy Systems - ESP-BU15 | 1 | 2 |
| | Homegrid Energy - Stack'D Series | 5 | 4 |
| | Fortress Power - eFlex | 1 | 2 |
| | Fortress Power - eVault Max | 1 | 4 |
| | Cadenza Innovation - CI48400-I-2P | 1 | 4 |
| | Sol-Ark - 12K | 1 | 1 |
| | Electriq Power - PowerPod 2 | 1 | 1 |
| C&I | Tesla - Megapack | 27 | 27 |
| | Tesla - Megapack 2 | 1 | 1 |
| | ELM Fieldsight - MG1000 | 2 | 2 |
| | ELM Fieldsight - CMG125 | 2 | 2 |
| | ELM Fieldsight - MG500 | 1 | 1 |
| | Socomec - SUNSYS HES L | 3 | 3 |
| | BYD Energy Storage - CP32-B2800-U-R2M01 | 1 | 1 |

1. Counts by storage type includes only projects in the “approved” or “completed” stages.

2. Count of participants here includes all those participants served by an energy storage system of a given make and model. Note: “System” is defined as the full collection of equipment (e.g., batteries/inverters) and balance of plant sited at a particular location. As such, the hybrid housing project has not been allocated between residential and C&I, and is instead classified under large C&I.

3. As discussed in Section 2 above, Guidehouse did not receive interval energy data corresponding to a single Generac system, and as such, the system is not included in program evaluation metrics.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-12 shows the number of applications submitted by contractor, with both number of residential and C&I applications. There are 29 contractors with at least one residential

application, 8 contractors with at least one C&I application, and 2 contractors with at least one of both residential and C&I applications.

**Table 3-12. Number of Approved or Completed Applications by Contractor**

| Contractor | Residential Applications | C&I Applications |
|---|---|---|
| **Earthlight Technologies, LLC** | 80 | 2 |
| **SAVKAT, Inc.** | 59 | 0 |
| **Green Power Energy, LLC** | 43 | 0 |
| **RWE Clean Energy, LLC (formerly ConEdison Solutions)** | 20 | 12 |
| **Synergy Smart Homes** | 14 | 0 |
| **Earth Smart Solar** | 12 | 0 |
| **Eastern CT Solar, LLC** | 10 | 0 |
| **Venture Home Solar, LLC** | 10 | 0 |
| **Aegis Solar Energy** | 9 | 0 |
| **Sunlight Solar Energy, Inc.** | 7 | 0 |
| **Helio Solar** | 6 | 0 |
| **Summer Hill Solar** | 4 | 0 |
| **EcoSolar Installations, LLC** | 4 | 0 |
| **Ion Solar Pros** | 2 | 0 |
| **Infinity Solar Systems** | 2 | 0 |
| **Powur PBC** | 2 | 0 |
| **EcoSmart Home Services** | 2 | 0 |
| **ELC INC** | 1 | 0 |
| **West Electric LLC** | 1 | 0 |
| **Porticade Construction LLC dba Action Solar** | 1 | 0 |
| **Momentum Solar** | 1 | 0 |
| **Son Energy Systems** | 1 | 0 |
| **RT's Construction** | 1 | 0 |
| **Dyna Electric** | 1 | 0 |
| **Ovanova** | 1 | 0 |
| **Trinity Solar, Inc.** | 1 | 0 |
| **Green Banyan Consulting, LLC** | 1 | 0 |
| **PurePoint Energy** | 1 | 0 |
| **SunBug Solar** | 1 | 0 |
| **CPower** | 0 | 14 |
| **Siemens Industry, Inc. / Calibrant Energy** | 0 | 3 |
| **HQCA Energy Solutions, LLC** | 0 | 2 |
| **Enel X North America, Inc.** | 0 | 1 |
| **QCells Enable** | 0 | 2 |
| **Waldron Engineering & Construction, Inc.** | 0 | 1 |

1. Count only includes projects in the “approved” or “completed” stages.
Note: The hybrid housing project, despite having 162 associated participants, is considered a single Large C&I application for this table.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Guidehouse also received actual program administration costs incurred by the Program Administrators to date, which is shown in Table 3-13.

**Table 3-13. Program Administrative Costs ($)**

| Category | 2023 Costs |
|---|---|
| Personnel | $1,032,678.00 |
| Evaluation, Measurement, and Verification[1] | $216,344.00 |
| Marketing | $159,125.00 |
| IT | $46,840.00 |
| Other | $756,027.00 |
| ***Total*** | **$2,211,014.00** |

Note: Table displays 2023 administrative costs only, as costs for the first quarter of 2024 are not yet finalized for reporting.
1. The EM&V category includes vendors supporting the Program Administrators' compliance with Orders within the ESS dockets.
*Source: Connecticut Green Bank, Eversource, and UI*

Table 3-14 displays the upfront incentives encumbered by customer type. As of March 2024, over $30M in upfront incentives have been encumbered by projects either in the approved or completed stages, with Eversource's C&I projects making up over two thirds of the approved or completed encumbered incentives to date.

**Table 3-14. Estimated Upfront Incentives Encumbered by Project Status ($)**

| Utility | Customer Type | Status as of March 31, 2024 | | |
|---|---|---|---|---|
| | | Submitted ($)[1] | Approved ($)[2] | Complete ($)[3] |
| Eversource | Residential Standard | 66,204 | 689,025 | 636,091 |
| | Residential Underserved | 0 | 148,564 | 47,236 |
| | Residential Low-income | 12,096 | 0 | 19,900 |
| | *Residential Subtotal* | *78,300* | *837,589* | *703,227* |
| | Small C&I | 0 | 3,244,960 | 132,000 |
| | Medium C&I | 0 | 5,755,026 | 0 |
| | Large C&I | 0 | 14,483,843 | 55,800 |
| | *C&I Subtotal* | *0* | *23,483,829* | *187,800* |
| | ***Eversource Subtotal*** | ***78,300*** | ***24,321,418*** | ***891,027*** |
| UI | Residential Standard | 16,000 | 75,518 | 41,464 |
| | Residential Underserved | 0 | 787,620 | 28,164 |
| | Residential Low-income | 0 | 0 | 0 |
| | *Residential Subtotal* | *16,000* | *863,138* | *69,628* |
| | Small C&I | 0 | 0 | 0 |
| | Medium C&I | 75,770 | 3,372,250 | 0 |
| | Large C&I | 0 | 1,159,677 | 0 |
| | *C&I Subtotal* | *75,770* | *4,531,927* | *0* |
| | ***UI Subtotal*** | ***91,770*** | ***5,395,065*** | ***69,628*** |
| **Total Incentives Encumbered: Residential** | | **94,300** | **1,700,727** | **772,855** |
| **Total Incentives Encumbered: C&I** | | **75,770** | **28,015,756** | **187,800** |
| **Total Incentives ($)** | | **170,070** | **29,716,483** | **960,655** |

1. Incentives for submitted status projects are estimated based on system capacity, location, and low-income status.
2. Incentives for approved projects are estimated in the same manner as submitted projects. However, this number is reflective of the amount of funds reserved as part of that approval.
3. Completed projects incentives are based upon what has actually been paid for installed systems.

Note: The hybrid housing project has been fractionalized above to both the 161 residential underserved participants and single large C&I participant benefitting from a single energy storage system. Upfront incentives for the hybrid housing project are fractionalized as roughly 75% of incentives classified under the 161 residential underserved participants and 25% of cost classified under the single large C&I participant. The 75%/25% split of upfront incentives is calculated by applying the upfront incentive formulas for residential underserved and large C&I participants to the 47% and 53% split of project capacity, respectively.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-15 shows the average total project upfront incentive for approved projects, segmented by utility and customer type. Residential underserved participants within Eversource's service territory saw a higher average total project incentive relative to UI underserved participants due to a large share of the 19 systems having received the maximum allowable cap of $16k in upfront incentives.

**Table 3-15. Average Total Project Upfront Incentive ($/Participant)**

| Utility | Customer Type | Average Total Project Incentive ($/Participant)[1] |
|---|---|---|
| Eversource | Residential Standard | 5,409 |
| | Residential Underserved | 10,305 |
| | Residential Low-income | 6,633 |
| | *Residential Average* | *5,771* |
| | Small C&I | 482,423 |
| | Medium C&I | 719,378 |
| | Large C&I | 908,728 |
| | *C&I Average* | *763,601* |
| | ***Eversource Average*** | ***84,606*** |
| UI | Residential Standard | 5,086 |
| | Residential Underserved | 4,827 |
| | Residential Low-income | N/A |
| | *Residential Average* | *4,858* |
| | Small C&I | *N/A* |
| | Medium C&I | *1,686,125* |
| | Large C&I | *289,919* |
| | *C&I Average* | *755,321* |
| | ***UI average*** | ***27,599*** |
| **Average Incentives Encumbered by Residential Participants** | | **5,389** |
| **Average Incentives Encumbered by C&I Participants** | | **762,258** |
| **Average Project Incentive[2]** | | **61,849** |

1. Average total project incentive is defined as upfront and performance per participant. However, there have not been any performance-based incentives for any projects so far, so this table only reflects upfront incentives.
2. Average Project Incentive is calculated as the simple average incentive per participant.

Note: Average total project incentive analysis includes only projects in the "approved" or "completed" stages.

Note: The hybrid housing project has been fractionalized above to both the 161 residential underserved participants and single large C&I participant benefitting from a single energy storage system. Upfront incentives for the hybrid housing project are fractionalized as roughly 75% of incentives classified under the 161 residential underserved participants and 25% of cost classified under the single large C&I participant. The 75%/25% split of upfront incentives is calculated by applying the upfront incentive formulas for residential underserved and large C&I participants to the 47% and 53% split of project capacity, respectively.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-16 displays battery only and average battery system project costs, segmented by utility and customer type. As noted in the footnotes of each table, the treatment of the hybrid multifamily project heavily affects UI residential underserved estimates due to the higher relative number of residential underserved projects in UI service territory associated with the hybrid project as compared to UI's overall number of underserved projects.

Table 3-16 also displays that the average cost for Medium C&I exceeds the average project costs for Large C&I in UI's service territory, indicating a wide variance and the potential for different energy storage use cases among C&I customers.

**Table 3-16. Average Project Cost ($/Participant)**

| Utility | Customer Type | Battery Only Cost ($/Participant) | Total Energy Storage System Cost ($/Participant)[1] |
|---|---|---|---|
| | Residential Standard | 19,972 | 32,437 |
| | Residential Underserved | 21,185 | 35,653 |
| | Residential Low-income | 17,142 | 33,435 |
| | *Residential Average* | *20,027* | *32,677* |
| **Eversource** | Small C&I | 837,464 | 1,246,612 |
| | Medium C&I | 1,209,056 | 2,081,841 |
| | Large C&I | 1,951,439 | 3,713,202 |
| | *C&I Average* | *1,508,314* | *2,735,234* |
| | ***Eversource Average*** | ***174,848*** | ***313,816*** |
| | Residential Standard | 18,563 | 34,857 |
| | Residential Underserved | 1,008 | 10,613 |
| | Residential Low-income | N/A | N/A |
| | *Residential Average* | *3,111* | *13,517* |
| **UI** | Small C&I | N/A | N/A |
| | Medium C&I | 2,225,875 | 4,203,521 |
| | Large C&I | 928,121 | 1,524,194 |
| | *C&I Average* | *1,360,706* | *2,417,303* |
| | ***UI Average*** | ***44,250*** | ***86,359*** |
| **Average Cost for Residential Participants** | | **12,951** | **24,663** |
| **Average Cost for C&I Participants** | | **1,484,377** | **2,683,677** |
| **Average Cost** | | **122,714** | **223,017** |

Note: Average project cost analysis includes only projects in the "approved" or "completed" stages.
Note: To accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I). Capacity and costs for the hybrid housing project have been fractionalized with 47% of capacity and cost classified under the 161 residential underserved participants and 53% of capacity and cost classified under the single large C&I participant.
Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.
1. Total system costs includes the cost of the battery module as well as balance of system, inverter, engineering and design, interconnection, monitoring, and permitting cost. The cost does not include solar PV.
*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-17 displays the total installed costs encumbered by customer type. C&I continues to have higher total installed costs as compared to the residential program, accounting for approximately 90% of total allocated installed costs.

**Table 3-17. Total Installed Costs Allocated to Participants by Project Status ($)**

| Utility | Customer Type | Status as of March 31, 2024 | | |
|---|---|---|---|---|
| | | Submitted ($)[1] | Approved ($)[2] | Complete ($)[3] |
| Eversource | Residential Standard | $594,741 | $3,562,327 | $4,384,786 |
| | Residential Underserved | - | $438,570 | $238,840 |
| | Residential Low-income | $31,917 | - | $27 |
| | *Residential Subtotal* | *$626,658* | *$4,000,897* | *$4,623,653* |
| | Small C&I | $5,177,428 | $8,350,189 | $376,096 |
| | Medium C&I | - | $16,654,729 | - |
| | Large C&I | - | $58,979,872 | $431,359 |
| | *C&I Subtotal* | *$5,177,428* | *$83,984,790* | *$807,455* |
| | ***Eversource Subtotal*** | ***$5,804,086*** | ***$87,985,687*** | ***$5,431,108*** |
| UI | Residential Standard | $63,550 | $506,228 | $295,489 |
| | Residential Underserved | - | $1,598,977 | $194,632 |
| | Residential Low-income | - | - | - |
| | *Residential Subtotal* | *$63,550* | *$2,105,205* | *$490,121* |
| | Small C&I | - | - | - |
| | Medium C&I | $948,153 | $8,407,042 | - |
| | Large C&I | - | $6,096,777 | - |
| | *C&I Subtotal* | *$948,153* | *$14,503,819* | - |
| | ***UI Subtotal*** | ***$1,011,703*** | ***$16,609,024*** | ***$490,121*** |
| **Total Allocated Installed Costs: Residential** | | **$690,208** | **$6,106,102** | **$5,214,051** |
| **Total Allocated Installed Costs: C&I** | | **$6,125,581** | **$98,488,609** | **$807,455** |
| **Total Installed Costs ($)** | | **$6,815,789** | **$104,594,711** | **$5,921,229** |

1. Incentives for submitted status projects are estimated based on system capacity, location, and low-income status.
2. Incentives for approved projects are estimated in the same manner as submitted projects however this number is reflective of the amount of funds reserved as part of that approval.
3. Completed project incentives are based upon what has actually been paid for installed systems.

Note: In order to accurately reflect the impact of the hybrid housing project, all 162 participants are counted individually within their respective subcategories (i.e., 161 participants are counted under residential underserved, and one is counted under large C&I). Capacity and costs for the hybrid housing project have been fractionalized with 47% of capacity and cost classified under the 161 residential underserved participants and 53% of capacity and cost classified under the single large C&I participant.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-18 shows average total system costs by kW and kWh by the customer type and application status associated with each project. Average costs for approved systems are slightly lower than those for completed systems, indicating the possibility that battery system costs are decreasing; however, the limited number of participants makes it difficult to draw conclusions in price trends at this time.

**Table 3-18. Average Total Energy Storage System Costs ($/kWh and $/kW)**

| Cost \| Status[1] | Project Type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Resi. Standard | Resi. Under-served | Resi. Low-Income | Resi. Avg. | Small C&I | Medium C&I | Large C&I | C&I Avg. | Overall Avg.[3] |
| $/kW \| Submitted[2] | $2,960 | N/A | $4,156 | ***$3,110*** | $10,355 | $1,258 | N/A | ***$4,290*** | **$3,296** |
| $/kW \| Approved | $3,495 | $3,611 | N/A | ***$3,508*** | $2,640 | $1,662 | $1,322 | ***$1,645*** | **$2,410** |
| $/kW \| Completed[2] | $4,326 | $5,218 | $3,813 | ***$4,381*** | $3,009 | N/A | $1,725 | ***$2,367*** | **$4,357** |
| $/kWh \| Submitted[2] | $1,591 | N/A | $1,583 | ***$1,590*** | $5,177 | $883 | N/A | ***$2,314*** | **$1,705** |
| $/kWh \| Approved[2] | $1,601 | $1,671 | N/A | ***$1,609*** | $553 | $524 | $552 | ***$544*** | **$1,117** |
| $/kWh \| Completed[2] | $1,855 | $2,263 | $1,785 | ***$1,883*** | $570 | N/A | $773 | ***$671*** | **$1,869** |

1. Total system costs may be inclusive of non-energy storage equipment, (e.g., installation costs associated with paired PV).
2. The relatively low customer counts of completed or submitted projects for some customer types (e.g., submitted project statuses) may result in non-representative estimates for average cost.
3. Guidehouse used a weighted average by summing the total system costs and dividing by the total kW(h)s to reflect the effect of system size on cost.

Note. Calculations shown above are given by system. As such, the hybrid housing project is classified as a single large C&I system. If the average total storage system cost was artificially fractionalized to each additional participant benefitting (i.e., the 161 underserved residential customers), the approved Residential Avg. of $/kW would drop to $2,501. Later recommendations assume that the hybrid project was relatively unique.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

Table 3-19 shows average battery only costs by kW and kWh by the customer type and application status associated with each project. Trends in battery only costs follow closely the trends in total energy storage system costs presented in Table 3-18.

**Table 3-19**: **Average Battery Only Costs ($/kWh and $/kW)**

| Cost \| Status | Project Type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Resi. Standard | Resi. Under-served | Resi. Low-Income | Resi. Avg. | Small C&I | Medium C&I | Large C&I | C&I Avg. | Overall Avg.[2] |
| $/kW \| Submitted[1] | $1,908 | N/A | $2,706 | ***$2,008*** | $1,529 | $1,013 | N/A | ***$1,185*** | **$1,878** |
| $/kW \| Approved | $2,171 | $2,357 | N/A | ***$2,192*** | $1,816 | $1,030 | $8,987 | ***$1,028*** | **$1,465** |
| $/kW \| Completed[1] | $2,516 | $3,097 | $1,740 | ***$2,544*** | $2,208 | N/A | $1,099 | ***$1,653*** | **$2,533** |
| $/kWh \| Submitted[1] | $1,029 | N/A | $1,031 | ***$1,029*** | $764 | $761 | N/A | ***$762*** | **$987** |
| $/kWh \| Approved[1] | $994 | $1,094 | N/A | ***$1,005*** | $376 | $317 | $4,429 | ***$331*** | **$677** |
| $/kWh \| Completed[1] | $1,082 | $1,333 | $819 | ***$1,095*** | $418 | N/A | $492 | ***$455*** | **$1,087** |

1. The relatively low customer counts of completed or submitted projects for some customer types (e.g., submitted project statuses) may result in non-representative estimates for average cost.

2. Guidehouse used a weighted average by summing the batteries and storage costs and dividing by the total kW(h)s to reflect the effect of system size on cost

Note: Calculations shown above are given by system. As such, the hybrid housing project is classified as a single large C&I system. If the average total storage system cost was artificially fractionalized to each additional participant benefitting (i.e., the 161 underserved residential customers), the approved Residential Avg. of $/kW would drop to $1,518. Later recommendations assume that the hybrid project was relatively unique.

Note: Since the hybrid project was approved, PURA's Year 3 Final Decision changed the eligibility of low-income projects to include affordable multifamily housing. As of March 31, 2024, this project was classified as underserved; however, Green Bank is correcting its enrollment data to reflect this recent change, and it will be captured in the Program Annual Review that is due August 1, 2024, in compliance with Order No.3 of the Final Decision in Docket No. 22-08-05.

*Source: Guidehouse analysis of Connecticut Green Bank program tracking data as of March 31, 2024*

## 3.3 Findings and Recommendations

**Table 3-20. Program Tracking Metrics Findings and Recommendations**

| Finding | Recommendation |
|---|---|
| Residential enrollment is below installed 2024 50 MW capacity targets for both residential and C&I at 2.7% and 0.8% of installed capacity completed to target, respectively. However, there is significant interest in C&I participation with enough MWs of capacity approved to surpass the program's 50 MW target awaiting completion. | Program Administrators should consider raising incentives and/or changing program dispatch requirements, such as softening the passive dispatch requirement, in the future to encourage additional enrollment in the residential program as it remains well below its 2024 capacity target. |
| The share of low-income and underserved participants is in line with targets as a percentage of residential projects, making up 41% of residential participants relative to the 40% target and the share of residential capacity is slightly lower than target at 32% of residential capacity relative to the 40% target. This represents a 10% decrease from the same figures in the year two annual report. Additionally, the low-income share of the installed capacity target remains extremely low at only about 1% of residential capacity and participation from low-income participants. Multifamily affordable housing is also an additional avenue through which low-income participation and capacity targets can be reached, as demonstrated by the hybrid project. | Program Administrators should continue to focus on increasing enrollment for underserved participants, especially those that are low-income, and leverage insights from research on barriers to entry for these populations, as detailed in Section 6. To improve the share of underserved and low-income participation and capacity relative to targets, Program Administrators could continue to explore program elements to incentivize multifamily affordable housing participation. |
| The average upfront incentive for residential participants is approximately $5.4k and for C&I participants is approximately $762k. Compared to the average installed total system costs of $24.7k and $2.68M, for residential participants and for C&I participants, respectively, the upfront incentive covers roughly 22% of residential participants' battery system cost and roughly 28% of C&I participants battery system cost. Both average upfront incentive and total system costs increased for residential and C&I from previous years proportionally, and therefore rising costs due to inflation and other market factors have negated the increased incentives. Moreover, respondents have reported cost as their largest barrier to enrollment, as explored in the research in Section 6. | Program Administrators could review and potentially update program incentives in the future to help meet program goals, keeping in mind rising total battery system costs for both C&I and residential participants. |
| Average time for approving applications is 28 and 257 days for residential and C&I projects, respectively. Application times for applications submitted after 2022 have decreased by roughly 28% for residential applications and 34% for C&I applications. | The Green Bank should continue to review the administrative processes for application approval to identify areas for reducing bottlenecks, especially for C&I applications. Specifically, any facilitation or coordination that the Green Bank could provide to shorten the period between application approval and completion would help to progress the program toward its capacity goals. |

*Source: Guidehouse analysis*

# 4. Program Evaluation Metrics

This section describes the program evaluation metrics that Guidehouse calculated for this final evaluation of the 2022-2024 program cycle and provides key findings and recommendations.

## 4.1 Program Evaluation Metrics

Table 4-1, Table 4-2, Table 4-3, and Table 4-4 display key program evaluation metrics by event date and aggregated by season. These include the number of participants in active events, battery energy availability, and average power per event. The tables also include an estimate of maximum expected energy storage system dispatch based on the battery energy storage available at the start of the event, and actual performance relative to that metric. This estimate of maximum expected average power assumes that energy storage dispatch during events is constrained by the available energy at the start of events (i.e., the product of battery energy storage capacity and state of charge at the start of an event) and that batteries maintain no backup reserve by the end of the event, as stipulated in the program manual for active dispatch events. Note then that this metric may overstate the actual maximum achievable power from participating energy storage systems in two cases:

1. If the energy storage is instead constrained by its maximum rated continuous discharge power (i.e., if the nominal duration of the energy storage system is greater than the event duration), and/or

2. If the energy storage participant or manufacturer requires some backup reserve of stored energy that would not discharge during active events.

In the first case, as identified in Table 3-10, enrolled residential energy storage systems generally have nominal durations of less than 3 hours, meaning that the power rating of energy storage is not typically a constraining factor for meeting dispatch requirements (e.g., a 10 kW by 20 kWh would be able to dispatch its full capacity in two hours, or over a duration longer than two hours). Still, this metric is less than 100% for the residential batteries that participated in active events during the analysis timeframe, with the percent of maximum expected power discharged per event roughly between 65% and 35%. This indicates that batteries maintained significant reserved storage capacity beyond the 20% reserve margin assumed in the program guidelines. This may reflect an intentional backup reserve setting that system manufacturers or battery owners maintain, or a technical limitation of the batteries to fully discharging.

Table 4-1, Table 4-2, and Table 4-4 show a steady increase in participants and average event kW during each subsequent event as more systems connected to DERMS over time.

Residential participation in active events has fluctuated by approximately +/- 10% around an average of 74% of enrolled devices participating in events with an average battery energy availability of ~18 kWh per participant per event.[20]

[20] Participation (%) is defined as the share of devices with an average dispatch less than zero (dispatching energy more than charging energy) during the event window divided by the count of devices enrolled at the time of the event.

**Table 4-1 Program Evaluation Metrics by Active Event Date – Summer Season**

| Event Date[1] | Number of Eligible Participants | Active Event Participation (%)[2] | Battery Energy Availability (kWh/ Participant) | Battery Energy Availability (kWh/Event) | Average Power per Event (kW/ Program) | Maximum Expected Average Power based on Energy Availability (kW/ Participant)[3] | Average Power per Event (kW/ Participant) | % of Maximum Expected Power per Event (%)[4] |
|---|---|---|---|---|---|---|---|---|
| **9/16/2022** | 1 | 100% | 17 | 17 | 3.9 | 5.7 | 3.9 | 69% |
| **9/22/2022** | 1 | 100% | 17 | 17 | 4.0 | 5.7 | 4.0 | 70% |
| **9/28/2022** | 1 | 100% | 17 | 17 | 3.9 | 5.7 | 3.9 | 69% |
| **Summer 2022 Average** | **1.0** | **100%** | **17** | **17** | **3.9** | **5.7** | **3.9** | **69%** |
| **7/3/2023** | 32 | 78% | 17 | 529 | 87 | 5.7 | 2.7 | 48% |
| **7/5/2023** | 37 | 78% | 16 | 589 | 88 | 5.3 | 2.4 | 45% |
| **7/6/2023** | 37 | 81% | 16 | 598 | 119 | 5.3 | 3.2 | 60% |
| **7/7/2023** | 37 | 78% | 15 | 571 | 95 | 5.0 | 2.6 | 51% |
| **7/8/2023** | 37 | 76% | 16 | 581 | 88 | 5.3 | 2.4 | 44% |
| **7/11/2023** | 37 | 65% | 16 | 599 | 83 | 5.3 | 2.2 | 42% |
| **7/12/2023** | 37 | 70% | 15 | 569 | 96 | 5.0 | 2.6 | 52% |
| **7/13/2023** | 36 | 61% | 16 | 570 | 89 | 5.3 | 2.5 | 46% |
| **7/14/2023** | 36 | 67% | 16 | 569 | 93 | 4.0 | 2.6 | 65% |
| **7/15/2023** | 36 | 67% | 16 | 591 | 116 | 8.0 | 3.2 | 40% |
| **7/17/2023** | 32 | 66% | 17 | 538 | 108 | 8.5 | 3.4 | 40% |
| **7/18/2023** | 37 | 62% | 16 | 601 | 119 | 8.0 | 3.2 | 40% |
| **7/19/2023** | 37 | 70% | 15 | 571 | 113 | 7.5 | 3.1 | 41% |
| **7/20/2023** | 37 | 76% | 17 | 615 | 134 | 8.5 | 3.6 | 43% |
| **7/24/2023** | 31 | 90% | 17 | 514 | 105 | 5.7 | 3.4 | 60% |
| **7/25/2023** | 36 | 67% | 17 | 601 | 124 | 8.5 | 3.5 | 41% |
| **7/26/2023** | 37 | 62% | 17 | 618 | 122 | 8.5 | 3.3 | 39% |
| **7/27/2023** | 32 | 62% | 16 | 517 | 76 | 5.3 | 2.4 | 45% |
| **7/28/2023** | 37 | 59% | 16 | 604 | 101 | 8.0 | 2.7 | 34% |
| **7/29/2023** | 32 | 62% | 17 | 551 | 104 | 8.5 | 3.3 | 38% |
| **8/8/2023** | 50 | 82% | 15 | 757 | 162 | 7.5 | 3.3 | 43% |
| **8/9/2023** | 50 | 84% | 16 | 794 | 174 | 8.0 | 3.5 | 44% |
| **8/10/2023** | 49 | 78% | 16 | 760 | 161 | 8.0 | 3.3 | 41% |
| **8/14/2023** | 54 | 81% | 14 | 759 | 195 | 7.0 | 3.6 | 52% |
| **8/21/2023** | 55 | 73% | 16 | 863 | 195 | 8.0 | 3.5 | 44% |
| **8/22/2023** | 6 | 50% | 14 | 82 | 15 | 7.0 | 2.6 | 37% |
| **8/30/2023** | 64 | 89% | 15 | 956 | 242 | 7.5 | 3.8 | 50% |
| **9/5/2023** | 6 | 67% | 12 | 73 | 17 | 6.0 | 2.8 | 47% |
| **9/6/2023** | 64 | 66% | 16 | 1004 | 201 | 8.0 | 3.1 | 39% |
| **9/7/2023** | 64 | 67% | 15 | 969 | 153 | 5.0 | 2.4 | 48% |
| **Summer 2023 Average** | **39** | **71%** | **16** | **617** | **119** | **6.8** | **3.0** | **45%** |
| **Overall Average** | **36** | **74%** | **16** | **563** | **109** | **6.7** | **3.1** | **47%** |

1. All rows given for the summer season represent averages across each active event within the 2022-2023 seasons. Summer season events are July through September. Events are EDC-specific and may or may not overlap. This difference in event schedule results in some events with a lower number of participants due to not all Program batteries being called.
2. Participation (%) is defined as the share of devices with an average dispatch less than zero (dispatching energy more than charging energy) during the event window divided by the count of devices enrolled at the time of the event.
3. Calculated as Battery Energy Availability per participant divided by the length of the event, which was three hours for every event evaluated. Note that the listed values may exceed the maximum achievable power of participating energy storage systems.
4. Calculated as Average Power per Event divided by Maximum Expected Average Power based on Energy Availability.

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all active events called since the program's inception.*

**Table 4-2. Program Evaluation Metrics by Active Event Date – Winter Season**

| Event Date[1] | Number of Eligible Participants | Active Event Participation (%)[2] | Battery Energy Availability (kWh/ Participant) | Battery Energy Availability (kWh/event) | Average Power per Event (kW/ Program) | Maximum Expected Average Power based on Energy Availability (kW/ Participant)[3] | Average Power per Event (kW/ Participant) | % of Maximum Expected Power per Event (%)[4] |
|---|---|---|---|---|---|---|---|---|
| **2/4/2023[5]** | 4 | 75% | 25 | 99 | 13.8 | 8.3 | 3.4 | 41% |
| **3/7/2023[5]** | 5 | 80% | 23 | 117 | 14.8 | 7.7 | 3.0 | 38% |
| **3/24/2023[5]** | 6 | 83% | 21 | 126 | 15.8 | 7.0 | 2.6 | 37% |
| **Winter 2023 Average** | **5** | **79%** | **23** | **114** | **15** | **7.7** | **3.0** | **39%** |
| **1/17/2024** | 104 | 79% | 13 | 1380 | 212 | 4.3 | 2.0 | 47% |
| **1/19/2024** | 96 | 65% | 9 | 888 | 94 | 3.0 | 1.0 | 32% |
| **3/21/2024** | 125 | 94% | 15 | 1829 | 334 | 5.0 | 2.7 | 53% |
| **Winter 2024 Average** | **108** | **79%** | **12** | **1366** | **213** | **4.1** | **1.9** | **44%** |
| **Overall Average** | **57** | **79%** | **18** | **740** | **114** | **5.9** | **2.4** | **41%** |

1. All rows given for the winter season represent averages across each active event within the 2023-2024 season. Winter season events are November through March. Events are EDC-specific and may or may not overlap. This difference in event schedule results in some events with a lower number of participants due to not all Program batteries being called.
2. Participation (%) is defined as the share of devices with an average dispatch less than zero (dispatching energy more than charging energy) during the event window divided by the count of devices enrolled at the time of the event.
3. Calculated as Battery Energy Availability per participant divided by the length of the event, which was three hours for every event evaluated. Note that the listed values may exceed the maximum achievable power of participating energy storage systems.
4. Calculated as Average Power per Event divided by Maximum Expected Average Power based on Energy Availability.
5. A subset of OEM-specific batteries were enrolled during the 2023 winter season, but not called for events, and were enrolled as a small test group.

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all active events called since the program's inception.*

Table 4-3 displays the same performance metrics for active events exclusively for the single C&I system for which data was available. The C&I device enrolled late in the summer 2023 season, with only the opportunity to participate in two events, which it did not to any significant degree. However, the device did participate more significantly for the three winter events, dispatching 40% of its maximum expected power as opposed to the 2% dispatched in summer 2023.

**Table 4-3. Program Evaluation Metrics by Active Event Date – C&I**

| Event Date[1] | Number of Eligible Participants | Active Event Participation (%)[2] | Battery Energy Availability (kWh/ Participant) | Battery Energy Availability (kWh/Event) | Average Power per Event (kW/ Program) | Maximum Expected Average Power based on Energy Availability (kW/ Participant)[2] | Average Power per Event (kW/ Participant) | % of Maximum Expected Power per Event (%)[3] |
|---|---|---|---|---|---|---|---|---|
| **9/6/2023** | 1 | 100% | 660 | 660 | 2.92 | 125 | 2.92 | 1% |
| **9/7/2023** | 1 | 100% | 660 | 660 | 3.92 | 125 | 3.92 | 2% |
| **Summer-2023 Average** | 1 | **100%** | **660** | **660** | **3.4** | **125** | **3.4** | **2%** |
| **1/17/2024** | 1 | 100% | 660 | 660 | 102.64 | 125 | 103 | 58% |
| **1/19/2024** | 1 | 100% | 660 | 660 | 30.97 | 125 | 31 | 18% |
| **3/21/2024** | 1 | 100% | 660 | 660 | 77.86 | 125 | 78 | 44% |
| **Winter-2024 Average** | 1 | **100%** | **660** | **660** | **70.49** | **125** | **70** | **40%** |
| **Overall Average** | **1** | **100%** | **660** | **660** | **43.662** | **125** | **44** | **25%** |

1. All rows given for the winter season represent averages across each active event within the 2023-2024 season. Winter season events are November through March. Events are EDC-specific and may or may not overlap. This difference in event schedule results in some events with a lower number of participants due to not all Program batteries being called.

*2. Calculated as Battery Energy Availability per participant divided by the length of the event, which was three hours for every event evaluated. Note that the listed values may exceed the maximum achievable power of participating energy storage systems. Due to data availability, availability is given as the nameplate capacity (kWh) as opposed to the energy stored at the start of the event.*

3. Calculated as Average Power per Event divided by Maximum Expected Average Power based on Energy Availability. Due to the single device's nameplate capacity (kW) being less than 1/3 of the nameplate kWh, the maximum expected average power is based on nameplate capacity (kW).

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all active events called since the program's inception.*

Table 4-4 displays performance metrics for all passive events. Participation fluctuated significantly during the summer season, reaching as high as 95% and as low as 40% around an average of 75%. Power dispatched was similarly fluid, with an average of 53% of maximum power dispatched per event, slightly higher than the average power dispatched during active events.

## Table 4-4 Program Evaluation Metrics by Passive Event Date – Summer Season

| Event Date[1] | Number of Eligible Participants | Passive Event Participation (%)[2] | Battery Energy Availability (kWh/ Participant) | Battery Energy Availability (kWh/Event) | Average Power per Event (kW/ Program) | Maximum Expected Average Power based on Energy Availability (kW/ Participant)[3] | Average Power per Event (kW/ Participant) | % of Maximum Expected Power per Event (%)[4] |
|---|---|---|---|---|---|---|---|---|
| **6/1/2023** | 20 | 75% | 18 | 363 | 34.8 | 3.6 | 1.74 | 48% |
| **6/2/2023** | 20 | 85% | 18 | 364 | 41.6 | 3.6 | 2.08 | 58% |
| **6/5/2023** | 22 | 91% | 16 | 357 | 42.1 | 3.2 | 1.92 | 60% |
| **6/6/2023** | 22 | 95% | 17 | 370 | 42.0 | 3.4 | 1.91 | 56% |
| **6/7/2023** | 26 | 85% | 16 | 418 | 50.9 | 3.2 | 1.96 | 61% |
| **6/8/2023** | 26 | 85% | 16 | 424 | 47.2 | 3.2 | 1.81 | 57% |
| **6/9/2023** | 26 | 92% | 16 | 420 | 47.4 | 3.2 | 1.82 | 57% |
| **6/12/2023** | 26 | 88% | 16 | 423 | 50.0 | 3.2 | 1.92 | 60% |
| **6/13/2023** | 29 | 86% | 15 | 444 | 50.8 | 3.0 | 1.75 | 58% |
| **6/14/2023** | 29 | 90% | 15 | 444 | 57.3 | 3.0 | 1.98 | 66% |
| **6/15/2023** | 29 | 79% | 16 | 457 | 51.7 | 3.2 | 1.78 | 56% |
| **6/16/2023** | 29 | 93% | 16 | 466 | 56.6 | 3.2 | 1.95 | 61% |
| **6/19/2023** | 28 | 50% | 16 | 458 | 9.2 | 3.2 | 0.33 | 10% |
| **6/20/2023** | 29 | 93% | 16 | 464 | 62.0 | 3.2 | 2.14 | 67% |
| **6/21/2023** | 29 | 83% | 16 | 463 | 57.1 | 3.2 | 1.97 | 62% |
| **6/22/2023** | 29 | 86% | 16 | 453 | 55.2 | 3.2 | 1.90 | 59% |
| **6/23/2023** | 33 | 91% | 16 | 523 | 69.0 | 3.2 | 2.09 | 65% |
| **6/26/2023** | 32 | 91% | 15 | 492 | 65.4 | 3.0 | 2.04 | 68% |
| **6/27/2023** | 33 | 91% | 14 | 455 | 62.2 | 2.8 | 1.89 | 68% |
| **6/28/2023** | 33 | 88% | 14 | 475 | 54.1 | 2.8 | 1.64 | 59% |
| **6/29/2023** | 33 | 82% | 16 | 516 | 58.3 | 3.2 | 1.77 | 55% |
| **6/30/2023** | 33 | 91% | 16 | 518 | 62.7 | 3.2 | 1.90 | 59% |
| **7/3/2023** | 5 | 80% | 14 | 68 | 8.3 | 2.8 | 1.65 | 59% |
| **7/10/2023** | 37 | 76% | 15 | 568 | 56.6 | 3.0 | 1.53 | 51% |
| **7/17/2023** | 5 | 60% | 12 | 60 | 7.3 | 2.4 | 1.46 | 61% |
| **7/21/2023** | 36 | 86% | 15 | 558 | 73.2 | 3.0 | 2.03 | 68% |
| **7/24/2023** | 5 | 80% | 14 | 68 | 8.6 | 2.8 | 1.71 | 61% |
| **7/27/2023** | 5 | 40% | 12 | 62 | 4.3 | 2.4 | 0.85 | 35% |
| **7/31/2023** | 37 | 95% | 16 | 587 | 95.0 | 3.2 | 2.57 | 80% |
| **8/1/2023** | 49 | 61% | 17 | 812 | 54.2 | 3.4 | 1.11 | 33% |
| **8/2/2023** | 50 | 70% | 16 | 809 | 88.1 | 3.2 | 1.76 | 55% |
| **8/3/2023** | 50 | 74% | 15 | 755 | 92.6 | 3.0 | 1.85 | 62% |
| **8/4/2023** | 50 | 74% | 13 | 674 | 68.4 | 2.6 | 1.37 | 53% |
| **8/7/2023** | 50 | 70% | 13 | 646 | 59.8 | 2.6 | 1.20 | 46% |
| **8/11/2023** | 60 | 50% | 16 | 938 | 30.6 | 3.2 | 0.51 | 16% |
| **8/14/2023** | 6 | 50% | 14 | 82 | 6.9 | 2.8 | 1.14 | 41% |
| **8/15/2023** | 60 | 58% | 12 | 708 | 34.5 | 2.4 | 0.57 | 24% |
| **8/16/2023** | 61 | 56% | 13 | 771 | 44.6 | 2.6 | 0.73 | 28% |
| **8/17/2023** | 61 | 72% | 12 | 762 | 71.3 | 2.4 | 1.17 | 49% |
| **8/18/2023** | 61 | 59% | 16 | 957 | 72.0 | 3.2 | 1.18 | 37% |
| **8/21/2023** | 6 | 50% | 13 | 79 | 6.3 | 2.6 | 1.05 | 40% |
| **8/22/2023** | 55 | 64% | 16 | 890 | 83.3 | 3.2 | 1.51 | 47% |

| Event Date[1] | Number of Eligible Participants | Passive Event Participation (%)[2] | Battery Energy Availability (kWh/ Participant) | Battery Energy Availability (kWh/Event) | Average Power per Event (kW/ Program) | Maximum Expected Average Power based on Energy Availability (kW/ Participant)[3] | Average Power per Event (kW/ Participant) | % of Maximum Expected Power per Event (%)[4] |
|---|---|---|---|---|---|---|---|---|
| **8/23/2023** | 61 | 62% | 14 | 826 | 95.0 | 2.8 | 1.56 | 56% |
| **8/24/2023** | 62 | 61% | 13 | 825 | 64.9 | 2.6 | 1.05 | 40% |
| **8/25/2023** | 64 | 83% | 11 | 696 | 59.6 | 2.2 | 0.93 | 42% |
| **8/28/2023** | 64 | 83% | 14 | 885 | 128.1 | 2.8 | 2.00 | 71% |
| **8/29/2023** | 64 | 86% | 13 | 837 | 113.0 | 2.6 | 1.77 | 68% |
| **8/31/2023** | 64 | 69% | 16 | 1006 | 74.8 | 3.2 | 1.17 | 37% |
| **Overall Average** | **36** | **76%** | **15** | **535** | **55** | **3.0** | **1.6** | **53%** |

1. All rows given for the passive season represent averages across each passive event within the 2023 summer season. Summer passive season events are June through August. Events are EDC-specific and may or may not overlap. This difference in event schedule results in some events with a lower number of participants due to not all program batteries being called.

2. Participation (%) is defined as the share of devices with an average dispatch less than zero (dispatching energy more than charging energy) during the event window divided by the count of devices enrolled at the time of the event.

3.. Calculated as Battery Energy Availability per participant divided by the length of the event, which was three hours for every event evaluated. Note that the listed values may exceed the maximum achievable power of participating energy storage systems.

4.. Calculated as Average Power per Event divided by Maximum Expected Average Power based on Energy Availability.

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all active events called since the program's inception.*

Table 4-5 displays the program evaluation metrics by the seasonal peak event, as well as both summer and winter peak hours. The single seasonal (and annual) peak in 2022 occurred before the first ESS active event was called; however, in 2023, an active event was called during the 2023 ISO-NE Peak Hour, resulting in 186 kW of peak reduction. Two active events in summer 2023 were called during the summer peak period, while two active events in winter 2024 were called during the winter peak period (with peak period as defined in Table 4-5). In both cases, average power per event was less than the program-wide average power per event.

Table 4-5 also shows that the passive dispatch window was able to generate an average reduction of 1.6 kW per participant during times in which an active event was not called, resulting in overall program peak reduction of 1.7 kW during active or passive events called during the summer peak period. Additionally, the passive and active windows combined to overlap with 61 days' peak hours, resulting in an average program dispatch of 55 kW across all June-August peak hours, irrespective of if a passive or active event was concurrent with each peak hour. Dispatch during the winter period was roughly commensurate with summer

performance; however, total winter dispatch (i.e., not filtered to only event windows) was very limited due to fewer active events called and no passive dispatch.

**Table 4-5. Evaluation Metrics by Seasonal Peak Event**

| Evaluation Metric | Average Power per Participant (kW) | Average Power per Program (kW) | Dates (#) |
|---|---|---|---|
| **2022 ISO-NE Peak Hour (August 8, 2022, 3 p.m.-4 p.m. ET)** | **N/A** | **N/A** | **1** |
| **2023 ISO-NE Peak Hour (September 7, 2023, 5 p.m.-6 p.m. ET)** | **2.9** | **186** | **1** |
| Active Dispatch during Summer Peak Period (non-holiday weekdays 1 p.m.-5 p.m. ET, June-August) | 2.5 | 83 | 2 |
| Passive Dispatch during Summer Peak Period (non-holiday weekdays 1 p.m.-5 p.m. ET, June-August) | 1.6 | 118 | 48 |
| Active or Passive Dispatch during Summer Peak Period (non-holiday weekdays 1 p.m.-5 p.m. ET, June-August) | 1.7 | 119 | 49 |
| Active Dispatch during Summer ISO-NE Peak Hours (June-August) | 2.8 | 101 | 20 |
| Passive Dispatch during Summer ISO-NE Peak Hours (June-August) | 1.6 | 57 | 47 |
| Active or Passive Dispatch during Summer ISO-NE Peak Hours (June-August) | 2.0 | 77 | 61 |
| **Total Dispatch during Summer Peak Period (non-holiday weekdays 1 p.m.-5 p.m. ET, June-August)[1]** | **0.3** | **39** | **65** |
| **Total Dispatch during Summer ISO-NE Peak Hours (June-August)[1]** | **1.4** | **55** | **92** |
| Active Dispatch During Winter Peak Period (non-holiday weekdays 5 p.m.-7 p.m. ET, December-January) | 1.4 | 292 | 2 |
| Active Dispatch During Winter ISO-NE Peak Hours (December-January) | 1.6 | 163 | 2 |
| **Total Dispatch During Winter Peak Period (non-holiday weekdays 5 p.m.-7 p.m. ET, December-January)[1]** | **0.1** | **24** | **85** |
| **Total Dispatch During Winter ISO-NE Peak Hours (December-January)[1]** | **0.1** | **9** | **124** |

1. "Total Dispatch..." metrics presented above are provided as averages calculated without filtering to only active or passive dispatch windows. Other rows for active, passive, or active or passive dispatch are averages over only the event window range.

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all active events called since the program's inception.*

Table 4-6 displays the percentage of active events aligned with the daily, seasonal, and annual peaks. No seasonal or annual peak events occurred prior to summer 2023 within the time period covered in the interval energy data. Notably, Eversource categorized the dispatch events called prior to summer 2023 as "test events" due to the limited number of systems available at that time. All events prior to summer 2023 occurred during the same 3-hour afternoon period (4-7pm), which was identified as most likely to include the daily peak. For the other two events pre-summer 2023 that missed the peak, the daily peak occurred in the late morning. Notably, for

each of these morning events, ISO-NE's day-ahead forecast had projected peak demand to occur in the afternoon rather than in the morning. Due to the requirement that events be called 24 hours in advance, Eversource may not have known to call a morning event on those days. In addition, because the program manual stipulates that active dispatch events may only be called during 12-9pm, events likely could not have been called that would have aligned with the morning peak, regardless. As more devices enrolled into the ESS program, and dispatch events were no longer considered "test events," peak coincidence improved from 50% in the year two annual evaluation to 67% for the collective summer 2023 and winter 2023/24 seasons. In aggregate, 63% of active events called by either EDC aligned with the ISO-NE daily peak.

**Table 4-6. Peak Targeting Percentages**

| Utility | Percentage of Active Events Aligned w/ Daily Peak | Percentage of Active Events Aligned w/ Seasonal Peak | Percentage of Active Events Aligned w/ Annual Peak |
|---|---|---|---|
| **Eversource** | 68% | 67% | 100% |
| **UI** | 60% | 67% | 100% |

Note: Aligned events refer to active events that are called during the time window of each peak (e.g., daily, seasonal, or annual) from the period of winter 2022-2023 through winter 2023-2024. Guidehouse excludes the ISO-NE annual peaks for 2022 and 2024 for the calculation of "Percentage of Active Events Aligned w/ Annual Peak," as the first ESS event in 2022 was after the 2022 annual peak, and the annual peak for 2024 has likely not yet occurred.

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all active events called since the program's inception.*

Table 4-7 displays battery performance metrics for the whole of the event season. These include battery availability (uptime) as a percentage of energy storage systems available at the start of events, solar energy used to recharge energy storage systems after dispatching vs. grid charging, and estimated bill savings. The number of systems analyzed is not uniform throughout the evaluation season due to factors such as systems enrolling into ESS and/or unenrolling.

During events called between September 2022 and March 2024, nearly all batteries were available at the start of events, as demonstrated by the 99% Battery Availability (Uptime).

Energy storage systems charged primarily from PV with a 71% share of average total device energy (kWh) charged from PV for "Solar Energy Used." However, this share of PV charging is well below the nearly 100% PV charging expected from participating systems.

The calculation for estimated bill savings is done in aggregate across the whole period with which telemetry data is available. Given that nearly all enrolled energy storage systems were charging with standard flat electricity rates (i.e., not Time-of-Use (TOU) rates that change throughout the day), there was no opportunity for bill savings from load shifting, and thus estimated bill savings are estimated to be negative due to energy storage performance loss. Given the relative infrequency of energy storage cycling and the relatively high round-trip efficiency of the energy storage systems, this increase in bills was minor for participants.

**Table 4-7. Battery Performance Metrics**

| Performance Metric | Value |
|---|---|
| Battery Availability (Uptime)[1] (%) | 99% |
| Solar Energy Used[2] (%) | 71% |
| Estimated Bill Savings[3] ($) | -$6,865.05 USD |
| Estimated Bill Savings[3] ($/participant) | -$54.48 USD |

1. Uptime is calculated as the percentage of energy storage systems with any available energy stored at the start of each active event, averaged over the course of the event season.
2. Solar Energy Used is calculated as the percentage of charging done from PV throughout the whole of the event season.
3. Estimated Bill Savings are calculated over the whole of the evaluation period, summed across all systems. In order to isolate bill savings from energy storage alone, calculations assume that, in the absence of a battery, paired PV would otherwise meet home load at the same price as customers are charged for normal energy consumption. Negative values indicate that the system costs more to charge than it earns through bill savings from discharging onsite.

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all events called since the program's inception.*

Table 4-8 displays emissions evaluation metrics for Carbon Dioxide ($CO_2$), Nitrogen Oxide ($NO_X$), and Sulfur Oxide ($SO_X$). Avoided emissions are calculated both using the EPA AVERT model and the AESC estimates of marginal emissions for $CO_2$ and $NO_x$. Given the limited number of energy storage systems enrolled at the time of evaluation, emission reductions are presented in pounds (lbs.) as opposed to tons.

**Table 4-8. Emissions Evaluation Metrics**

| Emissions Metric | Avoided Emissions, per EPA AVERT | Avoided Emissions, per 2021 AESC |
|---|---|---|
| Avoided $CO_2$ Emissions (lbs.) | 45,089 | 42,378 |
| Avoided $NO_X$ Emissions (lbs.) | 0.90 | 3.17 |
| Avoided $SO_X$ Emissions (lbs.) | 0.30 | N/A |

Note: Given the reduced amount of energy storage, energy storage dispatch was scaled up by 100 in the case of $CO_2$ & NOx, and SOx, to generate AVERT metrics, at which point, outputs were then scaled down by 100. 2021 AESC marginal emissions data does not include marginal SOx, so an estimate of avoided SOx emissions is not available with that method.

*Sources: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all active events called since the program's inception. AVERT Model is available at: https://www.epa.gov/AVERT. 2021 AESC is available at: https://www.synapse-energy.com/project/aesc-2021-materials.*

Table 4-9 displays evaluation metrics by outage type, stratified by outages over or under 5 minutes in duration and with greater than or less than 10 participants in order to highlight the magnitude of each outage and its effects on program participants. From September 2022 through March 2024, 26 outage events occurred for more than 5 minutes for storage participants, with energy storage systems responding to 23 of them. Two outage events lasted for less than five minutes, and no storage systems dispatched during these quick outages.

**Table 4-9. Evaluation Metrics by Outage Type**

| Outage Duration | Participants Affected per Outage | Number of Instances | Energy Discharged During Outage (kWh/Outage) | Instances Battery Provided Backup Power (#) | Total kWh Dispatched |
|---|---|---|---|---|---|
| Less than 5 min | Less than 10 participants | 2 | 0 | 0 | 0 |
| Less than 5 min | Greater than 10 participants | 0 | 0 | 0 | 0 |
| More than 5 min | Less than 10 participants | 26 | -2.4 | 23 | -65 |
| More than 5 min | Greater than 10 | 0 | 0 | 0 | 0 |

*Source: Guidehouse analysis of interval energy data from September 15, 2022, through March 31, 2024, inclusive of all outage events identified since the program's inception.*

## 4.2 Findings and Recommendations

**Table 4-10. Evaluation Metrics Findings and Recommendations**

| Finding | Recommendation |
|---|---|
| The share of energy storage system manufacturers in active events fluctuated throughout 2022-2024, with an overall average of 75% of devices participating in each active event. Additionally, these devices did not dispatch optimally, with a 3-year average dispatch around 50% of the energy expected during each event. | Guidehouse recommends that the Program Administrators continue discussions with manufacturers about uniform dispatch capabilities and backup reserve settings to maximize active dispatch event performance. |
| The timing of active events called during the analysis period was concurrent with the daily peak load for 65% of Eversource events and 61% of UI events. While this was an improvement from the year 2 peak concurrence of 50%, often when the timing did not align, the events were only off by an average of 1 hour from the daily ISO-NE peak. Importantly, rather than utilizing the full 3-hour active event window, EDCs often only called 2-hour events resulting in missing the peak hour for that day. | Guidehouse recommends that Eversource and UI consider expanding the active event window while considering the tradeoffs for longer dispatch periods (greater chance of hitting peak) vs. battery discharge available at time of peak, especially considering most missed peak concurrences were by one hour either before or after the event. |
| Energy storage systems connected to DERMS charged from their co-located solar PV systems 71% of charging time, which represents a decrease from the year 2 evaluation that reported 99.4% charging from PV, though with a smaller sample size. | Guidehouse recommends that the Program Administrators investigate what barriers, if any, are preventing participating systems from recharging with solar PV systems, including the timing of active and passive event windows and any battery settings that may cause a battery system to recharge at night from the grid after an event rather than from solar the next day. |
| Average active event participation across the evaluation period was 74% for the summer season and 79% for the winter season. Event participation decreased as more devices enrolled in the program, and the summer 2023 season in particular experienced sporadic participation, some of which may be due to battery manufacturer settings preventing certain systems from responding to events due to weather conditions. | Guidehouse recommends that the Program Administrators continue conversations with battery manufacturers around settings that may prevent battery systems from responding to active events when called. More frequent reviews of battery interval data (i.e., mid-season or monthly) could also reveal issues with participation that may be addressed before the season is over. |

| Finding | Recommendation |
|---|---|
| No active events were called in June during either summer season, and the majority of active events for the summer 2023 season were called in July. The ISO-NE peaks for 2022 and 2023 also occurred in August and September, respectively. | Guidehouse recommends that the Program Administrators consider extending and aligning the passive program season with the active season to better coincide with seasonal peaks (i.e., extending passive dispatch through September). |
| Average passive event participation varied greatly in the summer 2023 season, ranging from 40% to 95% of systems participating per event with an average of 75% participation for the season. Average power dispatched during these events was similarly varied with a slightly higher average than active events at 53% of available maximum power dispatched. This figure is well below the program target of 80% of available power dispatched. No systems met the program's 90% dispatch requirement in the first passive dispatch season. | Guidehouse recommends that the Program Administrators further investigate barriers to passive event participation and confirm with battery manufacturers whether systems enrolled in the program can comply with the 90% passive dispatch requirement. Program Administrators should also consider modifying or suspending the claw back provision until the issues with passive event compliance are better understood. The Program Administrators could consider a grace period in which participants are not subject to claw back until their second or third summer in the program, which would allow time for adjusting battery settings to meet the passive dispatch requirements and ease the concerns of potential participants, as noted by the research in Section 6. |
| Estimated bill savings were marginally negative (i.e., customers' bills were higher than they would have been without energy storage) due to round-trip efficiency losses and lack of participation in TOU rates. | Guidehouse recommends that Program Administrators consider requiring residential customer participation in TOU rates or provide education on potential benefits of TOU rates with battery storage. |
| Both Eversource and UI called the same events for residential and C&I participants. While the utilities retain the ability to call events independently, the active events called by both utilities in the summer 2023 season largely aligned. | N/A |

*Source: Guidehouse analysis*

# 5. BCA

This section discusses changes to the benefit-cost model, specifically the incorporation of evaluated data, updates to prospective inputs based on the assessment of evaluated data, and updates to prospective inputs based on the latest avoided costs and BCA results.

## 5.1 Benefit-Cost Model

In compliance with Order No. 7 of the Final Decision in Docket No. 17-12-03RE03, the Green Bank filed a BCA reflecting final program design in October 2021, which included details on BCA approach and the Excel-based model.[21] This approach, including the model, has been used in all subsequent BCA filings related to the program, including the August 2022 ESS Annual Program Review (filed as Attachments 3 and 4) and, most recently, in written comments filed in September 2022 under Docket No. 22-08-05.[22, 23]

Section V.F of the Final Decision directed that the annual EM&V report include "the actual, realized benefit-cost ratios for all five cost tests listed in Section IV" as a program metric.[24] However, given the approach to the BCA described above, the fully actual and realized benefits from energy storage systems presently installed will not be known for some years. To the extent that a portion of costs and benefits within the broader BCA are actual and realized, they are accounted for in the updated BCAs (e.g., installed costs, upfront incentive payouts, and program administration costs to date). Additionally, the program tracking metrics and evaluation metrics discussed in this report can inform updates to assumptions about the long-term projected program performance.

[21] Connecticut Green Bank 17-12-03RE03 Order 7 compliance re-file under Docket 21-08-05, 10/4/2021, available at: https://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/06045b22997703bc8525876400540604?OpenDocument

[22] Connecticut Green Bank Order 9 Compliance, August 2022 Energy Storage Solutions Annual Program Review, under Docket 21-08-05, available at: https://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/d645a7e8cbbc5d5f852588a700554341?OpenDocument

[23] Connecticut Green Bank Written Comments for 22-08-05 under Docket 22-08-05, 9/21/2022, available at: www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/a25d58daf02b9681852588c4006b9e33?OpenDocument

[24] Ibid, pg. 45

**Table 5-1. Cost Test Definitions**

| Benefit/Cost Category | RIM | PCT | PACT | SCT | TRC | CTET |
|---|---|---|---|---|---|---|
| Utility System Impacts[1] | Benefit | | Benefit | Benefit | Benefit | Benefit |
| Societal Impacts[2] | | | | Benefit | | Benefit |
| Reduced Arrearages[3] | | Benefit | | Benefit | | Benefit |
| Avoided Backup Generator | | Benefit | | | | |
| Participant Bill Savings | Cost | Benefit | | | | |
| Program Incentives | Cost | Benefit | Cost | | | Cost |
| Non-Program Incentives | | Benefit | | | | |
| Program Administration | Cost | | Cost | Cost | Cost | Cost |
| ESS Technology Costs | | Cost | | Cost | Cost | |

1. Includes: Energy Savings components of Avoided Energy, DRIPE Energy, and Cross-DRIPE; Peak Savings components of Avoided Generation Capacity, Avoided Transmission Capacity, Avoided Distribution Capacity, Reliability, and DRIPE Capacity
2. Includes: Non-Embedded Emissions
3. Refers in full to the utility system benefit of reduced arrearages, collection costs, debt write-offs, or administrative costs

*Sources: Guidehouse analysis; CTET cost test as defined by CT DEEP in April 2022*[25]

During the year two evaluation, the model was also updated to enable calculation of a sixth cost test. In accordance with the Connecticut Department of Energy and Environment Projection's Updates to Connecticut Conservation and Load Management Cost-Effectiveness Testing, the Connecticut Efficiency Test (CTET) was added and is now reported on as an additional BCA metric.[26] The CTET is essentially a modified PACT, also including monetized avoided non-embedded emissions and reduced arrearages as additional benefits. For this program, the reduced arrearages benefit is assumed to be negligible.

PURA directed the Program Administrators to set program incentives that could deliver an overall benefit-to-cost ratio of 1.4 from the RIM cost test perspective.[27] The Final Decision provided a BCA submitted by the Connecticut Green Bank to the Request for Program Design (RFPD). The BCA submitted to the RFPD estimated benefits and costs for systems installed in the first 3-year program cycle over the life of those energy storage systems, which was assumed to be 10 years. The BCA underpinning the cost-effectiveness of the program is dependent on the performance of installed energy storage systems beyond the years in which they are installed.

Also, during the year two evaluation, the benefit-cost model was expanded from providing exclusively a prospective BCA to including both evaluated data and prospective estimates.[28] As the program continues to accumulate actual data from participants, the BCA will continue to assess assumptions for enrollment, system size, performance, and cost on an as-needed basis given any variation between observed actuals and prior assumptions. For the following three-

[25] Ibid.

[26] CT DEEP, Attachment B – Cost-Effectiveness Testing Update, published April 2022, available at: https://portal.ct.gov/-/media/DEEP/energy/ConserLoadMgmt/Attachment-B---Cost-Effectiveness-Testing-Update.pdf

[27] Public Utilities Regulatory Authority Final Decision under Docket 17-12-03RE03, July 28, 2021, available at: https://www.dpuc.state.ct.us/2nddockcurr.nsf/8e6fc37a54110e3e852576190052b64d/6991ef77ba07bae185258752007994f7?OpenDocument

[28] "Prospective" refers both to projected systems that have not yet been installed and projected impacts of systems that have already been installed in later years of their useful life. In this report, the prospective benefit-cost analysis captures 10 years of benefits and costs for systems with projected installation dates between 2022 and 2027.

year evaluation, assumptions have been modified for both enrollment and assumed performance.

The model incorporates evaluated data for systems installed in 2022 and 2023[29]. Evaluated data for systems installed in the first quarter of 2024 is used to inform total expected installs and performance in 2024. Similarly, the evaluated data is used to inform prospective inputs for systems expected to come online between 2024 and 2027. For example, the evaluated installed costs for 2022-2024 systems were used to update the projected installed costs of prospective 2024-2027 systems, as described further in Section 5.2.

Aside from these updates to the model, the general approach to BCA is unchanged from the prior filings. Select BCA input parameters have been changed, as described in the following section.

## 5.2 Benefit-Cost Model Inputs

As described in Section 5.1, the updated benefit-cost model includes both evaluated and prospective inputs. See Table 5-2 for a summary of the 2023 evaluated data used as input in the benefit-cost model. For the year three report, Guidehouse updated the following assumptions.

**BCA Inputs Based on Evaluated Data** – Guidehouse revised BCA projections with metrics evaluated from programing tracking and energy interval data in 2023. These additions are a continuation of conversions regarding transition from projections to actuals (as was done with 2022 actuals added during the Year 2 evaluation). In addition to the inclusion of actual data for 2022 and 2023, evaluated data was used to inform updates to inputs for the prospective BCA, including updates to enrollment and installed costs that align with actual evaluated data through the end of 2023. The enrollment assumptions used in the BCA are based on the date of completed installation. While data from early 2024 was available, the BCA requires a full year of costs and benefits to be included as evaluated data, and therefore 2024 was projected.

[29] See Section 2.1 for more details on the data received.

**Table 5-2. Summary of Benefit-Cost Model Inputs from Evaluated Data**

| Customer Segment | Number of Installs | Total Power (kW) | Total Energy (kWh) | Installed Cost ($) | Upfront Incentive ($) | 2023 Summer Peak Capacity Savings (kW) |
|---|---|---|---|---|---|---|
| Residential Standard | 110 | 858 | 82 | $3,409,738 | $476,964 | 23 |
| Residential Underserved | 9 | 69 | 6 | $335,623 | $42,624 | 18 |
| Residential Low-Income | 3 | 27 | 2 | $100,304 | $19,900 | 13 |
| Small C&I | 1 | 125 | 28 | $376,096 | $132,000 | 21 |
| Medium C&I | 0 | 0 | 0 | $0 | $0 | 0 |
| Large C&I | 1 | 250 | 23 | $431,359 | $55,800 | 0 |

*Source: Guidehouse analysis*

**Program Enrollment** – Guidehouse updated the program enrollment forecast seen in the Year 2 evaluation for MWs installed in 2024 through 2027 and requested the Program Administrators review and provide updates to the prospective program enrollment numbers based on enrollment to date. The updated projected program enrollment is shown in Table 5-3. Low participation in 2022, 2023 and the first quarter of 2024 resulted in higher projected installations allocated to later years. Within each customer segment, 80% of projected enrolled capacity is assumed to be within Eversource service territory and the remaining 20% within UI service territory. Initial applications have been slightly higher within Eversource territory than this expectation (85% to 15%) as identified in Table 3-8, but this is assumed to realign with expectations over time.

The assumption of elevated enrollment in 2024-2027 carries some risk as it relates to BCA for two reasons. If these enrollment targets are not met, then fewer benefits will accrue from the program than the benefits presented in the following Section 5.3, and the fixed costs of the program, such as administration, may reduce the program's cost-effectiveness since they would be spread across fewer projects.

**Table 5-3. Program Enrollment Forecast (MW)[30]**

| Customer Type | 2024 | 2025 | 2026 | 2027 |
|---|---|---|---|---|
| ***Residential*** | 28 | 37 | 37 | 46 |
| Standard | 17 | 22 | 22 | 28 |
| Underserved | 8 | 11 | 11 | 14 |
| Low-Income | 3 | 4 | 4 | 5 |
| ***C&I*** | 26 | 35 | 35 | 43 |
| Small | 6 | 8 | 8 | 10 |
| Medium | 8 | 11 | 11 | 13 |
| Large | 12 | 16 | 16 | 20 |
| ***Total*** | **54** | **72** | **72** | **90** |

*Source: Enrollment projections confirmed by Connecticut Green Bank, Eversource, and UI*

**Administrative Costs** – Guidehouse updated the ESS administrative costs based on actual costs to date in 2022, 2023 and Q1 2024, and with updated projected costs through 2036. Guidehouse requested the Program Administrators review and provide updates to the estimated program administrative costs, in addition to actual program administrative costs incurred as identified in Table 3-13. These costs were updated based on recently filed projections of program administration costs and were allocated to the power capacity of systems installed between 2022-2027 in alignment with the scope of this BCA. They are shown in Table 5-4.

[30] Enrollment for 2022 and 2023 is actual, the future years are prospective projections based on input from the Program Administrators.

**Table 5-4. Actual (through 2023) and Projected Program Administrative Costs ($)**

| Year | Residential | | | C&I | | |
|---|---|---|---|---|---|---|
| | Connecticut Green Bank | Eversource | UI | Connecticut Green Bank | Eversource | UI |
| 2022 | $1,521,716 | $124,658 | $268,589 | $0 | $0 | $0 |
| 2023 | $1,478,092 | $201,878 | $176,545 | $31,665 | $205,138 | $117,696 |
| 2024 | $1,548,292 | $255,016 | $186,334 | $446,791 | $259,134 | $124,222 |
| 2025 | $2,905,704 | $947,117 | $439,667 | $387,185 | $947,117 | $439,667 |
| 2026 | $1,662,079 | $890,306 | $684,448 | $221,472 | $890,306 | $684,448 |
| 2027 | $1,694,735 | $996,088 | $902,494 | $225,823 | $996,088 | $902,494 |
| 2028 | $1,728,370 | $1,040,892 | $1,129,271 | $230,305 | $1,040,892 | $1,129,271 |
| 2029 | $1,448,696 | $830,332 | $1,046,360 | $193,039 | $830,332 | $1,046,360 |
| 2030 | $1,195,360 | $761,392 | $982,515 | $159,282 | $761,392 | $982,515 |
| 2031 | $1,024,180 | $702,568 | $944,144 | $136,472 | $702,568 | $944,144 |
| 2032 | $954,727 | $580,900 | $934,902 | $127,217 | $580,900 | $934,902 |
| 2033 | $976,955 | $554,679 | $921,205 | $130,179 | $554,679 | $921,205 |
| 2034 | $979,355 | $530,919 | $837,301 | $130,499 | $530,919 | $837,301 |
| 2035 | $877,653 | $452,665 | $862,904 | $116,947 | $452,665 | $862,904 |
| 2036 | $719,616 | $347,046 | $665,071 | $95,889 | $347,046 | $665,071 |
| Total | $542,965 | $415,961 | $797,051 | $0 | $0 | $0 |

*Sources: Guidehouse analysis of projections provided by the Connecticut Green Bank, Eversource, and UI for years 2024-2036. Administrative costs in 2022 and 2023 are actual costs. Forward-looking estimates (2025 and on) are subject to change since the Program Administrators are soliciting bids from DERMS vendors for a new 3-year contract.*

**Peak Reduction**– Guidehouse updated the average max expected peak reduction for residential systems in the BCA only (not for the C&I systems). The 2022-2024 program evaluation metrics led Guidehouse to reduce the prospective assumption for typical residential peak reduction for residential energy storage systems. Guidehouse evaluated the performance of participating systems during active and passive windows concurrent with the ISO-NE daily peak. These values are shown in Table 5-5. Due to the high number of residential non-participants during both active and passive events, as seen in Table 4-1, Table 4-2, and Table 4-4, the estimates for prospective performance are higher than observed performance. For this reason, we relied on participant-only performance to avoid negatively biasing the assumed future performance due to reported temporary technical constraints limiting 2023 performance by some battery partners. Guidehouse assumes that issues resulting in a device's complete non-participation – an average power greater than or equal to zero during an event window (i.e., no dispatch or mostly charging) – will be largely resolved in future program years and should therefore be excluded from analysis to estimate future performance. No adjustments were made to C&I estimates due to the small number of participants to date.

**Table 5-5. ESS Specifications – Average System Max Expected Peak Reduction[1]**

| | Residential Standard | Residential Underserved | Residential Low-Income | Small C&I | Medium C&I | Large C&I |
|---|---|---|---|---|---|---|
| Passive Dispatch Backup Reserve | 50% | 50% | 50% | 20% | 20% | 20% |
| Passive Max Expected Peak Reduction | 73% | 73% | 73% | 80% | 80% | 80% |
| Active Max Expected Peak Reduction | 116% | 116% | 116% | 80% | 80% | 80% |

1. Prospective assumption for average system size and installed cost (applied to projected 2024-2027 systems).
*Source: Guidehouse analysis of program tracking data provided by the Connecticut Green Bank*

**System Size and Cost** – Guidehouse did not update the average system size or cost for residential or C&I systems in the BCA. Guidehouse also chose to maintain the prospective assumption for typical energy storage system sizes and installed costs last modified in the ESS Year 2 annual evaluation due to the change in program size and cost assumptions being very recent. These values are shown in Table 5-6. The assumed size of residential systems and average installed costs have not been updated based on the average of residential applications; the capacity and cost of the hybrid project as allocated to residential customers, as described in Section 3.1.5, is not reflected in the new residential averages.

**Table 5-6. ESS Specifications – Average System Size and Installed Cost[1]**

| Item | Residential | Small C&I | Medium C&I | Large C&I |
|---|---|---|---|---|
| ESS kW | 8.1 | 200 | 500 | 1,000 |
| ESS kWh | 18.5 | 540 | 1,350 | 2,700 |
| Installed Cost ($) | $27,750 | $432,000 | $978,750 | $1,755,000 |

1. Prospective assumption for average system size and installed cost (applied to projected 2024-2027 systems).
*Source: Guidehouse analysis of program tracking data provided by the Connecticut Green Bank*

**Avoided Costs** – Guidehouse updated the avoided costs assumed in the BCA for the years 2025, 2026, and 2027 due to the release of Synapse Energy's AESC 2024 in February 2024.

Table 5-7 includes the estimates and input selections used from both the latest AESC released in February 2024 (2024 AESC) in addition to the AESC released in 2021 (2021 AESC). The 2024 AESC is used only to monetize the estimated energy system benefits associated with program installs in 2025, 2026, and 2027. In prior evaluations, the ESS program evaluated cost-effectiveness using counterfactual one in the 2021 AESC for systems installed 2022-2027; however, given the availability of updated avoided cost estimates, the BCA uses both the 2021 AESC under counterfactual one and the 2024 AESC under counterfactual one and counterfactual six. Guidehouse continues to use the 2021 AESC for systems installed in 2021-2024, because due to its release in 2024, the 2024 AESC only provides avoided cost estimates for systems installed in 2024 and onwards.

In addition to updated avoided cost estimates, the 2024 AESC introduces two new counterfactuals not present in the 2021 AESC, counterfactual five and counterfactual six, the latter of which was designed uniquely to model the impacts of behind the meter storage. In this evaluation, results are presented using both 2024 AESC counterfactual one – for consistency

with prior evaluations – as well as 2024 AESC counterfactual six, given its much closer applicability to a behind the meter storage program like ESS.

Table 5-7 lists the avoided costs sources used by the benefit-cost model to monetize program utility system benefits.

Table 5-7 includes the estimates and input selections used from both the latest AESC released in February 2024 (2024 AESC) in addition to the AESC released in 2021 (2021 AESC). The 2024 AESC is used only to monetize the estimated energy system benefits associated with program installs in 2025, 2026, and 2027. In prior evaluations, the ESS program evaluated cost-effectiveness using counterfactual one in the 2021 AESC for systems installed 2022-2027; however, given the availability of updated avoided cost estimates, the BCA uses both the 2021 AESC under counterfactual one and the 2024 AESC under counterfactual one and counterfactual six. Guidehouse continues to use the 2021 AESC for systems installed in 2021-2024, because due to its release in 2024, the 2024 AESC only provides avoided cost estimates for systems installed in 2024 and onwards.

In addition to updated avoided cost estimates, the 2024 AESC introduces two new counterfactuals not present in the 2021 AESC, counterfactual five and counterfactual six, the latter of which was designed uniquely to model the impacts of behind the meter storage. In this evaluation, results are presented using both 2024 AESC counterfactual one – for consistency with prior evaluations – as well as 2024 AESC counterfactual six, given its much closer applicability to a behind the meter storage program like ESS.

**Table 5-7. Sources of Avoided Costs used in the BCA**

<table>
<tr><th>Utility System Benefit Category</th><th colspan="2">Avoided Cost Source(s)</th></tr>
<tr><td>Avoided Energy<br>Avoided Generation Capacity<br>Avoided Pooled Transmission Facilities<br>Reliability<br>Intrastate DRIPE Energy<br>Rest-of-Pool DRIPE Energy<br>Intrastate DRIPE Capacity<br>Rest-of-Pool DRIPE Capacity<br>Intrastate Cross-DRIPE<br>Rest-of-Pool Cross-DRIPE<br>Non-Embedded Emissions</td><td>2021 AESC: AppdxB of “AESC 2021 User Interface – CF1.xlsb,”<br><br>Updated August 30, 2021, available here: https://www.synapse-energy.com/project/aesc-2021-materials.<br><br>Input selections:<br>• Connecticut<br>• Counterfactual #1<br>• Default presets<br>• New England MAC (electric sector) GHG cost basis<br>• 8% wholesale risk premium<br>• 9% energy losses<br>• 16% peak demand losses<br>• $73 value of lost load<br>• 2% inflation rate</td><td>2024 AESC: AppdxB of “AESC 2021 User Interface – CF1.xlsb,” and “AESC 2021 User Interface – CF6.xlsb,”<br><br>Updated February 7, 2024, available here: https://www.synapse-energy.com/aesc-2024-materials.<br><br>Input selections:<br>• Connecticut<br>• Counterfactual #1 and #6<br>• Default presets<br>• New England MAC (electric sector) GHG cost basis<br>• 8% wholesale risk premium<br>• 9% energy losses<br>• 16% peak demand losses<br>• $61 value of lost load<br>• 2.25% inflation rate</td></tr>
<tr><td>Avoided Transmission Capacity<br>Avoided Distribution Capacity</td><td colspan="2">2022-24 Connecticut Conservation & Load Management Plan: Figure 5-A of “Final 2022 2024 Plan to EEB (9-2-21).pdf,” available here: https://app.box.com/s/43qlddtxd0cxg4z9z4iaon4k0fc1utbh</td></tr>
</table>

*Source: As identified by Guidehouse in Connecticut Green Bank 17-12-03RE03 Order 7 compliance refile under Docket 21-08-05, 10/4/2021*

## 5.3 BCA Metrics

This section presents overall program, residential, and C&I results for six cost-effectiveness metrics[31] calculated by the benefit-cost model for the 2022-2024 program cycle.

Figure 5-1 and Figure 5-2 show results for the overall program. Assuming counterfactual one within the 2024 AESC, the RIM is now below the 1.4 target, and the PCT remains below 1. However, assuming counterfactual six, utility benefits are significantly greater, causing the RIM to go well above the 1.4 target. Utility benefits are not an element of the PCT, and for this reason, the PCT remains below one under either counterfactual.

As described in the year two evaluation, the PACT and CTET are essentially the same at the program level given that benefits from reduced arrearages benefits are assumed to be negligible, and that greenhouse gas emissions are estimated to have a minor. For the same reasons, the SCT and TRC are essentially the same as well.

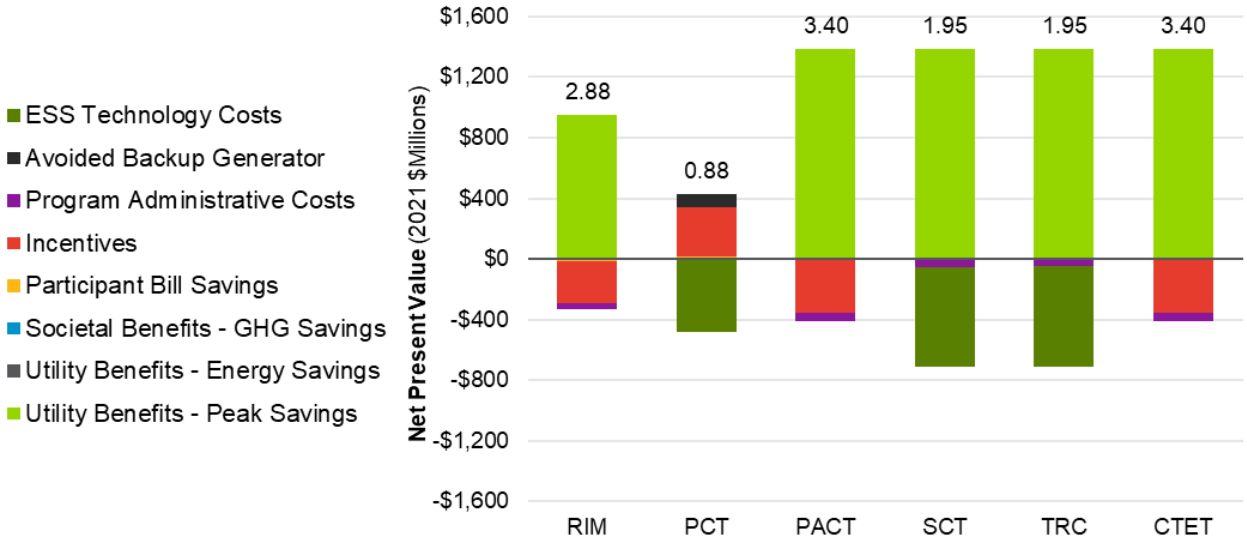
**Figure 5-1. Overall Program BCA Results using AESC 2024 Counterfactual One**




*Source: Guidehouse analysis*

[31] See Table 5-1 for cost test definitions.

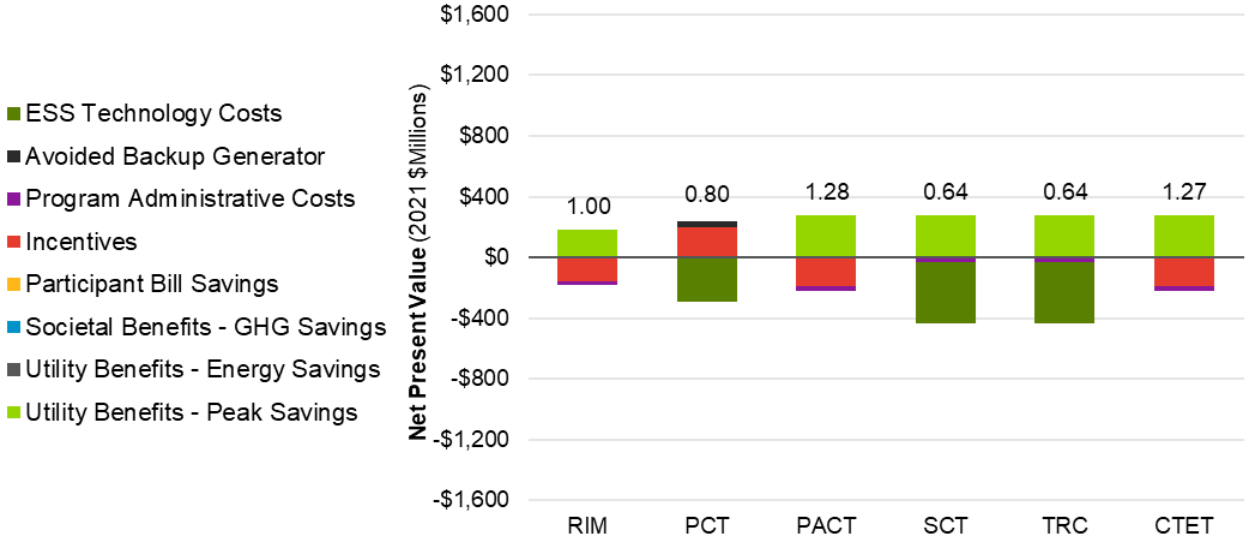
**Figure 5-2. Overall Program BCA Results using AESC 2024 Counterfactual Six**




*Source: Guidehouse analysis*

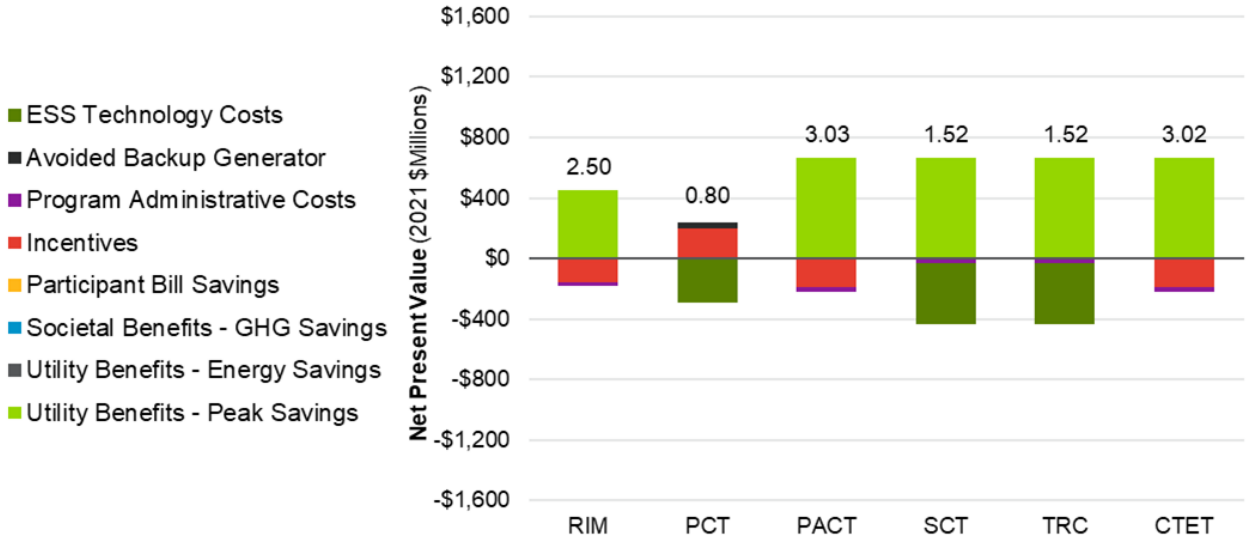
Figure 5-3 and Figure 5-4 show BCA results for the residential portion of the program. As in Figure 5-1, Figure 5-2, and Figure 5-3, assuming counterfactual one within the 2024 AESC, the residential RIM is now below the 1.4 target, and the PCT remains below 1, while the RIM under counterfactual six is above 1.4. Additionally, the residential BCA is below the program-wide BCA for all evaluated ratios, indicating that the residential program is driving down overall metrics.

**Figure 5-3. Residential Program BCA Results using AESC 2024 Counterfactual One**




*Source: Guidehouse analysis*

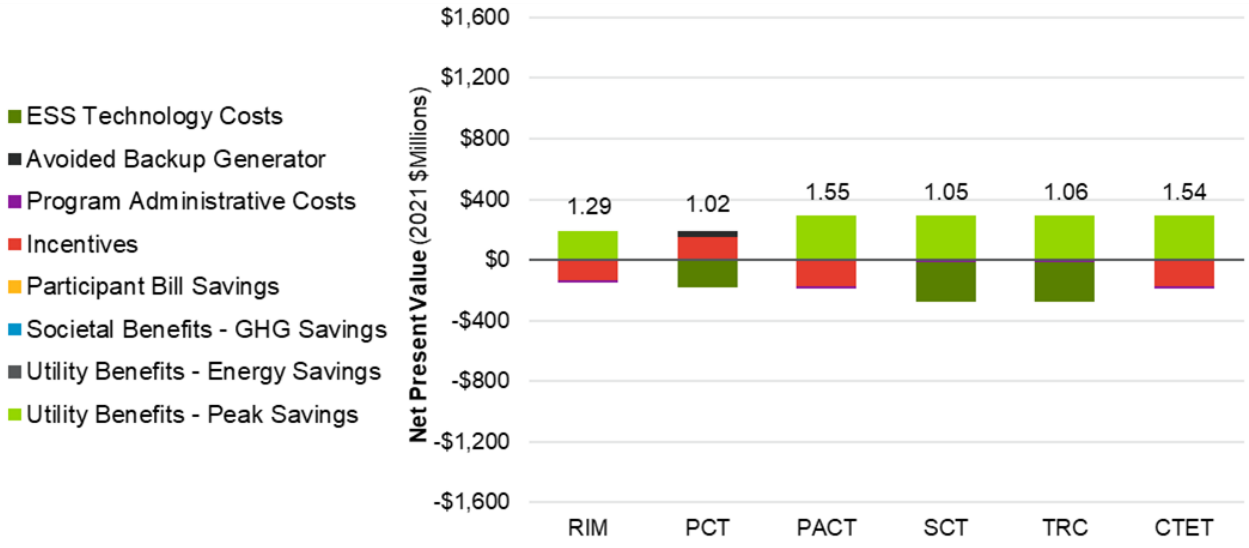
**Figure 5-4. Residential Program BCA Results using AESC 2024 Counterfactual Six**




*Source: Guidehouse analysis*

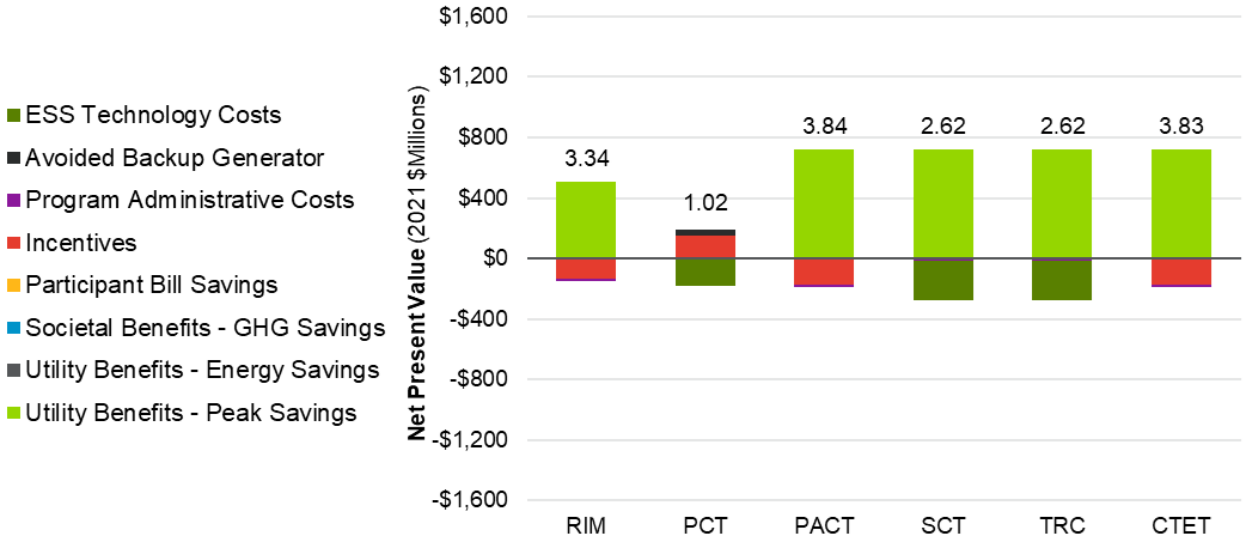
Figure 5-5 and Figure 5-6 show results for the C&I program. In line with the program-wide and residential RIM, using counterfactual one, the RIM is below the 1.4 target, while under counterfactual six, the RIM is above 1.4. The C&I PCT, however, differs from the program-wide and residential PCTs, in that the C&I PCT is slightly greater than one. The RIM of 1.29 and PCT of 1.02 indicate that the C&I benefit-cost results are much closer to cost-effectiveness targets than residential or program-wide results.

**Figure 5-5. C&I Program BCA Results using AESC 2024 Counterfactual One**




*Source: Guidehouse analysis*

**Figure 5-6. C&I Program BCA Results using AESC 2024 Counterfactual Six**




*Source: Guidehouse analysis*

## 5.4 Findings and Recommendations

This section discusses findings and recommendations from the BCA. Of note, the program is still in its first three-year cycle, and participation is relatively low for both its residential and C&I components. Therefore, this BCA represents mostly prospective data constructed using assumptions informed by the evaluated data. As additional evaluated data become available, the accuracy of prospective assumptions will improve, and the proportion of "actuals" within the BCA will increase.

**Table 5-8. BCA Findings and Recommendations**

| Finding | Recommendation |
|---|---|
| Even when controlling for the counterfactuals, (i.e., using counterfactual one from both the 2021 and 2024 AESC), prospective BCA results are markedly different after updating the BCA to include the 2024 AESC for systems installed in 2025-2027. The 2024 AESC included significant updates from the prior iteration and is a more up-to date source for prospective avoided cost assumptions such avoided energy and avoided generation capacity. The 2021 AESC is required to supplement the 2024 AESC because the 2024 AESC does not provide estimates for systems installed prior to 2024. | Guidehouse recommends that Program Administrators consider using the 2024 AESC to model cost-effectiveness for systems installed in 2025-2027 but continue to use the 2021 AESC to model cost-effectiveness for systems installed in 2022-2024. |
| The overall program and residential BCA results vary significantly when modeled using either AESC counterfactual one or six, with counterfactual one modeling below program targets, and counterfactual six modeling significantly above program targets.<br>Counterfactual six was not yet available at the time in which counterfactual one was chosen; however, counterfactual six is ideal for an evaluation of an energy storage program such as ESS, as explained in Section 5.2. | Guidehouse recommends that Program Administrators consider adopting counterfactual six for ESS program evaluation going forward. |
| Under counterfactual six, the overall program, residential, and C&I RIMs (at 2.88, 2.50, and 3.34 respectively) are all significantly higher than the prior BCA iterations. However, the program-wide and residential PCTs are below one (0.88 and 0.80 respectively). | If counterfactual six is adopted, Guidehouse recommends that Program Administrators consider increasing incentive levels given high RIM and low PCT values. Program Administrators should continue to monitor residential and C&I program RIM and PCT in tandem with periodic evaluations of incentive levels. |
| Given continued limited enrollment, BCA estimates remain primarily based on “prospective” enrollment as opposed to actuals. Based on this fact, estimates are primarily reliant on a high number of assumed installs in 2024-2027, which carries some risk for actual BCA. | N/A |

*Source: Guidehouse analysis*

# 6. Residential Enrollment Barriers Research

## 6.1 Research Background and Summary

As shown in Section 3, ESS has been undersubscribed relative to expected participation levels among residential customers, particularly low-income and underserved customers. Current enrollment is low relative to the program goals for this segment of 150 MW of residential storage by 2027, of which 60 MW must come from the underserved and low-income segments.

The Program Administrators suspected that several factors could be contributors to this low level of enrollment, including:

- **Rising costs of energy storage**: Since the original incentive levels were proposed, residential battery storage costs have risen significantly; currently, average installed costs for an average system size of 8 kW/19 kWh battery are around $27,000, which is significantly higher than the assumptions made during program planning (an average of 5 kW/13.5 kWh batteries at a cost of $11,000).

- **Lack of awareness:** Customers may not be aware of the ESS programs. Among other reasons, this could be due to lack of installer enthusiasm for the program due to barriers.

- **Lack of interest**: Customers may not have a need or interest in installing energy storage at this time. This could be due to the fact that they already have a backup generator or due to the lack of significant storms in the past few years and a low perceived need for backup electricity.

- **Low on priority list for LMI customers**: Energy storage, and more broadly outage resilience, may be low priority for low-income customers compared to other expenses such as food, rent, and utilities.

- **Added complications for solar installers:** Installers may not encourage customers to adopt energy storage alongside solar if it complicates the sale.

- **Siting limitations**: Due to fire code restrictions, energy storage faces challenges in siting, particularly for low-income customers, where it is more challenging to identify appropriate spaces for siting the systems on their properties.

To increase participation in the program, the Program Administrators requested that Guidehouse conduct research to better understand residential barriers to adoption. This research included two tasks:

1. Interviews with installers to better understand barriers to selling energy storage through the program.

2. An online survey of existing solar customers who did not enroll in the energy storage program to explore barriers, customers' interest, and willingness to pay for battery energy storage.

## 6.2 Installer Interviews

In February and March 2024, Guidehouse conducted in-depth interviews with five installers currently working in the ESS program.

### 6.2.1 Objectives and Methods

The purpose of the in-depth interviews was to learn about customer barriers from installers who have participated in the ESS program to date. In particular, the Program Administrators were hoping to learn what barriers prevent installers from encouraging or successfully enrolling customers in the program, and if they would change anything about the program.

In collaboration with the Program Administrators, Guidehouse developed a detailed interview guide comprised of 24 questions that focused on understanding installers' perspectives on barriers and challenges in the residential market, their perspectives on customer attitudes and awareness of residential storage, and participation barriers specific to low-income customers. Some installers had not worked often with low-income customers and therefore did not contribute responses to the questions specific to low-income.

The Program Administrators selected five of the most active ESS installers in the state for the interviews, which Guidehouse conducted alone in February 2024. Each interview lasted for one hour.

### 6.2.2 Interview Results

Installers provided the following insights on barriers to participation in the residential ESS program:

**Program requirements:** Installers noted several issues with the program's requirements that may contribute to low enrollment. Two installers noted that the program requirements are confusing to customers, particularly the passive dispatch requirements.

Three also voiced concerns about the claw back provision, which they found to be too onerous and at odds with customers' preferences. Since energy storage customers typically seek resilience benefits, they argued that these customers are likely to retain a large reserve and opt-out of events, which could result in a customer not meeting passive dispatch requirements.

One installer also shared that customers have also expressed concerns about degradation of the battery from participating in the program due to frequent battery cycles. Four shared that customers have similarly expressed concerns over battery availability during times of need (outages etc.) due to the external controls on dispatch imposed by the ESS program since it could reduce their resiliency benefits.

**Low customer interest:** Installers noted that customer interest is a larger barrier than customer awareness of energy storage among solar customers. Compared to solar, customers are much less interested pursuing energy storage for their homes. A few installers provided estimates that only about 6-20% of their solar customers were electing to purchase storage alongside their solar. Some shared that the customers who are most interested in storage tend to approach their installer about it, and those that do not show interest upfront are a much more difficult sell.

**Siting restrictions:** Two installers expressed concerns about siting requirements as a barrier to energy storage installation. In particular, they noted that Connecticut's fire code is quite onerous for participants and limits where they can site the battery. Low-income customers in particular face additional siting challenges due to smaller homes and space constraints.

**Customer perceptions of batteries:** Customers can also overestimate the capabilities of batteries and potentially lose interest when they learn about their limitations. For example, an installer shared that customers occasionally expect the battery to provide backup power for their entire home or for a longer duration than a typical residentially sized battery is capable of doing.

**Upfront costs:** Installers typically shared that incentives were appropriate for the program and that they did not see incentive levels as a barrier. However, in the low-income market, one installer working primarily with low-income customers shared that storage systems were almost always unaffordable for most low-income customers, regardless of the incentive level provided. However, this installer had experienced some success in enrolling low-income customers with a monthly lease offering, which enables more low-income customers to enjoy resiliency benefits without purchasing the battery outright.

**Contract complications:** While installers typically expressed interest in selling storage to as many of their solar customers as possible, one notably shared that some sales team members will often avoid offering energy storage to solar customers because it can jeopardize the sale of the solar**.** They noted that unlike solar, the storage program is more complicated, expensive, and does not provide clear energy savings.

## 6.3 Non-participants Survey

In addition to the installer interviews, Guidehouse conducted an online survey to understand barriers preventing participation in the ESS program, the role of incentives in encouraging participation, and any barriers specific to low-income customers. The survey was conducted with UI and Eversource Residential Renewable Energy Solutions (RRES) participants since 2022 who had not also participated in ESS.

A full copy of the results of non-participant survey are given in Appendix B. A summary is provided below.

### 6.3.1 Objectives and Methods

The survey sought to understand the barriers that prevent eligible customers from participating in ESS, including any barriers specific to low-income customers, as well as the influence of incentives on interest in storage installation.

In collaboration with the Program Administrators, Guidehouse designed an online survey comprised of 21 questions that covered customers' awareness and interest levels of storage and the ESS program, reasons for not participating, and willingness to pay given varying incentive levels. The survey was reviewed and approved by the Program Administrators and was fielded in March and April 2024.

Guidehouse received RRES program participation data including about 2,700 customers from UI and about 8,000 customers from Eversource. Data indicating receipt of an adder for RRES was used to assign customers to respondent categories, described below.

The team utilized the Qualtrics survey platform to conduct the survey online, sending up to three email invitations to all customers in the sample. Eighty-seven UI customers completed the survey for a 3% response rate; 286 Eversource customers completed the survey for a 4% response rate. The first 300 respondents who completed the survey received a $10 Tango e-gift card[32].

The team conducted survey analysis looking at three different respondent categories to parse out any differences in participation barriers between standard and low-income customers. Customers who received an income-eligible[33] adder or economically distressed[34] adder in the RRES data were assigned to the "Low-income/underserved" respondent group. Customers who did not receive an income-eligible adder or economically distressed adder in the RRES data were assigned to the "Standard" respondent group. The "Total" respondent group included all respondents. While the respondent groups may not exactly match ESS criteria for low-income and standard customers, these groups allowed the team to analyze the data in a meaningful way, as there were too few income-eligible respondents to analyze their data separately and draw accurate conclusions. Though not exact, these respondent groups provide insight into similar types of respondents and allow the team to answer the research questions.

### 6.3.2 Results

Survey respondents revealed the following insights on ESS program awareness, barriers to program participation, perceived benefits of storage, preferred level of incentive for participation and barriers specific to low-income customers:

**Program awareness:** Approximately three-quarters of the total respondents were aware they could install storage at the time of their solar installation. However only one-quarter of respondents aware they could install storage reported that they were aware of the ESS program at the time of their solar installation.

Half of respondents who were aware of ESS received information on ESS from their solar installer; 70% of low-income/ underserved respondents of the same group received this information from their solar installer. It was also noted that low-income/underserved respondents reported they were unaware they could install storage at the time of their solar installation more frequently than standard respondents.

**Perceived benefits of storage:** About half of the total respondents cited backup power and resilience as the most important reason to install storage, followed by reduced reliance on a utility provider and energy independence. Low-income/underserved respondents more frequently sited reduced reliance on a utility provider / energy independence and carbon emission reduction / environmental benefits than did standard respondents as the most important reason to install storage. Several respondents noted that fossil fuel generators currently better served their needs and were a more cost-effective alternative to battery storage.

[32] The language explaining the potential to receive an e-gift card and the question collecting contact information for the e-gift card were both removed once the survey reached 300 completes. This language was replaced with a note at the beginning of the survey indicating all e-gift cards had been claimed, but customers were still welcome to complete the survey.

[33] Income-eligible is defined as customers with incomes that are 60% of or below state median income.

[34] Economically distressed is defined as customers living in designed economically distressed municipalities as defined by the CT Department of Economic Community Development.

**Barriers to participation:** When asked to rate their interest in installing storage, standard respondents reported a similar level of interest (5.2 rating out of 10) to low-income/underserved respondents (5.7 rating out of 10).

A majority (59%) of respondents who were aware of energy storage but did not install it at the time of their solar installation most frequently noted cost as their biggest barrier to participation. Some respondents (14%) noted that other technologies currently better suited their needs, and some respondents (12%) did not see the benefits of storage. A majority (62%) of low-income/underserved respondents without storage currently installed indicated the most important reason not to install storage was cost.

**Preferred payment level and structure:** On average, respondents who would consider installing storage in the future reported the highest upfront cost they would be willing to pay for storage to be about $3,300 for total respondents, $2,000 for low-income/underserved respondents, and $3,600 for standard respondents. The same group of respondents reported the highest monthly price they would be willing to pay monthly to lease storage to be about $45 on average for all respondent categories[35]. Standard and low-income/underserved respondents reported a difference in preferred payment structure; over half (59%) of the low-income/underserved respondents who would consider installing storage in the future would prefer paying monthly to lease storage, while over half (60%) of standard respondents of the same group would prefer paying upfront to own the storage.

[35] The averages described here include all submitted responses, including $0 responses. If $0 responses are excluded from the analysis, the averages increase. The average highest upfront cost increases to about $3,800 for total respondents, $2,600 for low-income/underserved respondents, and $4,100 for standard respondents. The average highest monthly cost increases to $70 for total respondents, $64 for low-income/underserved respondents, and $71 for standard respondents.

## 6.4 Key Takeaways and Recommendations

**Table 6-1. Research Findings and Recommendations for Standard Customers**

| Findings | Recommendations |
|---|---|
| **Low Awareness of the ESS Program:** | |
| About three-quarters of respondents were aware they could install storage at the time of their solar installation, while only about one-quarter of those respondents were aware of the ESS program. Moreover, responses revealed that installers do not always share information about the program with them. | Work with installers to ensure that all provide information on ESS to RRES customers.<br><br>Consider including additional education on the program through the RRES solar program application or bonus incentives for participation in both programs. |
| Low-income/underserved respondents reported that they were unaware they could install storage at the time of their solar installation more frequently than standard customers. | Send follow-up emails to RRES solar program participants that did not participate to provide education about and gauge interest in storage. |
| The installer interviews revealed that some contractors may be hesitant to push solar customers to sign up for energy storage since it can complicate the contract closing. | |
| **Low Customer Interest Levels** | |
| The installer interviews found that a low percentage of solar customers are interested in purchasing storage. The survey similarly revealed that customer interest was fairly low among standard solar respondents (5.2 rating out of 10). Low-income/underserved respondents reported a similar level of interest in installing storage (5.7 rating out of 10). | Review and consider updating program materials to highlight the backup power and resiliency benefits of storage, particularly its benefits over fossil fuel generators such as environmental benefits, while providing education on storage safety and acknowledging the limitations of energy storage technology. |
| When asked what would be the most important benefit of installing energy storage, most respondents mentioned backup power and resilience, as well as reduced reliance on a utility provider. | Work with solar installers to make sure they provide adequate program information to low-income/underserved customers. Consider offering bonus incentives for installers that sign up low-income customers for RRES and ESS. |
| **Storage Cost is the Largest Barrier:** | |
| The survey revealed that cost was the most important reason that customers chose not to install storage. On average, standard respondents reported the highest upfront cost they would be willing to pay for storage to be about $3,300 upfront or $45 monthly.<br>Costs are an even larger barrier for low-income/underserved customers, who reported that the highest they would be willing to pay for energy storage would be about $2,000 upfront. | Provide potential participants resources or low-interest loan offerings to reduce the upfront cost of storage installation to about $3,000.<br><br>Ensure customers, particularly low-income/underserved customers, are aware of any leasing options available through certain installers and refer those interested. |
| Low-income respondents reported they would prefer paying monthly to lease the storage than paying upfront to own the storage. | |

# 7. Key Findings and Recommendations

## 7.1 Key Findings

This report reviews the progress of the ESS program from its inception through March 31, 2024. The metrics illustrate that the program has continued to have slow uptake in the first three years relative to the targets set by PURA, especially for the residential sector. While completed systems remain well below target for both residential and C&I programs, approved C&I projects surpass the 2022-2024 capacity goal suggesting significant program progress in the coming years.

Due to the limited number of operational storage systems, especially in the early years of this program cycle, the evaluation findings are primarily driven by performance in the summer 2023 and winter 2023-2024 seasons, during which there was a large uptick in operational systems enrolled in the program. Therefore, the findings presented in this report may not be entirely reflective of the future market or metrics for the program.

General takeaways from this analysis include:

- The program continues to track below its installed capacity target for the first three-year cycle for both residential and C&I projects. The capacity of approved C&I projects, however, surpasses the program goal of 50 MW for completion in the coming years.

- The share of low-income and underserved participants is in line with the 40% target as a percentage of residential projects, making up 41% of residential participants. While the share of low-income and underserved as a percentage of expected installed capacity is low at 32% of residential capacity relative to the 40% target. Within low-income and underserved targets, low-income participation is below the 10% target, with only about 1% of residential participation and capacity from low-income.

- Energy storage systems connected to DERMS participated in an average of 74% of summer season active events and 79% of winter season active events throughout the evaluation period. However, these systems did not perform optimally in either season, dispatching on average 47% of the maximum expected energy during the three-hour event windows in summer season and 41% in winter season, even though in both seasons nearly 100% of energy was available on average at the start of the event.

- No active events were called in June during either summer season, and the majority of active events for the summer 2023 season were called in July. The ISO-NE peaks for 2022 and 2023 also occurred in August and September, respectively.

- Average passive event participation varied greatly in the summer 2023 season, ranging from 40% to 95% of systems participating with an average of 75% participation per event for the season. Average power dispatched during these events was similarly varied with a slightly higher average than active events at 53% of available maximum power dispatched. This figure is well below the program target of 80% of available power dispatched. No systems met the desired 90% dispatch requirement in the first passive dispatch season.

- The overall program and residential BCA results vary significantly when modeled using either AESC counterfactual one or six, with counterfactual one modeling below program targets, and counterfactual six modeling significantly above program targets. Under counterfactual six, the overall program, residential, and C&I RIMs (at 2.88, 2.50, and 3.34 respectively) are all significantly higher than the 1.4 RIM target.

- Given continued limited enrollment, the BCA is largely driven by "prospective" expected future enrollment and a high number of assumed installs in 2024-2027, which carries some risk for the future BCA if these installs are not realized.

- Almost three-quarters of respondents were aware they could install storage at the time of their solar installation; however, only about one-quarter of survey respondents were aware of the ESS program. Moreover, survey responses revealed that installers do not always share information about ESS, which was further corroborated by installer interviews revealing that some contractors are hesitant to push storage install because it can complicate contract closing.

- Low-income/underserved customers reported more often than standard customers they were unaware they could install storage alongside their solar installation. However, they did report a higher level of interest in installing storage than standard solar respondents, citing backup power and resilience and reduced reliance on a utility provider as their main reasons for interest in energy storage.

- Cost was the most important factor in a respondents' choice not to install storage. On average, standard respondents reported the highest upfront cost they would be willing to pay for storage to be about $3,300 upfront or $45 monthly. Costs are an even larger barrier for low-income customers, who reported that the highest they would be willing to pay for energy storage would be $2,000 upfront. Low-income respondents reported they would prefer paying monthly (also an average of $45 monthly like standard customers) to lease the storage than paying upfront to own the storage.

- The residential survey research also revealed some customers and installers believe the passive dispatch requirement (in particular the claw back mechanism) is onerous and therefore could be a barrier to enrollment.

## 7.2 Recommendations

For the 2025-2027 program cycle, Program Administrators should consider the following recommendations to increase enrollment and improve both passive and active event performance:

- In advance of the next three-year cycle, the DERMS provider, Program Administrators, and the evaluator should discuss roles and responsibilities to ensure an efficient and quick data request process. Additionally, all parties should consider centralizing data transfer as much as possible, with as much data coming from one source as is feasible to minimize the need for mapping files which maximizes the amount of data included in the analysis. Maximizing the amount of data included in each evaluation ensures performance is accurately captured in the year end evaluation and maximizes potential performance and impacts of participating systems.

- Program Administrators should consider requesting and reviewing data from partners frequently throughout the season to enable identification and resolution of data issues more quickly. More frequent data transfer and review enables all parties to address potential performance issues more quickly than a single end of season transfer, which in turn can improve overall performance.

- For the C&I sector, Program Administrators should consider any coordination or facilitation that could smooth the transition of projects from “Approved” to “Completed.”

- For the residential sector, Program Administrators should consider increasing incentives to increase enrollment, especially for low-income participants where enrollment to date is significantly below target. Multifamily affordable housing could be an avenue for increasing low-income participation.

- Aside from raising incentives, another option for increasing residential enrollment would be for Program Administrators to consider providing customers with more information on low-interest loans available to help reduce the upfront cost burden. Based on the research findings, we would also recommend providing customers with more information on the resiliency benefits of energy storage.

- To improve both passive and active event participation, Program Administrators should consider extending the passive season through September to align with the active season and better coincide with seasonal peaks.

- Program Administrators should continue conversations with battery manufacturers around uniform dispatch capabilities and backup reserve settings that may prevent battery systems from responding to active events when called. More frequent audits (i.e., – mid-season or monthly) of battery interval data could also reveal issues with participation before the season is over.

- Program Administrators should further investigate barriers to passive event participation and confirm with battery manufacturers whether battery storage systems enrolled in the program can comply with the 90% passive dispatch requirement. Based on these issues, as well as the earlier discussed research findings revealing the passive dispatch requirements to be a potential enrollment barrier, Program Administrators could consider modifications to the program’s current claw back provision until the passive event compliance issues are better understood. The Program Administrators could consider a grace period in which participants are not subject to claw back until their second or third summer in the program, which would allow time for adjusting battery settings to meet the passive dispatch requirements and ease the concerns of potential participants.

- Accounting for the potential adoption of counterfactual six and use of 2024 AESC to model cost-effectiveness for systems installed in 2025-2027, Program Administrators should consider increasing incentive levels given resulting high RIM and low PCT values and should continue to monitor residential and C&I program RIM and PCT in tandem with periodic evaluations of incentive levels to determine if further changes would be needed.

# Appendix A. Data Fields for Program Tracking Metrics

Table A-1 and Table A-2 include the data fields that the Connecticut Green Bank uses to track programmatic data on the storage systems evaluated in this report. Guidehouse used the fields in Table A-1 to compile and segment the data tables in Section 3.

**Table A-1. Data Fields Used for Program Tracking Metrics**

| Table # | Data Fields for Storage Systems Used in Metrics Evaluation |
|---|---|
| Table 3-2 displays the number of energy storage system participants, and percentage of the total, segmented by utility and customer type. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status |
| Table 3-3 displays the percentage of residential customers receiving upfront incentives by installed capacity and by number of participants. This table is intended to show the program's progress toward the goal of 40% (Justice 40 targets) low-income or underserved customers. | Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total Nameplate Capacity per Participant ID [kW] |
| Table 3-4 displays the percentage of qualified participants and installed capacity planning to bid into the FCM, as well as the percentage that is not qualified. | EDC<br>Rate Class<br>Sector<br>Total Nameplate Capacity per Participant ID [kW]<br>FCM Participant |
| Table 3-5 displays the count and percentage of approved applicants across applicants of all statuses | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status |
| Table 3-6 displays the average number of days between the original submitted date and approval date for applicants segmented by utility and customer type. | EDC<br>Rate Class<br>Sector<br>Original Submitted Date<br>Approval Date |
| Table 3-7 displays the percentage of participants, systems, and kWh paired with PV, segmented by utility and customer type | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Quantity<br>Total System Energy Capacity [kWh]<br>PV-Paired |
| Table 3-8 shows nameplate storage system capacity segmented by utility, customer type, and application status. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total Nameplate Capacity per Participant ID [kW] |

| Table # | Data Fields for Storage Systems Used in Metrics Evaluation |
|---|---|
| Table 3-9 shows capacity (rated energy) in kWh segmented by utility, customer type, and application status. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total System Energy Capacity [kWh] |
| Table 3-10 displays the average system size (in kW and kWh) for approved systems, segmented by utility and customer type. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total Nameplate Capacity per Participant ID [kW]<br>Total System Energy Capacity [kWh] |
| Table 3-11 shows the number of systems and participants by make and model. | Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Quantity<br>Manufacturer<br>Model Number |
| Table 3-12 displays the number of approved or completed applications by contractor | Sector<br>Enrollment Status<br>Quantity<br>Contractor |
| Table 3-13 displays the program administrative costs | N/A |
| Table 3-14 displays the upfront incentives encumbered by project status, segmented by utility and customer type. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Upfront Incentive Disbursed or To-Be Disbursed [$] |
| Table 3-15 displays the average upfront incentive for applicants segmented by utility and customer type. | EC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Upfront Incentive Disbursed or To-Be Disbursed [$] |
| Table 3-16 displays the average project cost per participant segmented by utility and customer type. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total Installed Project Cost [$] |
| Table 3-17 displays the total project cost per participant segmented by utility and customer type. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total Installed Project Cost [$] |

| Table # | Data Fields for Storage Systems Used in Metrics Evaluation |
|---|---|
| Table 3-18 shows average energy storage costs by kW and kWh by customer type and application status. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total Nameplate Capacity per Participant ID [kW]<br>Total System Energy Capacity [kWh]<br>Total Installed Project Cost [$] |
| Table 3-19 shows average battery costs by kW and kWh by customer type and application status. | EDC<br>Rate Class<br>Sector<br>Low-Income<br>Underserved<br>Enrollment Status<br>Total Nameplate Capacity per Participant ID [kW]<br>Total System Energy Capacity [kWh]<br>Batteries/Storage Cost [$] |

*Source: Enrollment data from the Connecticut Green Bank*

The Connecticut Green Bank tracks the following storage system data fields:

**Table A-2: Data Filed for Storage Systems Tracked by Connecticut Green Bank**

| Tracked Data Fields for Storage Systems[1] | | |
|---|---|---|
| **Project Identification** | **DERMS ID**<br>Program Dispatch<br>**Project Name**<br>Project-System Name<br>Summary Enrollment Status | **Enrollment Status**<br>**EDC**<br>Rate Code<br>**Rate Class**<br>**Utility Account Number** |
| **Customer Characteristics** | Participant Name / Business Name<br>Host Phone<br>Host Email Address<br>Host Contact Person<br>Host Street<br>Host City<br>Host State<br>Host Zip<br>Program Dispatch<br>**Multifamily** | **Low-Income**<br>**Underserved**<br>Multifamily Affordable Housing<br>Critical Facilities<br>**FCM Participant**<br>Grid Edge<br>Small Business<br>**Sector**<br>Segment<br>Residential Sector |
| **System Characteristics** | Preexisting Storage System<br>**Total Nameplate Capacity per Participant ID [kW]**<br>**Total System Energy Capacity [kWh]**<br>Total System Max Cont Discharge Rate [kW]<br>Total System Quantity<br>**Quantity**<br>Record Type Value<br>Default Record Type<br>**Manufacturer** | **Model Number**<br>Rated Round-trip Efficiency [%] Nameplate Capacity per Storage System [kW]<br>Rated Energy per Storage System [kWh]<br>Maximum Continuous Discharge Rate<br>Installed Location<br>**PV-Paired**<br>Paired PV System Size<br>**Contractor Name** |
| **System Costs Details** | **Upfront Incentive Disbursed or To-Be Disbursed [$]**<br>**Total Installed Project Cost [$]**<br>Balance of System Costs [$]<br>**Batteries/Storage Costs [$]**<br>Engineering and Design Costs [$]<br>Installation Labor Costs [$] | Interconnection Costs [$]<br>Inverter Costs [$]<br>Monitoring Costs [$]<br>Permitting Costs [$]<br>Solar PV/inverter(s) Costs [$]<br>Incentive Step |
| **Updates** | Created Date<br>Application Date<br>**Original Submitted Date**<br>**Approval Date** | Utility Approval to Energize Date<br>**Completed Date**<br>**Verified Connection to DERMS**<br>Payment Issued |

**1.** Data fields used for evaluation metrics indicated in **bold.**

*Source: Enrollment data from the Connecticut Green Bank*

# Appendix B. ESS Non-participants Survey Results


Guidehouse
Energy Storage Solutions
2024 Non-participants Survey Results
June 10, 2024

# Agenda

01
**Survey Overview**

02
**Technology Perceptions and Awareness**

03
**Program Perceptions and Awareness**

04
**Incentives**

05
**Potential Next Steps**

# Survey Overview

## Approach and Methodology

# Approach

**Survey Mode**
Guidehouse administered the survey online.



**Survey Timeframe**
The survey was fielded 3/28/2024 to 4/16/2024.

**Eversource Responses**
286 Eversource customers completed the survey for a 4% response rate.

**United Illuminating Responses**
87 UI customers completed the survey for a 3% response rate.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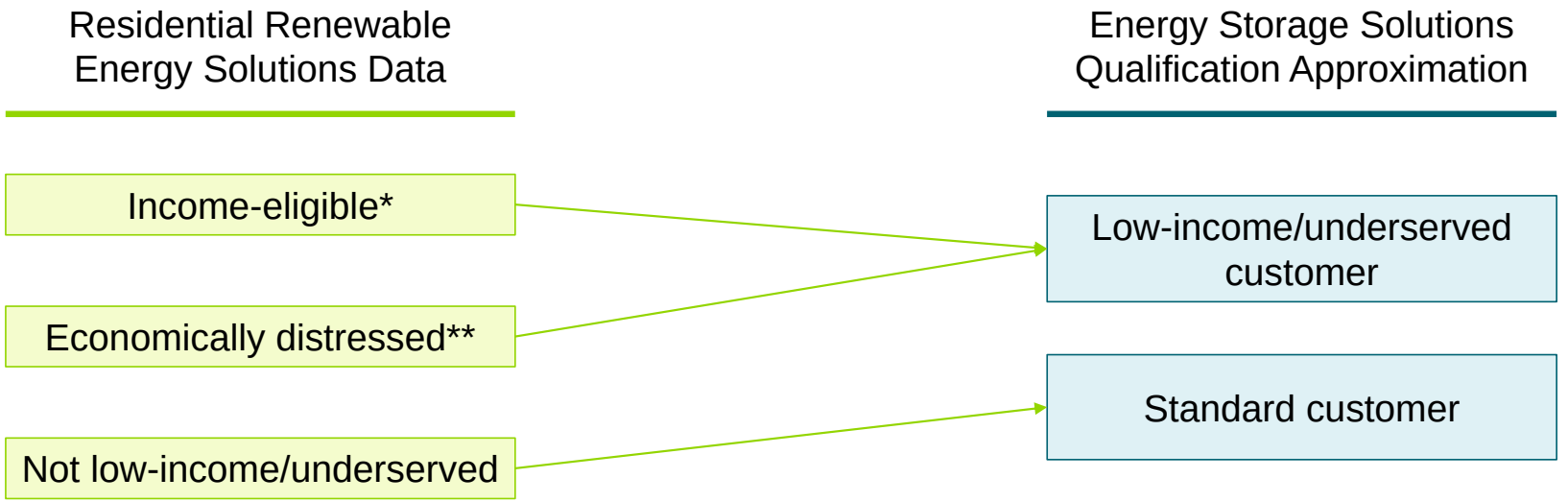
# RRES to ESS Income Category Mapping




*Income-eligible*: customers with incomes that are 60% of or below state median income
***Economically distressed*: customers living in designed economically distressed municipalities as defined by the CT department of economic and community development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# Research Questions and Key Takeaways



**What barriers are preventing eligible residential customers from participating in ESS?**

- **Costs:** Respondents indicated that energy storage is too cost prohibitive.
- **Program awareness:** Most respondents are aware of energy storage, but most do not know about the Energy Storage Solutions program.



**Are there barriers specific to low-income customers?**

- **Technology awareness:** Low-income/underserved respondents were less aware than standard customers they could install storage at their homes.



**Can incentives be used to overcome these barriers, and how will customers respond to different levels in incentives?**

- Respondents report a low likeliness to install storage if the upfront cost is $15,000 (1.4 out of 10), with only a moderate increase in likeliness to install at $11,000 (1.8 out of 10).



**At what level of incentive are standard and low-income customers willing to participate?**

- **Upfront cost:** Standard respondents are willing to pay **$3,600 upfront**, on average.
- **Upfront cost:** Low-income respondents are willing to pay **$2,000 upfront**, on average.


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# Technology Perceptions and Awareness

## Findings and Discussion


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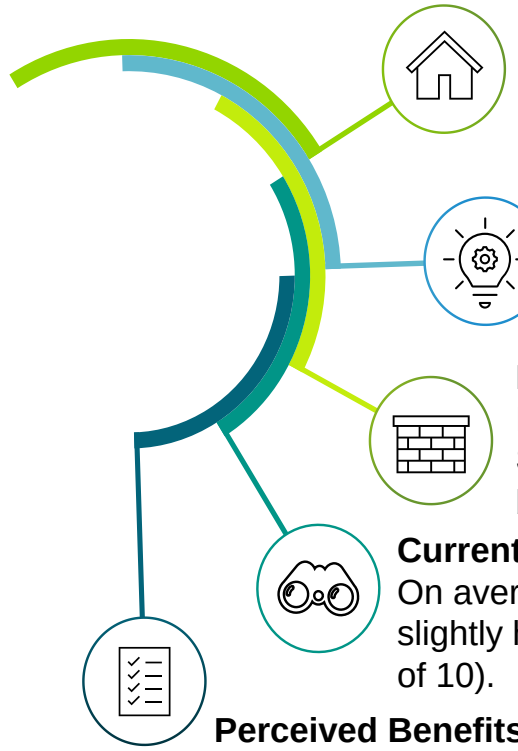
# Technology Perceptions and Awareness Overview



**Customers with Installed Storage**
Twelve percent of respondents currently have storage installed. Most who installed storage did so at or about the same time as solar.

**Storage Technology Awareness**
Most respondents (74%) without storage currently installed were aware of the technology at the time of their solar installation.

**Barriers to Adoption**
Respondents without storage installed are held back most frequently by cost (59%). Some find other technologies better suit their needs (14%), and some don't see the benefit of storage (12%).

**Current Interest**
On average, low-income/underserved respondents without storage currently installed reported a slightly higher interest in installing storage (5.7 out of 10) than did standard respondents (5.2 out of 10).

**Perceived Benefits of Storage**
About half of respondents (48%) sited back-up power / resilience as the most important reason to install storage.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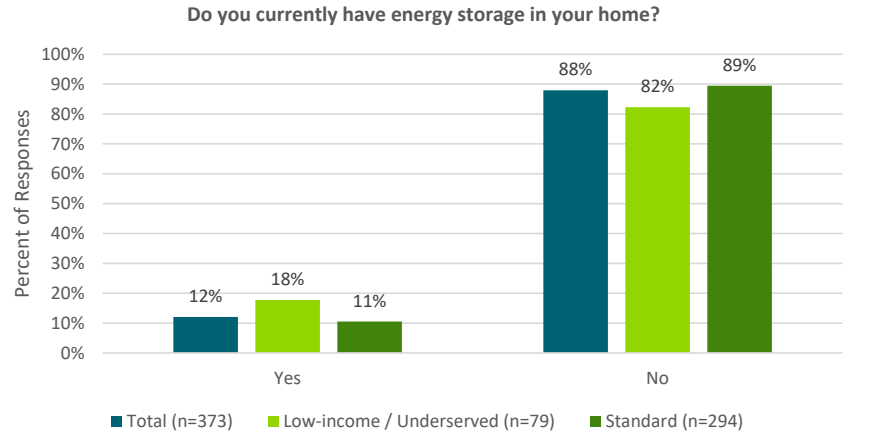
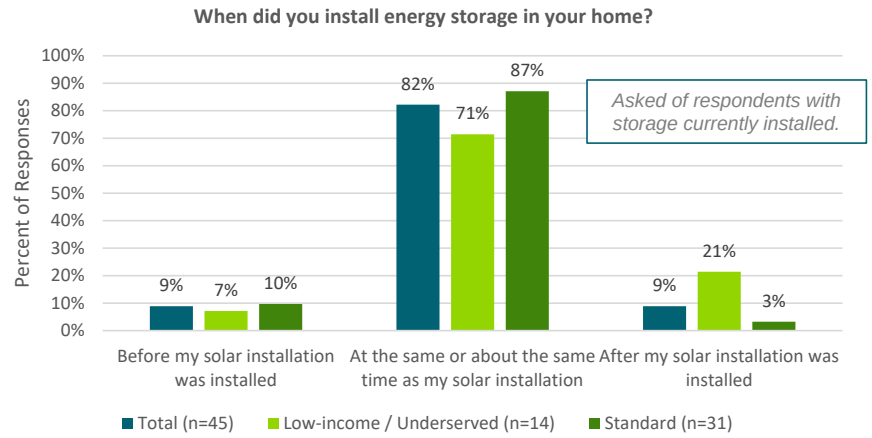
# Current Energy Storage and Installation




- **Most respondents (88%) do not currently have energy storage installed**.
- Of those who do have storage currently installed, 82% installed their storage at or about the same time as they installed solar.
- Of the same group, low-income/underserved respondents (21%) reported installing storage after their solar installation more frequently than standard respondents (3%).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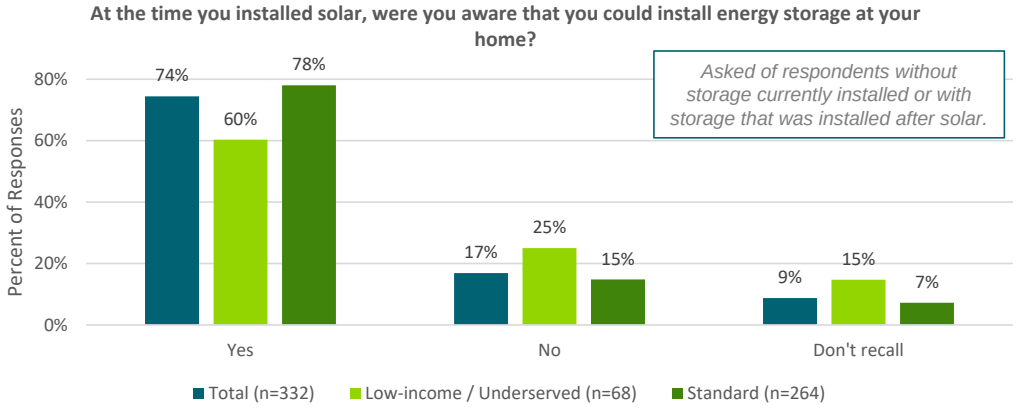
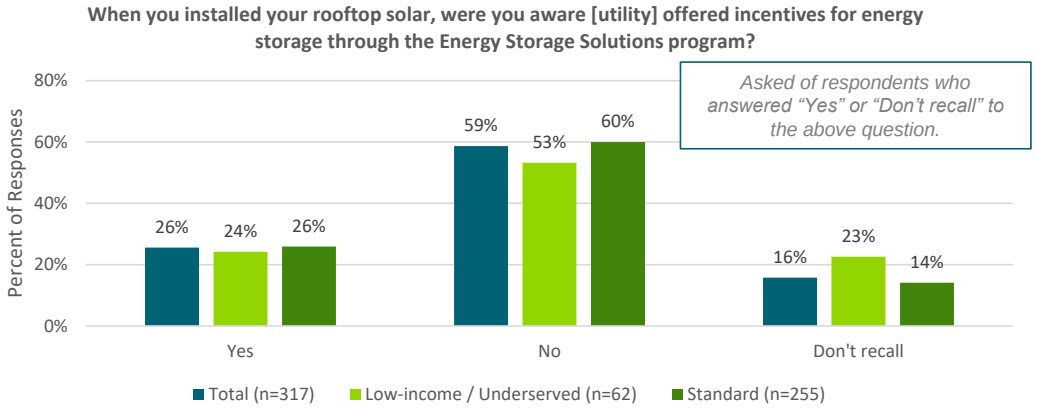
# Awareness of Storage at Time of Solar Installation




- About **three-quarters of respondents** (74%) were **aware they could install storage** at the time of their solar installation, while **only one-quarter** (26%) **were aware of the Energy Storage Solutions** (ESS) program.
- **Low-income/underserved respondents** reported they were **unaware they could install storage at the time of their solar installation more frequently** than did standard respondents (25% vs. 15%).
- Standard and low-income/underserved respondents who were aware of storage reported awareness of the incentives offered through the ESS program at about the same rate (26%, 24%).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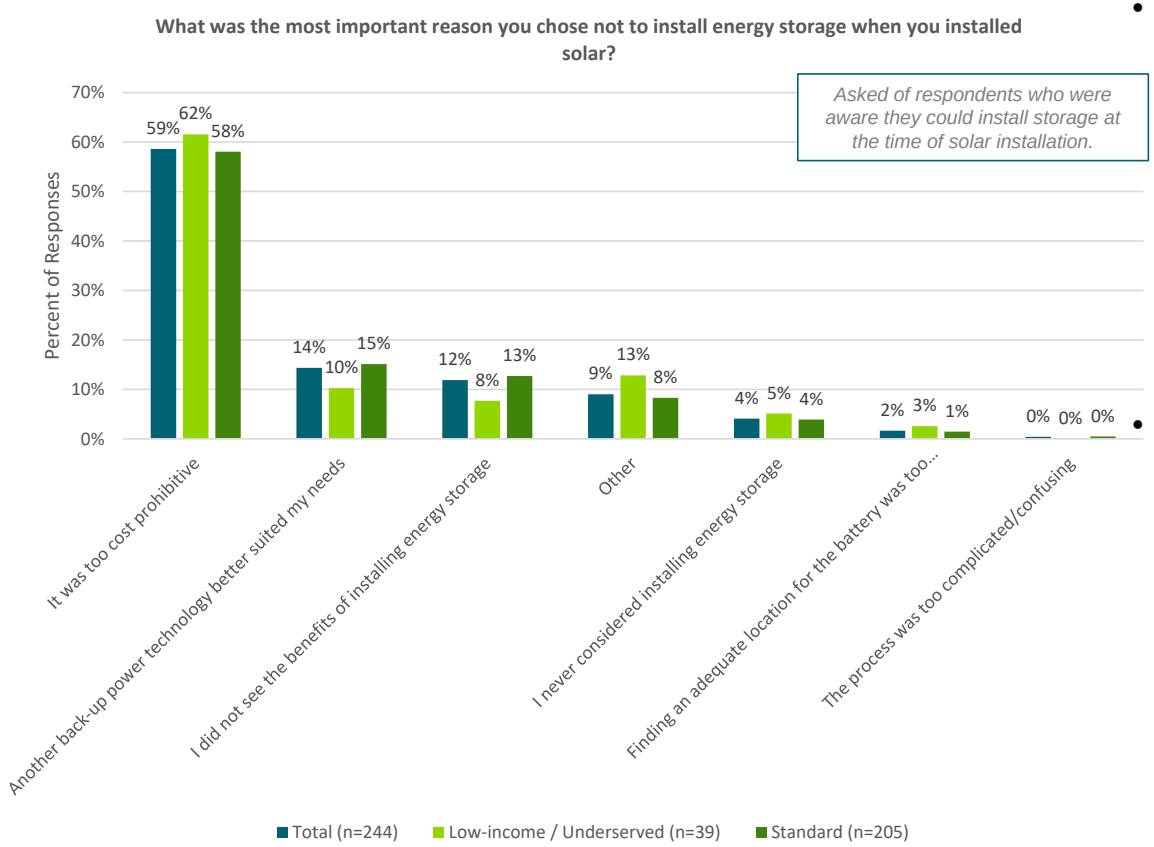
# Reasons Storage Was Not Installed




- Respondents who were aware they could install energy storage most frequently reported that the main reason they chose not to install storage when they installed solar was because:
  - It was too **cost prohibitive** (59%),
  - **Another back-up power technology** better suited their needs (14%), and
  - They did not see the **benefits** of storage (12%).

- Low-income/underserved respondents similarly indicated the most important reason not to install storage was due to cost (62% low-income vs. 58% standard).

> "All the solar companies advised against it, said there were supply chain and cost issues. Better to wait a year or two."
> -Low-income / Underserved Respondent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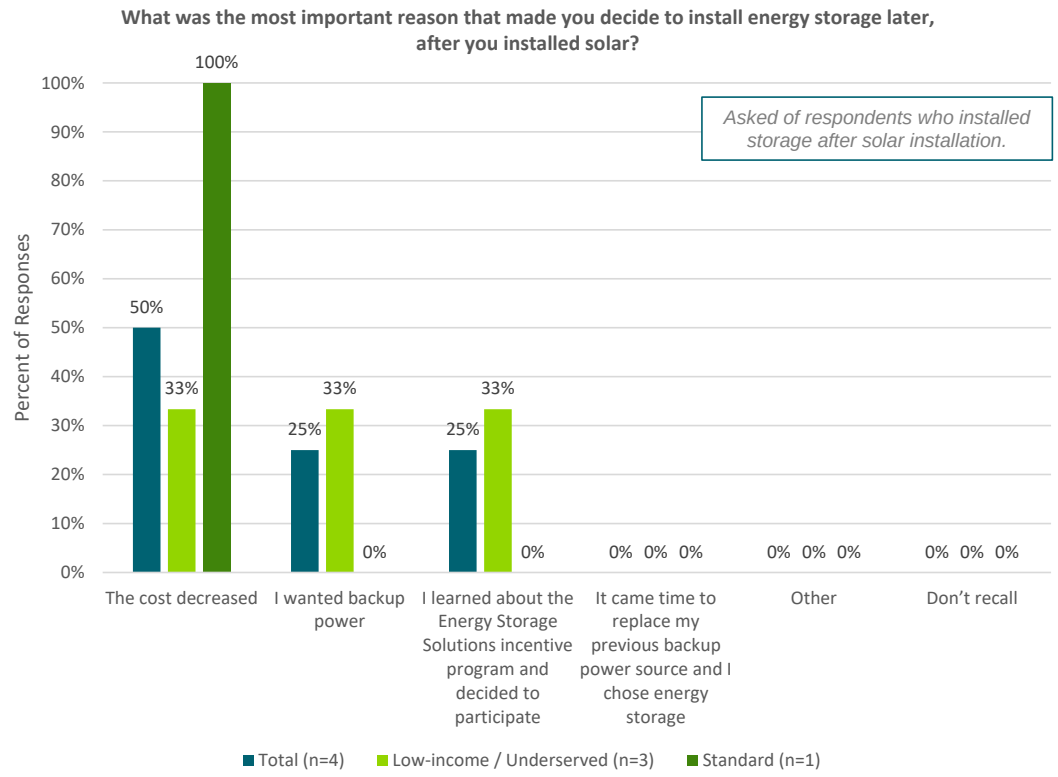
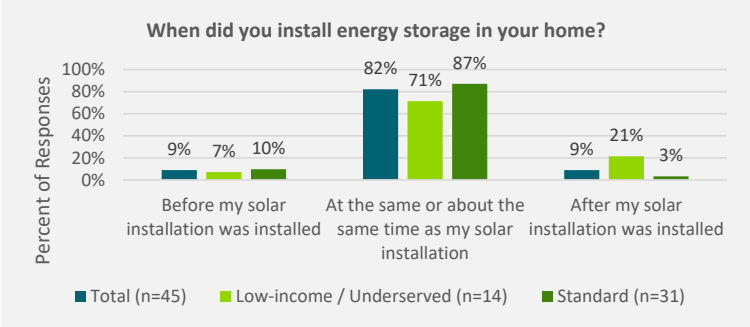
# Reasons for Delayed Installation




- Half of respondents who installed storage after solar installation did so **because the cost decreased**.





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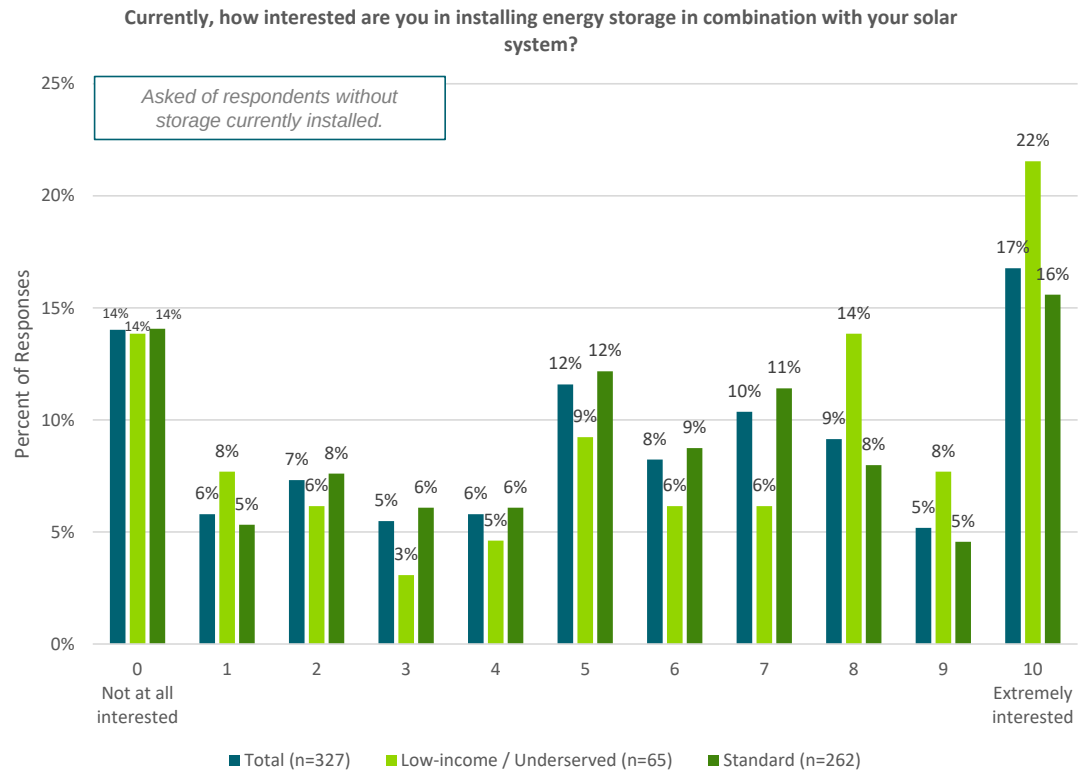
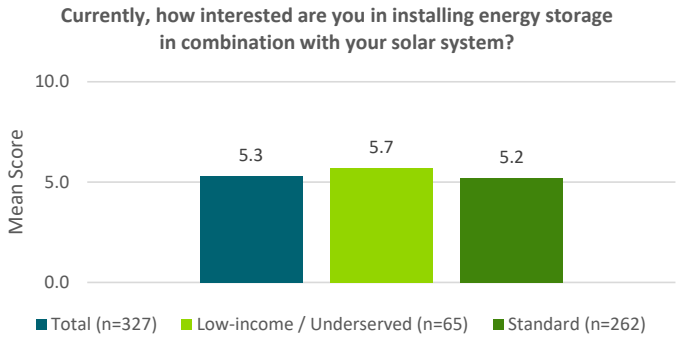
# Current Interest in Installing Storage




- On average, **low-income/underserved respondents reported a higher interest in installing storage** (5.7 out of 10) than did standard respondents (5.2 out of 10).





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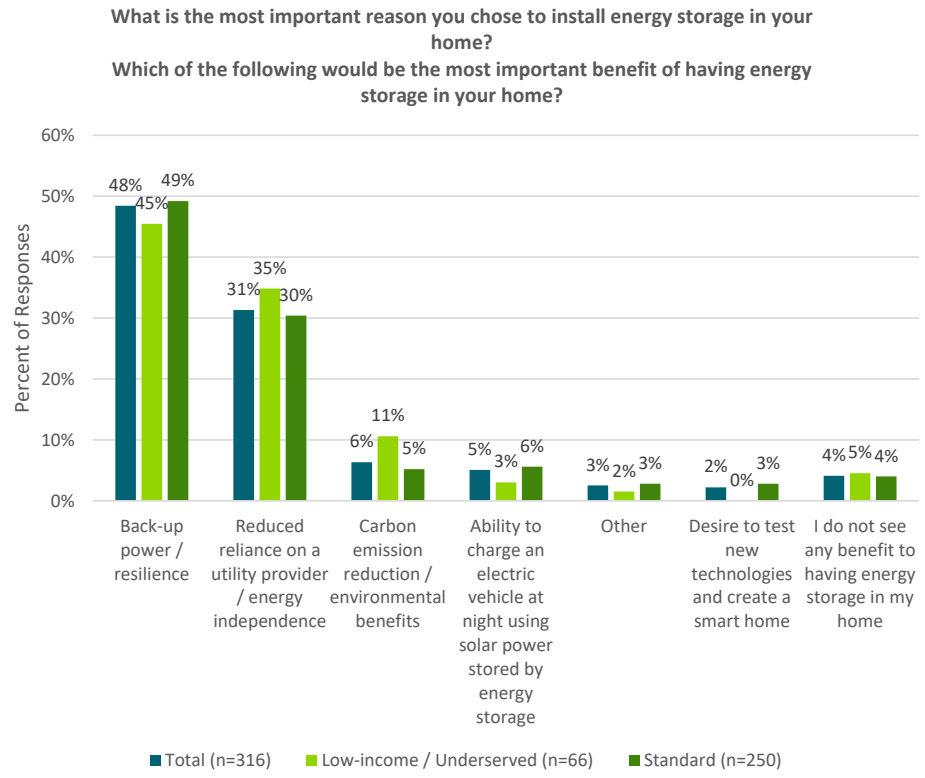
# Perceived Benefits of Storage




- Respondents most frequently reported **back-up power / resilience** (48%) as the **most important reason to install storage**, followed by reduced reliance on a utility provider / energy independence (31%).
- Low-income/underserved respondents more frequently sited **reduced reliance on a utility provider / energy independence** and **carbon emission reduction / environmental benefits** than did standard respondents as the most important reason to install storage.

*Respondents who currently have storage installed received the following question: "What is the most important reason you chose to install energy storage in your home?"*

*Respondents who do not currently have storage installed received the following question: "Which of the following would be the most important benefit of having energy storage in your home?*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# Program Perceptions and Awareness

## Findings and Discussion


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# Program Perceptions and Awareness Overview



**Prevalence of Program Awareness**
Only a quarter of respondents who were aware of storage but do not have it currently installed were aware of ESS at the time of their solar installation.

**Source of Program Awareness**
Respondents who had heard of ESS most frequently learned about the program from their solar installer (44%) or an internet search (35%).

**Information from Solar Installers**
Half of respondents who were aware of ESS but not have storage currently installed received information about the program from their solar installer.

**Reasons Not to Participate**
Almost half of the total respondents with storage currently installed don't recall why they did not participate in ESS when they installed storage. Some believe they did participate in the program.


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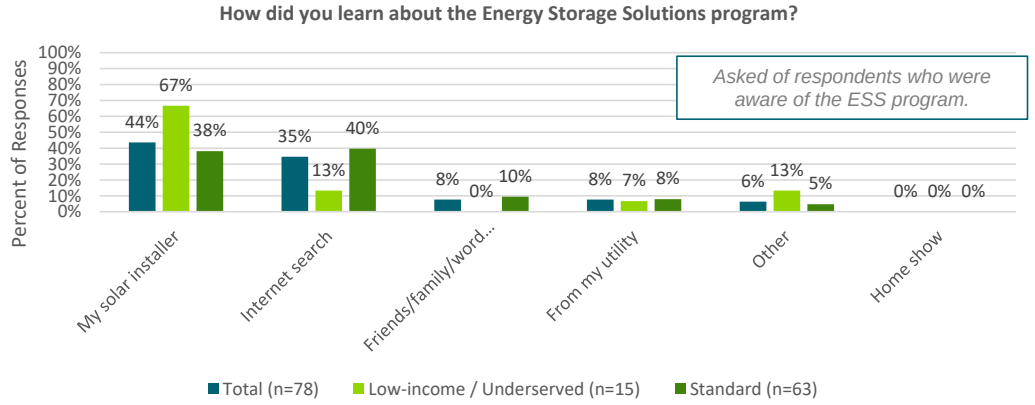
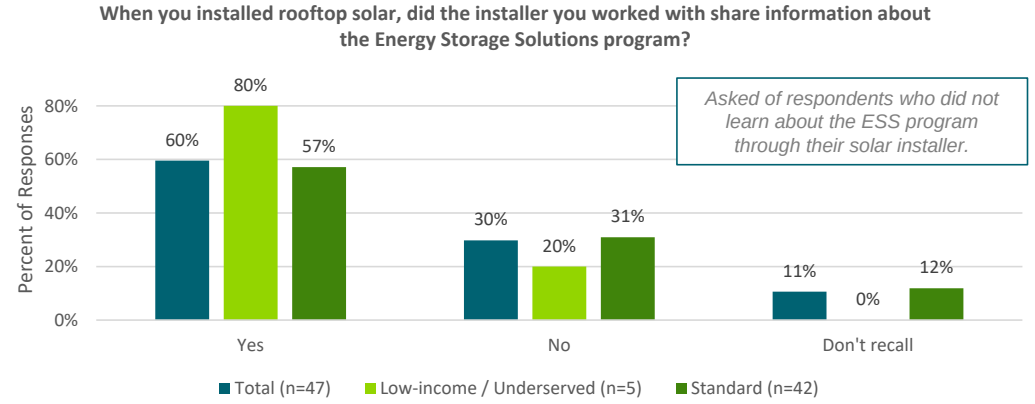
# Source of Program Awareness




- Respondents who had heard of ESS, **most frequently learned about the program from their solar installer** (44%) **or an internet search** (35%).
- For customers who had already heard of the program from another source, over half (60%) still indicated that their installer shared information about the program at the time of the solar install.
- In total, **half of respondents** who were aware of ESS (50%) **received information on ESS from their solar installer; 70% of low-income/ underserved respondents** of the same group received this information from their solar installer.
- Low-income/underserved customers were more likely to report that their solar installer shared information about the program than standard customers.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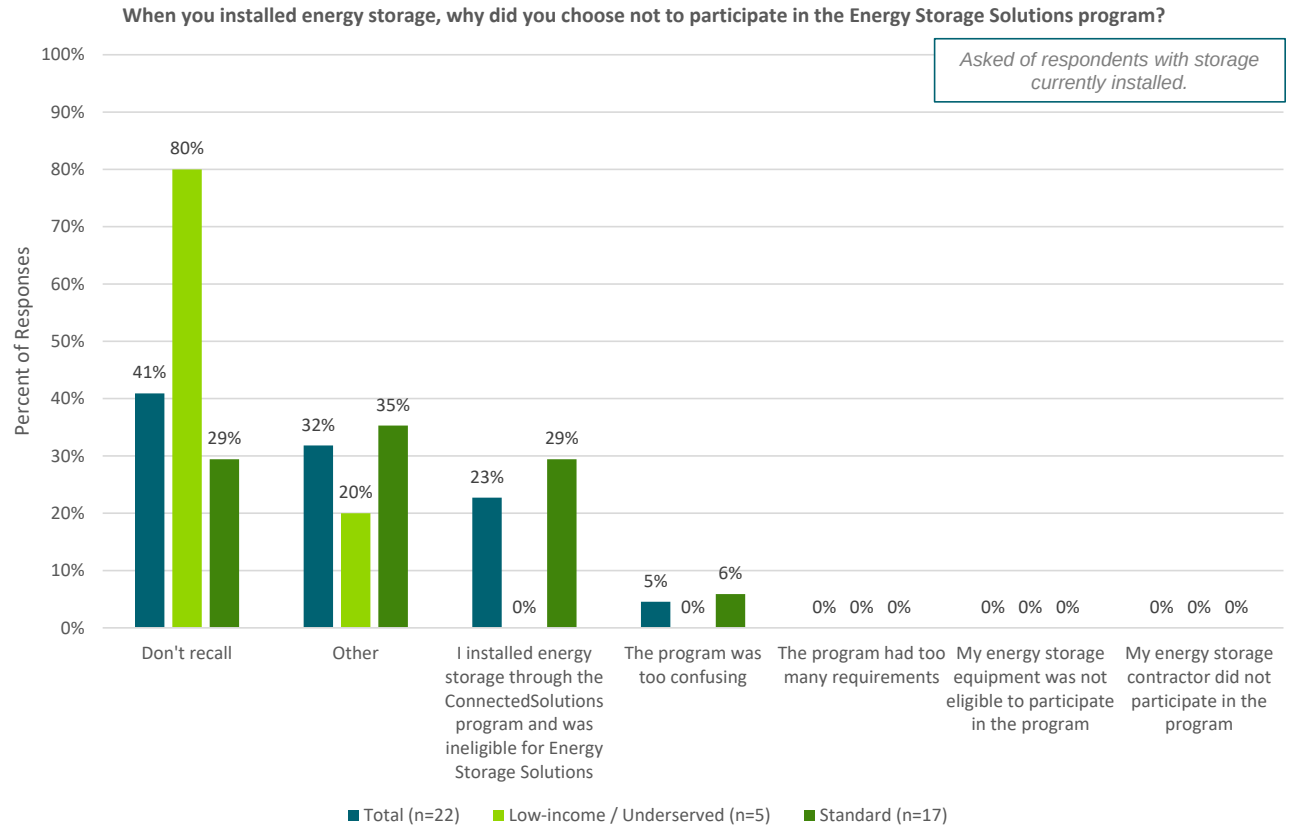
# Reasons for Not Participating




- Forty-one percent of respondents don't recall why they did not participate in ESS when they installed storage.
- Some respondents believe they did participate in ESS.

"I thought I did opt for this."
- Standard Respondent

"I did participate as far as I know"
- Standard Respondent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# Respondents Reported Additional Barriers

## New Technology

- “I worry about safety, the location of the battery. Its capacity and how much space will it take. This technology is rapidly evolving still which means a year from what we have today will likely become obsolete.” – *Standard Respondent*
- “Concerned about the safety. I would need to understand the composition of these batteries and their long-term safety record before making any decision on installing something like that in my home.” – *Standard Respondent*

## Gas Powered Generators

- “Current battery costs are too high (prohibitive) and not competitive with other options such as home generators.” – *Standard Respondent*
- “I have a propane back-up generator” – *Low-income/underserved Respondent*

## Cost Prohibitive

- “I was told by my salesman that the technology was on the verge of getting a lot cheaper and a lot better, and to check back in a few years. I currently lease solar, but plan to buy it when I'm eligible (in 5 years) and would most be interested then - but if I were to do a lease or monthly purchase plan now, I'd want it to be extremely affordable as such.” – *Low-income/underserved Respondent*
- “I did not buy energy storage because it would have significantly increased the cost of my overall system -- even with incentives -- and would not lead to any additional savings in my electric costs.” – *Standard Respondent*


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# Incentives

## Findings and Discussion


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# Incentives Overview



**Highest Acceptable Costs**
Respondents who would consider installing storage in the future reported the highest upfront cost they would be willing to pay for storage to be about **$3,300**, and the highest monthly price to be about **$45**.

**Likeliness to Install**
Respondents who would consider installing storage in the future report a low likeliness to install storage if the upfront cost is $15,000 (1.4 out of 10) or $11,000 (1.8 out of 10).

**Preferred Payment Structure**
Over half of low-income/underserved respondents who would consider installing storage in the future (59%) would prefer paying monthly to lease storage, while over half of standard respondents of the same group (65%) would prefer paying upfront to own the storage.


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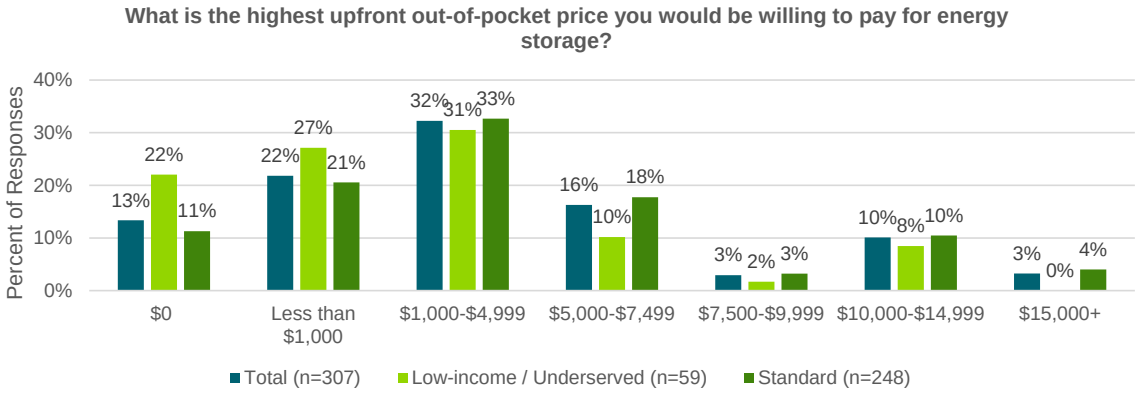
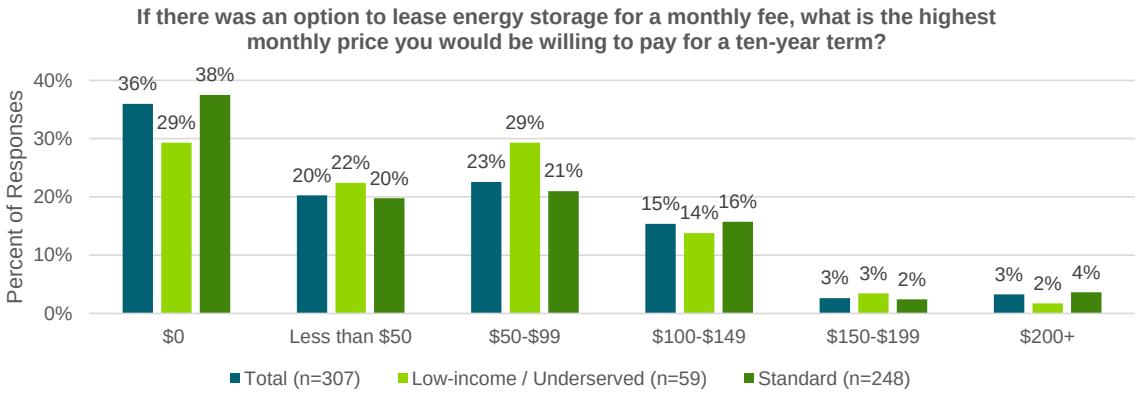
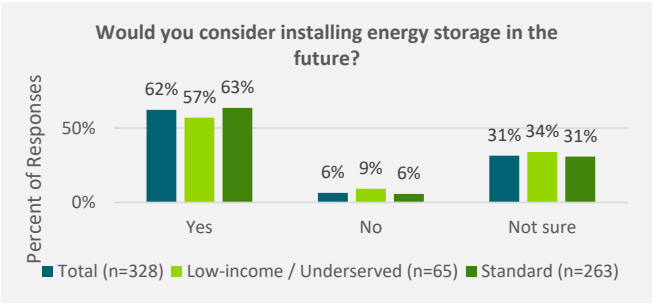
# Highest Acceptable Costs




*Note: Guidehouse removed from analysis a response of $6,000 for highest monthly price, assumed to be a typo or due to misunderstanding the question.*




- On average, respondents who would consider installing storage in the future reported the **highest upfront cost** they would be willing to pay for storage to be about **$3,300**.
- On average, respondents of the same group reported the **highest monthly price** they would be willing to pay for storage to be about **$45**.
- While averages for highest upfront cost differs between low-income/underserved respondents (~$2,000) and standard respondents (~$3,600), the average for **highest monthly price remains about $45 for both**.

*Both questions asked of respondents who do not currently have storage installed but would consider installing it in the future.*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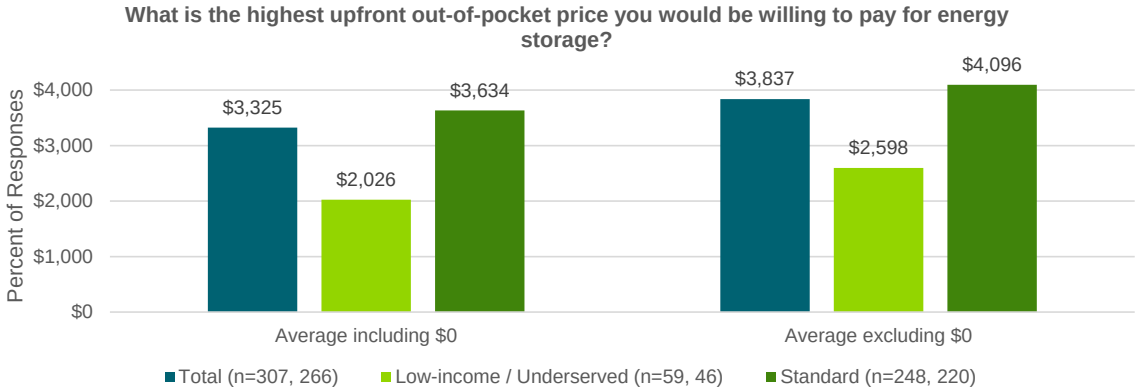
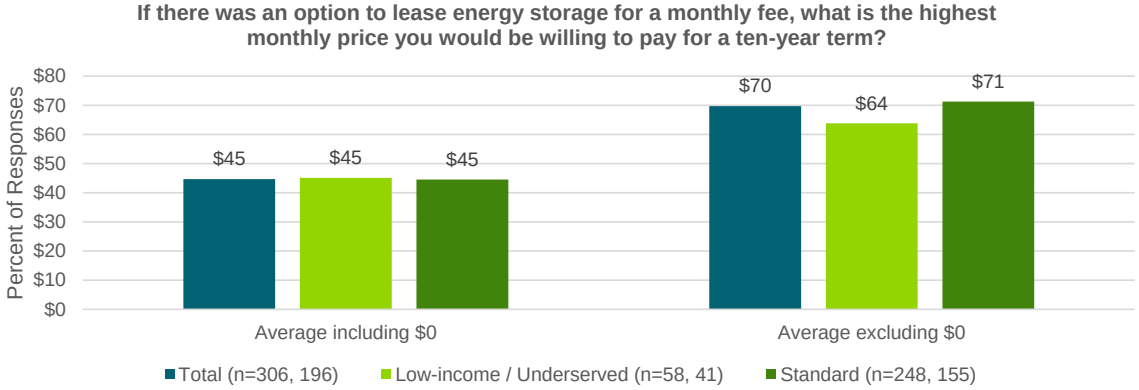
# Highest Acceptable Costs

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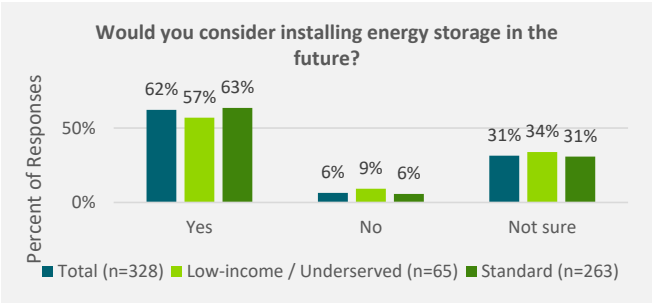


- Excluding $0 responses increases the average **highest upfront cost** to about **$3,800**.
- Excluding $0 responses increases the **highest monthly price** to about **$70**.
- Excluding $0 responses highlights a **difference in highest monthly price** for low-income/underserved respondents ($64) and standard respondents ($71).

*Both questions asked of respondents who do not currently have storage installed but would consider installing it in the future.*


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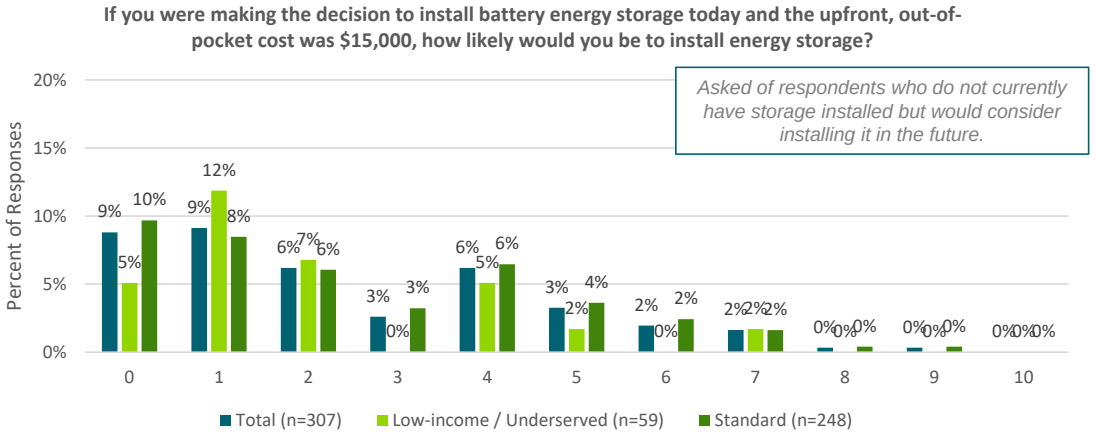
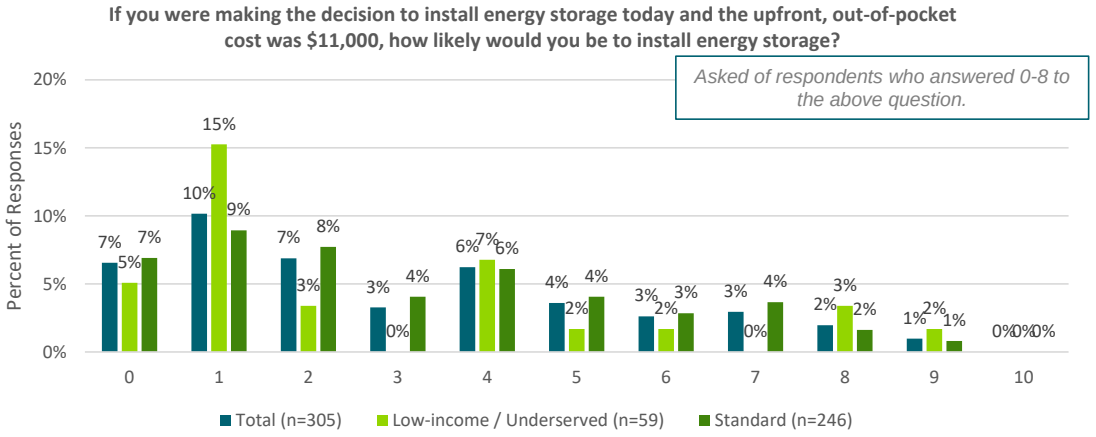
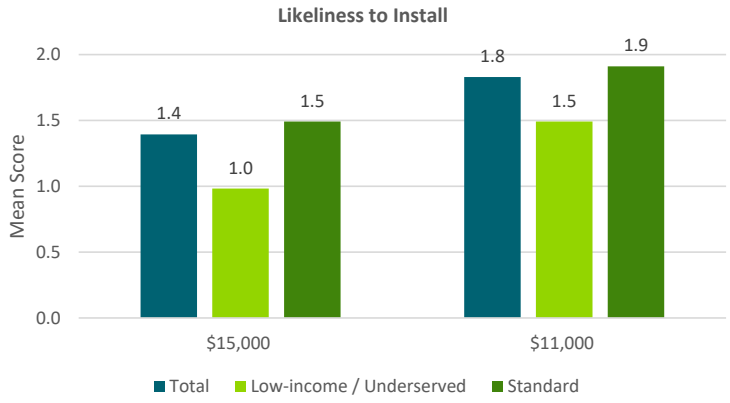
# Likeliness to Install at $15,000 and $11,000




- On average, respondents who would consider installing storage in the future report a **low likeliness to install storage** if the upfront cost is $15,000 (1.4 out of 10). Decreasing the upfront cost to $11,000 only marginally increased the likeliness to participate (1.8 out of 10).





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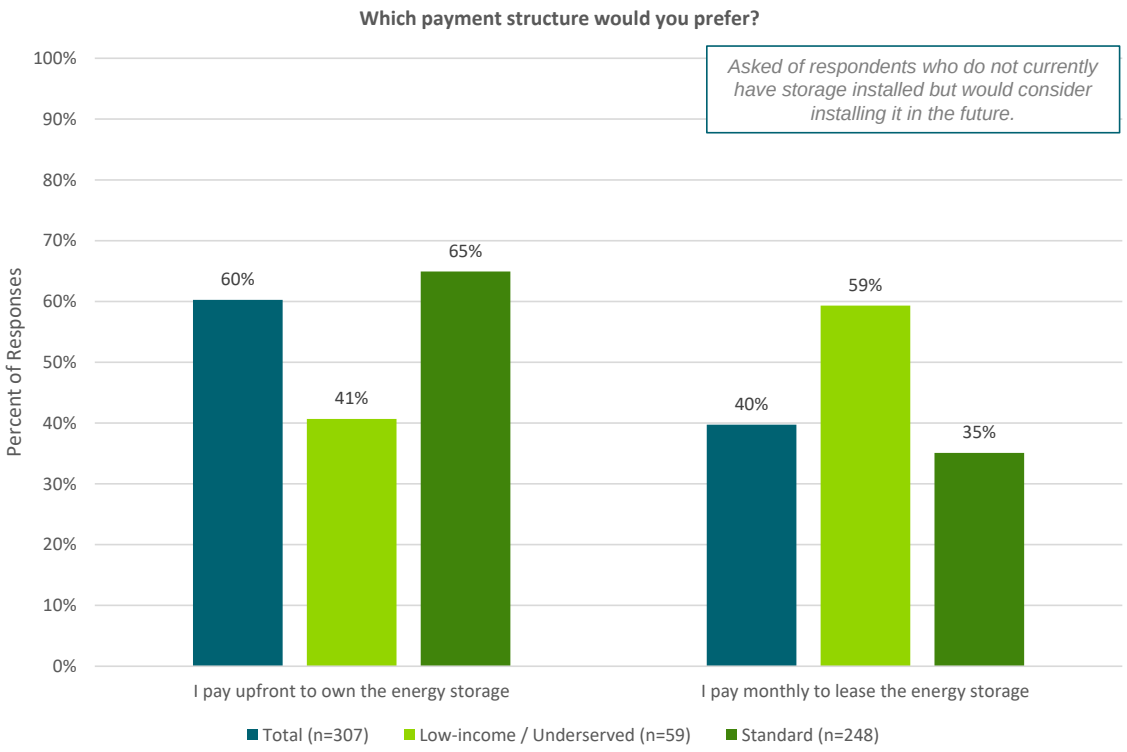
# Preferred Payment Structure




- Overall, respondents more frequently reported they would **prefer paying upfront to own the storage** (60%) than paying monthly to lease the storage (40%).
- **Low-income/underserved respondents**, however, more frequently reported they would **prefer paying monthly to lease the storage** (59%) than paying upfront to own the storage (41%).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# Potential Next Steps

## Ideas for Consideration


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# Ideas for Consideration: **Overall**

## Finding 1

About three-quarters of respondents (74%) were aware they could install storage at the time of their solar installation.

However, over half of respondents reported they were not aware of the Energy Storage Solutions program (59%) or don't recall if they were aware (16%) at the time of their solar installation.

## Idea 1

**Work with installers to ensure that everyone provides information on ESS when a customer is signing up for RRES. Consider including additional education on the program through the solar program application or bonus incentives for participation in both programs.**

**Send follow-up emails to solar program participants that did not participate to provide education about and gauge interest in storage.**

## Finding 2

About half of respondents sited back-up power / resilience as the most important reason to install storage (48%).

Some respondents noted fossil fuel generators better serve their needs.

## Idea 2

**Review and consider updating (if needed) program materials and work with solar installers to highlight the back-up power and resiliency benefits of storage, particularly its benefits over fossil fuel generators such as environmental benefits, while providing education on storage safety.**

## Finding 3

On average, respondents reported the highest upfront cost they would be willing to pay for storage to be about $3,300.

## Idea 3

**Provide potential participants resources or low-interest loan offerings to reduce the upfront cost of storage installation to about $3,000. More prominently share information on Smart-E Loans and education on how they can be used to install storage while keeping upfront costs low.**


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# Ideas for Consideration: **Low-income/Underserved**

## Finding 4

Reported they would prefer paying monthly to lease the storage (59%) than paying upfront to own the storage (41%).

Reported average upfront cost for energy storage to be ~$2,000, highest monthly price for energy storage ~$45.

## Idea 4

**Ensure customers, particularly low-income/underserved customers, are aware of any leasing options available through certain installers and refer those interested.**

## Finding 5

Reported they were unaware they could install storage at the time of their solar installation (25%). Of those low-income/underserved respondents who did know about the program, 70% learned about it through their solar installer.

Reported a higher interest in installing storage (5.7 out of 10).

Sited reduced reliance on a utility provider / energy independence and carbon emission reduction / environmental benefits as the most important reason to install storage.

## Idea 5

**Work with solar installers to ensure that they provide adequate program information to low-income/underserved customers. Consider offering bonus incentives for installers that sign up low-income customers for RRES and ESS.**

**Modify program materials if necessary to highlight the storage benefits of reduced reliance on a utility provider / energy independence and carbon emission reduction / environmental benefits for low-income/underserved respondents.**


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