

CONNECTICUT ENERGY EFFICIENCY BOARD

Evaluation Studies Completed and Underway in 2020

A REPORT TO THE ENERGY AND TECHNOLOGY COMMITTEE OF THE CONNECTICUT GENERAL ASSEMBLY



Connecticut Energy Efficiency Board Evaluation Committee
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Draft Report

PREFACE FROM THE EEB EVALUATION COMMITTEE

The Energy Efficiency Board (EEB) Evaluation Committee is pleased to present the Annual Report of the studies, results and recommendations via the EEB program evaluation, measurement, and verification (EM&V) process. Connecticut has one of the longest EM&V histories, contributing to some of the nation's strongest efficiency programs.

EM&V is very important to the efficiency programs' successes. Evaluations are designed to be comprehensive, independent, actionable and cost-effective. Impact results provide verification that the Fund is being used appropriately and provide beneficial programs and savings. Recommendations also provide essential information on how programs can be improved, additional measures developed, and customer needs met. The use of outside evaluators provides for independence and also allows Connecticut to take advantage of the successes and failures of other programs and jurisdictions.

What follows is a compilation of results and recommendations from studies completed in the last year. Review of the appropriate sections of the Board website will lead you to the full reports, should more detail be desired.

Additionally, this report is intended to provide an introduction to the wide range of studies typically completed by the EEB. These current and new studies cover evaluations of program savings, customer and vendor reception to program offerings, assessment of new opportunities and examinations of what pockets of savings remain available in areas already covered.

We believe that you will find the report informative. Please contact us with any questions you may have.

Offered by the EEB Evaluation Committee

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PREFACE FROM THE EVALUATION ADMINISTRATORS --- OVERVIEW AND VERIFICATION OF THE 2020 EVALUATION OF CONNECTICUT'S ENERGY EFFICIENCY FUND ACTIVITIES

The evaluation efforts conducted in 2020 were designed and managed by third-party independent experienced evaluators.¹ The evaluations themselves were also conducted by independent evaluation teams, operating under the guidelines of Connecticut's Evaluation Roadmap, which instituted policies to assure independence.

The evaluations completed in 2020 add to the evaluation evidence of accomplishments from the use of Connecticut's Energy Efficiency Fund (EEF).

The Evaluation Consultant Team² verified that the 2020 completed evaluations and on-going evaluations meet or exceed the rigor and energy efficiency evaluation practices conducted across the United States. The evaluation results and recommendations are similar to energy efficiency evaluation results elsewhere. The accumulation of the evaluations continues to demonstrate that activities supported by Connecticut's EEF are making reasonable energy efficiency achievements.

SERA Evaluation Administration Team

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¹ The Evaluation Consultant and the evaluation contractors conduct energy efficiency program evaluations across the nation and beyond. They are independent from Connecticut utilities and Connecticut boards, state regulatory staff and state agencies. All of the evaluators conducting Connecticut evaluation activities provide objective evaluation and verification, following evaluation ethics and "Guiding Principles for Evaluation" from the American Evaluation Association.

² The current Evaluation Administration Consultant, initially contracted in 2013, and most recently contracted in 2019, is a team of experienced independent evaluators led by Skumatz Economic Research Associates (SERA) and includes Ralph Prah and Associates, Wirtshafter Associates, BuildingMetrics, and Left Fork Energy. Each consultant on the team has between 20 and 40 years of experience in the field and has conducted work nationwide. The offices of these firms are located in Colorado, Florida, Massachusetts, and New York.

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LEGISLATIVE REPORT ON 2020 EVALUATION PROJECTS

1. INTRODUCTION

The Energy Efficiency Fund (EEF) and Utility Companies have a long history of providing efficiency programs to Connecticut energy consumers. An integral part of creating, delivering and maintaining quality programs is performing independent evaluations of programs and the markets they serve. The evaluators make recommendations for program modifications that are considered in prospective program development and implementation.

In 1998 the Energy Efficiency Board or EEB (previously the Energy Conservation Management Board) was formed and charged with responsibility to advise and assist the utility distribution companies in the development and implementation of comprehensive and cost-effective energy conservation and market transformation plans. The EEB has worked closely with the Companies to ensure all evaluations are relevant, independent, cost-effective and meet the needs of program administrators and planners who are charged with achieving substantial public benefits. In 2005, the EEB formed an Evaluation Committee that works with an EEB Evaluation Consultant to oversee evaluation planning and completion. In 2009, the Department of Public Utility Control (DPUC) decided that the EEB's Evaluation Committee and their consultant would be independent from the EEB and totally responsible for all aspects of the evaluation process.

Since that time, the evaluation process and oversight have changed through additional DPUC (now Public Utility Regulatory Authority (PURA)) decisions which were adopted and extended by PA 11-80, sec. 33, amending Conn. Gen. Stat. sec. 16-245m, in 2011. PA 11-80 required an independent, comprehensive program evaluation, measurement and verification process to ensure the Connecticut Energy Efficiency Fund's (CEEF) programs are: administered appropriately and efficiently; comply with statutory requirements; programs and measures are cost effective; evaluation reports are accurate and issued in a timely manner; evaluation results are appropriately and accurately taken into account in program development and implementation; and information necessary to meet any third-party evaluation requirements is provided.

The essential information gained through studies such as those discussed in this report is provided very cost-efficiently. The three-year 2019-2021 C&LM Plan budget is \$751 million. The accompanying three-year evaluation budget is \$8.0 million for all evaluation and related research studies, with the first year reflecting the last year of a short-term budget reduction from the Legislature. This represents an evaluation percent of 1.07%, reflecting a substantial decrease compared to figures of 1.4% in 2018, 1.9% in 2013 and 2.1% in 2012.

Research completed within the evaluation group provides many types of information. Impact and process evaluations form the bulk of budget for studies completed. Additional studies support how the current and future efficiency programs are developed, supported and improved through careful research into:

- Current market opportunities for program expansion

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- New end uses and equipment that may be included cost-effectively, including assessment of the associated barriers for inclusion of each
 - Customer segmentation, market assessment, market progress, and market research,
 - Examination of best practices in other jurisdictions

The EEB Evaluation Committee ensures the independence and objectivity of Evaluation Measurement and Verification (EM&V). It is critical that the programs be evaluated, measured, and verified in ways that provide confidence to the public that savings are real and enable the Companies and EEB to use savings estimates and Evaluator's recommendations to improve and advance programs with full confidence.

1.1 Definition of Evaluation Types

There are many types of evaluation supported by EEF funding. Research studies assist regulators, policy makers, the EEB and program administrators to maintain excellent practices and develop new programming options to meet Connecticut's growing efficiency needs throughout program formation and evolution. These studies include:

- Process Evaluations determine the efficacy of program procedures and measures. Process Evaluations assess the interactions between program services and procedures and the customers, contractors, and participating ancillary businesses. Process evaluation is essential to support development of improved program delivery, increased cost effectiveness and customer satisfaction.
- Impact Evaluations verify the magnitude of energy savings and the reasons for differences between projected and realized savings. The results and value of energy efficiency programs are reported to regulatory bodies, ISO-New England, Company management, and program planners and administrators. Many different types of impact studies may be completed including end-use metering, engineering modeling, billing analyses, participant interview, surveys and combinations of these.
- Market Assessments examine overall market conditions related to energy efficiency products and services, including current standard practices, average efficiency of equipment, consumer purchasing practices, and identification of market barriers. The assessments ascertain the extent to which efficiency programs are likely to influence customer adoption of measures and practices. Assessments are conducted to identify effective ways to influence key market players to take efficiency actions and increase the breadth and depth of the actions taken.
- Impact Support Studies (including measure effects / performance and methods studies) assess the adequacy of engineering methodologies and background assumptions, supporting the Program Savings Document (PSD) and providing the foundation against which evaluations will assess program performance. Methods studies address methodological issues and develop best practices for evaluation research.
- Baseline Studies provide direct impact support by assessing pre-conditions that will no longer be measurable after program interventions have occurred.

Collectively, these types of studies are sometimes referred to as Evaluation, Measurement and Verification (EM&V; defined at the top of the page). The evaluation process is a critical tool to measure energy savings, as well as other key attributes of each program, to allow optimum program design and careful management of consumer conservation funds. The various types of evaluation studies are

utilized to support ongoing improvement in program offerings and to measure the results of those programs. The audiences for evaluation include regulatory bodies, the regional electric system operator (ISO-New England), Company management and program planners and administrators, all of whom need the information to make decisions about program design and efficacy to enhance existing cost-effective programs and redesign programs that are not cost-effective to make them successful. Evaluation research provides the basis for determining program direction or focus; increasing participation and savings; expanding the reach of programs, developing messaging more relevant to the non-participating customers where appropriate; reducing costs; and fine-tuning procedures.

1.2 Organization of the Report

The remainder of this report is organized in chapters, based on the current status of the study.

- **Chapter 2 - Completed Studies** includes descriptions and summary results from completed studies that were filed in calendar year 2020. Findings and recommendations are summarized; links to the full reports are found at the end of each study description.
- **Chapter 3 – Studies in Progress** includes brief descriptions of study background and key outputs expected from each residential, commercial, and cross-cutting study that was underway – but not completed – in 2020.

Figure 1 summarizes the completed and in-progress and EM&V studies addressed in this Evaluation Legislative Report. Each is described in more detail in subsequent chapters, as noted.

Figure 1: List of Studies Addressed in the 2019 Legislative Report (by category)

(R=Residential; C=Comm'l / Industrial, X=All/Both Sectors)

Studies Completed in 2020 (Summaries included in Chapter 2)	Report Status
<u>R1963a - Short-Term Residential Lighting Analysis.</u>	Complete 2020
<u>R1963b - Short-Term Residential Lighting Analysis.</u>	Complete 2020
<u>R2023 - RASS Database Enhancement</u>	Complete 2020
<u>C1634 – Energy Conscious Blueprint (ECB) Impact Evaluation.</u>	Complete 2020
<u>C1635 – Energy Opportunities (EO) Impact Evaluation.</u>	Complete 2020
Studies underway in 2020 (Summaries included in Chapter 3)	
<u>X1931 - In-depth review of the Connecticut Program Savings Document (PSD).</u>	In progress 2020
<u>X1932 – Evaluation of Demand Reduction (DR) Programs (UI)</u>	In progress 2020
X1939 Early Retirement Program Evaluation	In progress 2020
X1941- Multi-Family Impact Evaluation	In progress 2020
X1942 – Cross-Cutting Non-Energy Impacts Evaluation	In Progress 2020
X2001 – Measure Life Study / EUL Update	In Progress 2020
<u>X2022 – Evaluation of Customer Engagement, Education, and Workforce / Training Initiatives</u>	In Progress 2020
C1901 - C&I Sector Wide Process Evaluation.	In progress 2020
C1902 – ECB Net to Gross and Baseline Evaluation	In progress 2020
<u>C1906 - Strategic Energy Management (SEM) Program Evaluation.</u>	In progress 2020
C2014 – C&I Lighting Saturation and Remaining Potential	In progress 2020
R1973 - Retail Non-Lighting Evaluation.	In progress 2020
R1959 - Single-Family Renovation and Addition Potential Analysis.	In progress 2020
R1965- HP/HPWH Baseline and Potential Assessment.	In progress 2020

Studies Completed in 2020 (Summaries included in Chapter 2)	Report Status
R1982 - HVAC / DHW Performance & Potential Evaluation	In progress 2020
R1983 HES & IE Process and NTG Evaluation And Impact Evaluation (R1984)	In Progress 2020
R2027 – Heat Pump and Heat Pump Water Heater Reliability Study	In Progress 2020
R2029 – Single Family Weatherization Metric and Update	In Progress 2020

This EM&V project list represents a portion of the projects from the adopted 3-year plan. The legislative budget sweep led to a reduction in funding for the first year of the EM&V Evaluation Plan for 2019-21, and this budget reduction leads to reductions in evaluation work that addresses gaps in the PSD and to program evaluations that will take time to make up.

2. PROJECTS COMPLETED IN 2020

R1963a Short-Term Residential Lighting Study

The R1963a Short-Term Residential Lighting Study explored the current state and short-term future of the lighting market in Connecticut and other jurisdictions. The study offers two recommendations:

1. The Companies should remove all support for reflector light emitting diode (LED) bulbs as soon as feasible.
2. The Companies should reduce the program resources going into the home improvement channel (see also the study suggestions).

The study also includes suggestions touching on the current strategy to increase LED adoption among hard-to-reach consumers and preparing for a future in which lighting ceases to be a substantial part of the residential portfolio of program offerings.

To arrive at these recommendations and suggestion and the following key findings, the study analyzed: (1) program tracking data; (2) lighting sales data; and (3) in-depth interviews with suppliers, stakeholders, and program staff members.

- LED sales – particularly reflector LEDs – are strong. LEDs accounted for the majority of overall 2019 retail light bulb sales in Connecticut, other New England states, and even areas of the country lacking upstream lighting programs (non-program areas). In 2019, over 80% of reflector bulbs sold in Connecticut and all other jurisdictions were LEDs. LEDs made up about 50% of A-line, globe, and candelabra bulb sales in Connecticut and nonprogram areas. The growth in LED sales for globe and candelabra bulbs was particularly strong between 2018 and 2019 in all jurisdictions considered.
- Program incentives still lift LED sales. The long-term engagement of the Companies in Connecticut’s residential retail market – through incentives, marketing, and education – paved the path for high LED market share. LED market share in Connecticut has mirrored program sales. When budget reductions forced the program to reduce its effort in 2018, market-level sales of LEDs decreased as consumers backslid to halogens. LED market share rebounded in 2019 with reinstatement of the program budget and incentives.
- Connecticut LED market share lags other program areas, and non-program areas have seen large growth in LED market share. Although LED market share in Connecticut has historically exceeded that of non-program areas, it falls short of neighboring states and many other areas with upstream lighting programs. Likewise, LED market share for all bulb shapes in non-program areas increased 108% between 2017 and 2019, compared to only 12% in Connecticut. This indicates that LED market progress happens even in the absence of program incentives.
- Program sales are concentrated among a subset of retailers. Programs have been particularly effective in ensuring that diverse retailers – including independent hardware stores and grocery stores – carry ENERGY STAR qualified LEDs, although one-half of program sales remain concentrated in-home improvement stores.

Report Link: https://www.energizect.com/sites/default/files/R1963a%20Short-term%20Lighting%20Report%202020%2009%2011%20FINAL_0.pdf

R1963b Short-Term Residential Lighting Study

The R1963b: Short Term Residential Lighting Analysis measured the availability and pricing of key light bulb types across a wide range of CT retailers and investigated the progression of federal standards for light bulbs. The research aims to determine the viability of continued promotion of residential lighting products. The study offers three recommendations:

- 1) Discontinue promotion of products at Club Stores where the product choice landscape already favors efficient LED products (no baseline products are sold) and redirect those efforts toward retailers where baseline products are a viable option for customers.
- 2) Review and refine the incentive strategies utilized in the program in the following ways:
 - a. For Non-Discount retailers, size incentives and design more targeted strategies to promote products based on the pricing and availability information and first cost differentials between LEDs and baseline products established in this study.
 - b. For Discount retailers, ensure that incentives are aggressive compared to the other retailers in the program.
- 3) Reduce incentives from products where the current levels exceed the incremental first cost between LEDs and baseline products (in 4 of 6 retail channels for 65W equivalent directional bulbs) unless there is some other compelling barrier to overcome.

These recommendations and the following key findings were established by gathering and analyzing: a) shelf stocking data, b) program tracking data, and c) documentation from two key DOE rulemaking decisions and subsequent lawsuits filed against DOE regarding those decisions. The key findings from this study are:

- Baseline products are widely available. First tier EISA compliant baseline halogen and incandescent bulbs for all shapes included in this study (A-Line, G25 Globe, Candelabra, and BR30 Directional bulbs) are widely available in the CT market (e.g., DIY, Food Market, Hardware/Lumber, & Mass Merchants).
- LED products are more expensive. Nearly all LED product types³ are priced higher before program incentives than their first tier EISA compliant baseline counterparts.
- Incentive strategy is not closely related to incremental cost. Program incentives are not sized according to the incremental first cost between LEDs and their corresponding baseline products. The fraction of incremental first cost covered by program incentives ranged from 24% to 232% across all retailers and product types.
- Baseline products are likely to remain in the market. Petitions against the DOE regarding rulemaking decisions in 2019 are making their way through the US Court of Appeals for the Second Circuit. A decision may be issued in the first case late in 2020. While this process continues, baseline products will remain available in the market.

Report Link:

https://www.energizect.com/sites/default/files/R1963b_STLighting_FINAL%20Report_102920_0.pdf

³ Exceptions at 80% significance: 65W Eq. BR30 bulbs in Hardware/Lumber and 40W Eq. Globes in Discount.

R2023 - RASS Database Enhancement

This 2020 study built on to the Residential Appliance Saturation Study (RASS) database constructed for a compressive RASS study conducted in 2019. The database serves as a resource for identifying saturations by customer group, measure gaps, opportunities for additional program efforts, and other research needs for use in planning for the C&LM plan and program targeting. This study was designed to enhance the capabilities of the database and incorporate additional data useful to program planning.

The new enhancements added data on EnergyStar saturations, and efficiency levels to the existing records. The project was completed in late 2020. It is anticipated that, as new residential data are collected from other projects, data that are suitable for incorporating into this database will be added

C1634: Energy Conscious Blueprint (ECB) Impact Evaluation

The Connecticut Energy Efficiency Board contracted with the Evaluation Administrators and Cadmus (the Team) to conduct an impact evaluation of Energize Connecticut’s Energy Conscious Blueprint (ECB) program for the 2017 and 2018 years. Four utilities—Eversource, United Illuminating, Connecticut Natural Gas, and Southern Connecticut Gas Company—participate in the ECB program to provide incentives for new construction, major renovation, tenant fit-out measures, and new (or end of useful life) equipment measures for commercial, industrial, or municipal customers throughout Connecticut. The goals for this evaluation were to assess the retrospective and prospective savings impacts of electric energy, electric demand, and natural gas through the ECB program.

The Team reviewed the ECB program tracking databases and stratified the population into five electric strata (cooling, lighting, heating, custom/other, process) and three natural gas strata (heating, domestic hot water, custom). The Team then performed on-site inspections and engineering analysis for 274 measures⁴, which contributed 27% of the 2017 and 2018 program electric consumption savings and 18% of the 2017 and 2018 program natural gas savings. The data collected from site visits included information from interviews, spot measurements, site observations, building management trend data, power metering trend data, and utility bills. The Team analyzed the data and calculated evaluated energy savings using the methodologies described in the Program Savings Document (PSD) or the most appropriate technical reference manual (TRM). For complicated or custom measures, the Team calculated evaluated energy savings based on custom engineering spreadsheet analysis, energy modeling, or a utility bill analysis.

Overall, the two program years achieved gross realization rates of 101.4% for electric savings, 98.6% for seasonal peak summer electric demand savings, 110.6% for seasonal peak winter electric demand savings, and 94.6% for natural gas savings, though some variability occurred between measure categories.

The Team calculated 104,605,400 kWh of evaluated electric energy savings, 16,279 kW of summer electric demand savings, 11,721 kW of winter electric demand savings, and 1,979,081 therms of natural gas savings. Prospective realization rates were calculated as 101.1% for electric savings, 132.5% for seasonal peak summer electric demand savings, 169.6% for seasonal peak winter electric demand savings, and 103.7% for natural gas savings.

The following table presents the prospective realization rates for each stratum.

⁴ Sampling was performed at the measure level, and multiple measures were sampled for some sites.

Figure: C1634-1

Strata	Total Measures	Electric Energy Savings (kWh) Prospective Gross Realization Rate	Summer Demand Savings (kW) Prospective Gross Realization Rate	Winter Demand Savings (kW) Prospective Gross Realization Rate	Natural Gas Savings (therms) Prospective Gross Realization Rate
Cooling, Electric	643	86.2%	89.7%	151.1%	N/A
Lighting, Electric	721	129.0%	104.6%	116.6%	N/A
Heating, Electric	117	97.8%	94.4%	93.0%	N/A
Custom/Other, Electric	222	98.5%	97.4%	106.3%	N/A
Process, Electric	449	80.3%	114.1%	112.5%	N/A
Heating, Gas	515	N/A	0%	N/A	97.0%
Domestic Hot Water, Gas	101	N/A	0%	N/A	88.7%
Custom/Other, Gas	45	100%	0%	N/A	90.7%
Total	2,813	102.0%	102.5%	114.7%	94.6%

Based on the evaluation findings, the Team compiled the following recommendations for consideration with the PSD.

1. Remove dual enthalpy economizer measures from the PSD and ECB-offered measures.
2. Combine results from this study and the C1635 Energy Opportunities Impact Evaluation study to assess and update hours of use (HOU) by building type for a future version of the Connecticut PSD.
3. Calculate chiller savings using an annual 8,760 hourly calculation method or an energy simulation model to account for the variable temperatures and change in average demand during summer and winter peak periods.

Report Link:

<https://www.energizect.com/sites/default/files/C1634%20ECB%20Evaluation%20Report%20-%20Final.pdf>

C1635: Impact Evaluation of PY 2016 & 2017 Energy Opportunities (EO) Program

This C1635 Energy Opportunities (EO) impact evaluation examined the performance of the 2016 and 2017 program years as well as 2018 C&I upstream lighting activity. This study was commissioned to understand the extent to which program performance is meeting program and policy goals and objectives and to recommend revisions to the Program Savings Document (PSD) to improve claimed savings estimates moving forward. The EO Program is the flagship C&I retrofit program offered by the companies with a 2020 savings goal of 114,405 MWh (39% of the overall portfolio goal)⁵.

This study is important due to the high contribution of EO Program savings relative to the portfolio and the duration since the previous study of this program (2014). The objectives were to (1) determine evaluated energy and seasonal peak demand savings and retrospective and prospective⁶ realization rates (RRs) for three electric end use groups (Lighting, HVAC, and Other) and two gas end use groups (HVAC/DHW and Other), (2) evaluate the 2018 Upstream lighting program and update PSD assumptions accordingly, and (3) update the PSD for lighting hours of use and seasonal peak coincidence factors based on data leveraging⁷.

On-site visits, including measurement and verification (M&V) were performed at a statistically selected sample of 88 Upstream lighting⁸, 65 EO lighting, 26 electric HVAC, 26 electric other sites, 20 gas HVAC/DHW sites, and 12 gas “other” sites. Equipment level analysis performed at International Performance Measurement and Verification Protocol (IPMVP) standard accompanied a statistical expansion to produce aggregate impacts, realization rates, and precisions. On the whole, the EO program is tracking most impacts reasonably well with pockets of improvement available, as evidenced in the realization rates below. The evaluation team recommends updating the following PSD realization rate assumptions by end use based on the results of this study.

⁵ 2020 Plan Update to the 2019-2021 Conservation & Load Management, Submitted by: Eversource Energy, United Illuminating, Connecticut Natural Gas Corporation, and Southern Connecticut Gas, p 91 [of full report].

⁶ Prospective realization rates were calculated by examining the changes that occurred in the PSD between the evaluation program years and the 2020 PSD. Whenever a measure that was in the sample experienced a PSD change during this timeframe, a new tracking savings estimate was calculated. Prospective realization rates were calculated using this new tracking savings estimate as the numerator.

⁷ Using lighting logger data from 266 sites and 2,699 loggers from the current study, the C14: 2014 CT EO evaluation, the C20: 2015 CT Energy Conscious Blueprint evaluation, and the 2014 and 2018 CT Small Business Energy Advantage studies (C9 and C1639, respectively).

⁸ Verification was performed at all 88 sites, while measurement was performed at 25 of these sites.

Figure C1635-1

End Use	Electric Energy RR	Summer Seasonal Peak Demand Realization Rate		Winter Seasonal Peak Demand Realization Rate		Gas Energy Realization Rate
		Actual Population ⁵	If Fully Populated ⁶	Actual Population ⁵	If Fully Populated ⁶	
Cooling	102.1%	192.5%	146.4%	146.2%	125.0%	-
Heating	102.1%	192.5%	146.4%	146.2%	125.0%	76.5%
Lighting	97.9%	98.9%	98.9%	115.3%	115.3%	-
Custom	93.8%	106.7%	103.1%	122.7%	120.1%	77.3%
EMS	67.6%	123.9%	114.7%	179.8%	162.1%	78.2%
Motors	67.6%	123.9%	114.7%	179.8%	162.1%	-
Other	67.6%	123.9%	114.7%	179.8%	162.1%	78.2%
Process	67.6%	123.9%	114.7%	179.8%	162.1%	78.2%
Refrigeration	67.6%	123.9%	114.7%	179.8%	162.1%	-
DHW	-	-	-	-	-	76.5%

⁵ Recommended realization rates if tracking system estimates for some sites are 0.00 kW as found in the current study tracking population.

⁶ Recommended realization rates if tracking system estimates are fully populated with non-zero values moving forward.

The evaluation team recommends revising the PSD to explicitly call for the use of site-specific hours of use assumptions when calculating EO lighting energy savings. The evaluation team recommends using the following C&I upstream lighting hours of use assumptions by building type below.

Figure C1635-2

Building Type	Upstream Hours of Use	Summer Seasonal Peak Coincidence Factor	Winter Seasonal Peak Coincidence Factor
24x7 lighting	8,760	100.0%	100.0%
Automotive	2,807	68.3%	36.9%
Education	2,967	36.8%	46.0%
Grocery	7,698	90.6%	85.6%
Health Care	5,564	82.5%	69.6%
Hotel/Motel	3,112	40.6%	37.5%
Industrial	5,793	83.0%	66.5%
Large Office	4,098	77.9%	58.2%
Other	6,211	86.9%	76.7%
Parking Lot/Streetlights	6,887	67.2%	87.3%
Religious Building/Convention Center	913	17.0%	9.2%
Restaurant	6,072	83.1%	77.0%
Retail	6,318	98.4%	85.6%
Small Office	3,595	76.8%	44.1%
Warehouse	5,667	89.3%	72.4%

The evaluation team recommends incorporating the following PSD upstream lighting savings factor assumptions by product type based on the results of this study.

Figure C1635-3

Upstream Lighting Product Type	Short-term In-service Rate	Long-term In-service Rate	Delta Watts	Electric Energy Interactive Factor	Summer Demand Interactive Factor
LED Linear	97.1%	97.4%	15.33	1.081	1.199
LED Downlights	85.9%	86.4%	41.16	1.023	1.189
LED A-line/Decorative	71.4%	74.9%	40.32	1.024	1.176
LED High/Low Bay	99.6%	99.7%	157.33	1.008	1.047

Report Link:

https://www.energizect.com/sites/default/files/C1635_FINAL%20Report_Energy%20Opportunities%20Impact%20Evaluation%2008272020.pdf

3. STUDIES IN PROGRESS IN 2020

The following studies had kick-offs in 2019 or 2020 and were still in progress at the end of 2020. Note that study numbers beginning with C are commercial, R means residential, and X studies cross both residential and commercial sectors.

X1931 - In-depth review of the Connecticut Program Savings Document (PSD).

The CT Program Savings Document (PSD) is used in developing the C&LM Plan. The document is updated annually by utility staff to incorporate results from Connecticut residential and commercial evaluation projects and savings and the variety of other local, state, and federal measure, savings, and other values that comprise the PSD. However, there has not been an independent, in-depth PSD review in the recent past. This study undertakes a comprehensive, systematic, measure-by-measure, data-driven review of Connecticut's PSD against a variety of studies and regional PSDs to identify data gaps, recommend near-term updates, and prioritize future research and evaluation opportunities. This study is designed to address five main objectives: 1) Conduct a comprehensive, data-driven review of the entries in the PSD to identify gaps, validate values against best available data, and provide prioritized opportunities for primary research; 2) Complete research to fill in data gaps and to update content based on best available data, including secondary research; 3) Recommend near-term PSD updates and develop a prioritized list of gaps that should be filled by primary research (near- and longer-term); 4) conduct agreed-upon high priority primary research on PSD entries for CT and 5) Suggest PSD update protocols for the future based on best practices research from other jurisdictions. The outcome for this study will be specific values and entries to be incorporated into a revised PSD.

X1932 – Evaluation of Demand Reduction (DR) Programs (UI) (All Sectors)

The CT utilities are increasing their attention to other types of programs as the reliance on lighting decreases. This includes demand reduction (DR) programs. There are a number of DR Projects / Pilots being developed by the utilities within the energy efficiency portfolio. Because the Utilities are offering a number of the DR programs across state lines, some of the DR projects / pilots are being assessed by independent evaluators in another state. However, this project is conducting evaluations of DR programs specific to CT, including HVAC and thermostat equipment, an Air conditioning project, and others.

The study is providing up-front work to ensure that the DR pilot projects are structured in a way that allows evaluation of results in consistent and valid manner, and collects data needed to conduct defensible estimates of kW savings for the program. After the fast-track review of the set of existing DR pilot evaluations, the work will involve monitoring / critiquing the pilots, assuring evaluations and pilots are well-designed for evaluation; and conducting evaluations of potential future pilot designs/performance. Depending on implementation schedule and number of participants in the program, the project will also estimate the kW savings associated with the program.

Researchable Questions

1. What kW reductions are realized by DR pilots?
2. How do DR pilots fit into existing EE efforts? Are there other efforts that would fit better with existing EE, or how does EE need to change to incorporate DR into the measure mix?

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3. Are any changes to research questions or methods recommended for utility-administered studies?
 4. How can the DR pilots be expanded/scaled up to a broader group of potential participants based on pilot eval results (e.g., will early adopters of pilots be more receptive & engaged or otherwise differ from the broader population)?

Methods

In the first period, the contractors have been in the role observers. In subsequent years, the contractors work with utilities, technical consultants, equipment manufacturers, and others with critical data to design evaluation plans, implement those plans, and analyze the results using data from the measures included in the program(s), including thermostats, wi-fi-connected heat pump water heaters (HPWH), AMI meters, billing records, and other customer data. On the C&I side, measures may include EMS, HVAC controls, lighting controls, process measures, battery storage or other measures. Surveys of customers may be a component of some of the individual studies.

This project began in 2019, and is continuing through 2021.

X1939 - Early Retirement Program Evaluation.

Connecticut's 2019–2021 Conservation & Load Management Plan outlines several early retirement programs. The C&LMP includes plans for small targeted initiatives (storage water heaters and HVAC equipment), early retirement incentives for air-to-air heat pumps for central A/C, and for and natural gas high efficiency boilers and furnaces, and for the replacement of larger commercial or industrial equipment such as large chillers. The primary objectives for this impact evaluation are to provide feedback on these types of programs and verify the savings claimed by the pilot programs that are being released throughout 2020. In Phase I, ERS will conduct secondary research and interviews to provide recommendations about program design and implementation. In Phase II, ERS will estimate the adjusted gross energy savings (natural gas and electric) and demand (both summer and winter) for CT early retirement programs. Data collection for this evaluation primarily consists of project file review and interviews with participating customers. The project will: 1) Provide feedback on early retirement program design, including which gross and net parameters are relevant for these programs; 2) Ensure that CT programs are using correct measure type and baselines in the PSD; 3) Examine non-energy impacts NEIs appropriate to the programs; 4) Optimize the program's design and delivery of services for effectiveness and efficiency; 5) Assess the savings and realization rate performance of the program to provide improvements to the design of early retirement programs.

X1941 - Multi-family Impact Evaluation.

The multifamily sector represents a large, relatively untapped opportunity for cost-effective energy savings. Historically, multifamily applications and projects have not been separately evaluated, but rather the results of residential and commercial evaluations have been applied to low-rise and high-rise multifamily, respectively. As the multifamily housing sector is growing in Connecticut and nationally, it is increasingly important to separately evaluate the impacts of energy efficiency measures in multifamily buildings. Connecticut is responding to identified gaps in realized savings that are ostensibly due to a

misalignment between actual savings levels likely to occur in multifamily properties and savings levels identified for commercial and residential sectors in the PSD.

This multifamily impact evaluation includes a gap analysis based on a thorough review of the PSD and other similar resources from other states and an engineering review of the calculations and assumptions. Based on this information, the study will recommend modifications to the PSD and utilize site specific information and billing data for a sample of participants to validate the accuracy of the proposed revised estimates, as explained in the following sections. The study includes a comprehensive review and update of measures, with special attention to measure categories with high levels of savings and those with significant variance in savings. Priority measures will likely include boiler, domestic hot water (DHW), insulation, in-unit appliances and lighting replacements. The study will use on-site verification to field test and further improve the PSD savings estimates. The study will use billing data from a sample of surveyed sites to verify savings estimates at the site level and, to the extent it can be correlated, to the measure-level. The study will then conduct analysis of the available site and utility data to identify whether billing data generally supports the revised PSD savings estimates. The study will compute a realization rate for the statewide multifamily program(s). Once all the data collection and analysis are complete, The study will provide recommendations for multifamily-specific saving methodologies to use in the PSD, along with program-level realization rates and program-level savings.

X1942 – Cross-Cutting Non-Energy Impacts Evaluation

Non-energy impacts (NEIs) are the effects, beyond energy savings, that energy efficiency program measures deliver to participants (comfort, productivity, etc.), utilities (T&D, bill payment improvements, etc.), and regional customers beyond participants (called “societal”, including emissions reductions, job creation, etc.). A traditional benefit-cost or cost-effectiveness test would include all benefits divided by all costs associated with the perspective of the “test”, but utility C/E tests have traditionally included only direct energy savings in the numerator, omitting indirect, harder-to-measure NEIs.

CT has been reviewing its cost effectiveness tests (C/E), and has been undertaking work consistent with the National Standard Practice Manual (NSPM) to review policy and options related to their C/E test, its perspective, and the potential role of various types of non-energy impact values in the revised test. Currently, only a limited set of NEIs are include in CT’s cost-effectiveness test.

This study will provide data and information to support review / revision work of CT cost-effectiveness test, and is designed to provide NEI results that can be included in updated C/E calculations as possible after CT’s C/E policy is updated.

The project is not a literature review; instead, it is data-focused, including substantial CT-based primary research. The study will provide quantitative estimates of high priority NEIs that can support revisions to cost-effectiveness tests, enhance the low income and other NEBs in PSD Appendix 6, and also identify next NEI research priorities.

The methods to be used are best practice, resulting in NEIs that are defensible, derived using transparent procedures, and not be perceived as a coming from a “black box”. The study will examine missing low income NEIs, and build off earlier CT projects in NEIs.

Researchable Questions / Objectives:

- Identify and implement cost-effective, efficient, state of the art estimates of NEIs to address priorities low income / residential and at least one commercial application for CT.
- Support policy and cost-effectiveness direction development, and answer issues addressed in the Order by expanding the coverage of NEIs in Appendix 6 of the PSD (from the current low-income NEBs, HES NEIs, and C&I BES NEIs).

The project involves detailed survey work, and calculation of NEIs associated with measures installed in the HES / HES-IE program, and two other programs. Additional efforts include an arrearage analysis, designed to allow quantification of the payment and financial benefits associated with CT’s low-income program.

The first round of NEI work is expected to be completed by Summer 2021. Other estimation work for other programs will continue into 2022.

X2001 – Measure Life Study / EUL Update

The measure lifetimes / EULs in the CT PSD are a key part of the cost-effectiveness calculations for measures and programs. However, the numbers in the PSD are very aged (>20 years), have been adopted / adapted from other locations (many without statistical underpinnings), and have not been updated to today's technologies or CT’s conditions. Defensible numbers are not available from literature; new surveys and statistical work are needed to support improved values.

Research Objectives: The research objectives for this project are to provide statistically-defensible, updated, CT-appropriate EULs for several major Residential and C/I measures. The selection of measures is prioritized based on savings, program importance, age, measure importance, and ability to conduct analytical / quantitative work that will meet budget (e.g., HVAC, DHW, but excluding lighting).

Researchable Questions:

- What are the highest priority EULs to address? Which can this study provide quantitative information for?
- How can the study be designed to use best (well-known) practices for EUL studies, but also leverage the fact that many years of participants can be surveyed in one sample to reduce cost and improve efficiency? For which measures can this work or not work? Can a template be developed and applied to future CT residential and commercial EUL studies?
- What are updated values for EULs for a set of priority residential and commercial EULs?

Methods:

The study is being conducted using the basic long-recognized statistical approaches for EULs – but can be conducted more efficiently than traditional studies that look at one program year, and later conduct

follow-up surveys to identify later, longer-term failures. Instead, this study uses the fact that programs have been offering many of the same types of measures for many years, and if multiple cohorts / vintages of participants receiving measures are surveyed now (including those installed more than 10 years ago down through recent-year participants), no follow-up studies are needed to identify long-period failures. This approach should save time and money, and lead to reliable estimates of updated measure lifetimes.

At least one new measure lifetime estimate is expected by summer 2021, with at least two lifetime estimates developed by the end of 2022.

X2022 – Evaluation of Customer Engagement, Education, and Workforce / Training Initiatives

The C&LM Plan includes workforce development / training, education, and community and customer engagement initiatives that represent substantial expenditures of the public funds (about \$14M over three years). To ensure a return on public investment, this study is conducting a formal evaluation of these activities to provide information to: (1) review best practices for the design and conduct of outreach / training programs; (2) provide information tailored to the three main initiatives on design, planning, and tracking; (3) identify which of the efforts currently underway have the ability to influence behaviors, and (4) where possible, quantify energy savings (either direct or indirect).

The key research questions being addressed by the project include:

- What are the learning objectives of current training/education/engagement activities? How do they need to be altered to refocus activity to causing action by attendees that leads to energy savings?
- How do current training/education/engagement activities conform to best practices in (adult and other) education and engagement?
- What actions and behaviors are attendees taking as a result of the initiatives / programs? Which can be linked to energy savings? What limits the effectiveness in achieving energy saving actions being taken?
- To what extent are training activities expanding the workforce? How many trainees get new jobs or expand services because of training?
- How should the initiatives be refocused to improve goals, links to savings, and future evaluability?
- What accounting/reporting/testing should be used during and after activities to improve effectiveness and document achievements?
- Are any of the actions producing sufficient savings that warrants a quantitative assessment? If so, can we design and implement that assessment?
- Which initiatives do not show promise for ultimate linking to energy savings?

To achieve these objectives, the evaluation is expected to conduct literature review, extensive interview and surveys, and examine the programs in detail. The following main activities include:

- Documentation of engagement efforts

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- Secondary data analysis to identify best practices and develop tailored best practices for the various types of initiatives included in the program
 - Conduct in-depth analysis of selected high-priority programs to conduct an evaluation assessment, quantify behavior changes, and where possible quantify savings and catalog savings opportunities.
 - Synthesize the analyses and develop recommendations for specific initiatives for the various initiatives and programs.

The work is intended to finish, in largest part, by summer 2021.

C1901 – C&I Sector Wide Process Evaluation.

This study is designed to understand how the portfolio of large C&I programs (Energy Opportunities, Energy Conscious Blueprint, Business and Energy Solutions) work together to deliver savings to the targeted sector. The key areas of interest are cost effectiveness, program optimization, market penetration, depth of savings, and customer equity. The study will use a consistent approach to investigate these issues, analyze the data for cross-program and cross-Company comparisons, and assess opportunities for closer synergies between programs. This comprehensive approach offers advantages over evaluations of individual programs where interactions between programs serving the same market can be less visible to the investigator. The approach also supports economies of scale where the sample sizes and number of interviews are smaller than for individual programs. The deliverable is a report with findings and recommendations for the key areas of interest.

C1902 – ECB Net to Gross and Baseline Evaluation

The Energy Conscious Blueprint (ECB) program serves commercial, industrial, or municipal customers of any size from Eversource, United Illuminating (UI), Connecticut Natural Gas (CNG), and Southern Connecticut Gas Company (SCG). The program offers incentives for new construction, major renovation, and tenant fit-out projects, as well as new (or end-of-useful-life replacement) equipment projects. Utility energy experts work with customers and design teams (architects, engineers, contractors) to identify potential energy conservation measures (ECMs). Savings estimates are calculated in advance of implementation, and upon completion and verification of measures, customers receive incentive payments. Projects may include energy-efficient lighting, HVAC, whole-building performance, energy-efficient envelopes, refrigeration, water heating equipment, or process equipment.

This study focuses on key issues related to proper baselines. This study will update baselines and net-to-gross ratios for true new construction and end of life replacements. It will incorporate baseline assessment to ensure that savings and program attribution calculations are aligned. This study updates specific PSD values that are widely used across the ECB program in savings analysis and reporting. The study will improve the accuracy of gross and net savings estimates by integrating research into market baselines, free ridership and spillover under a single study. The study will improve alignment between baseline and free ridership data to minimize the potential for double-counting impacts, particularly where market practices are better than common baselines.

C1906 – Strategic Energy Management (SEM) Program Evaluation.

The C1906 SEM Best Practices and Evaluation project focuses on evaluating the Strategic Energy Management (SEM program), a specific initiative of the Business and Energy Sustainability (BES) program designed to achieve energy and non-energy benefits. The study consists of three phases: the evaluation method development, the SEM process evaluation, and the SEM impact evaluation. The primary objectives for this study are to recommend reported and evaluated savings calculation approaches and identify data needs for SEM evaluation based on a literature review, to provide evaluation methodologies based on refinements to the best practices for SEM, and to perform process and impact evaluations on SEM using the best practices identified in the study.

This report addressed the first of three components of the C1906 study, focusing on best practices recommendations and data requirements for SEM program evaluation in Connecticut. It also includes selected preliminary SEM best practice findings for Connecticut’s SEM program design based on literature review of existing evaluation reports, SEM-related conference papers, white papers, and technical documents (e.g., the Uniform Methods Project SEM Evaluation Protocol). ERS and IEC reviewed eight SEM evaluation reports that covered program activity in 12 states, along with 16 other papers and documents, to develop the findings presented in this report. The authors also conducted in-depth interviews with program managers, implementers, and industry experts from across the country, many of whom contributed to the evaluation reports that were reviewed. Overall, the ERS team completed 10 interviews, including 4 with evaluators, 3 with technical leads, and 3 with SEM implementers.

For this component of the study, the ERS team identified the following program practices and observations that will aid the evaluation of SEM programs in Connecticut:

1. The implementer should collect and store robust data on energy consumption, facility characteristics, weather, and other influential independent variables as this data is essential for SEM evaluation.
2. The implementer bears significant responsibility for data collection.
3. The default savings approach should include a robust top-down analysis model that has been tested for validity and has accounted for non-routine adjustments and other factors.
4. Stakeholders should agree upfront on the data and methodological requirements for the SEM savings model and have a contingency plan in place.
5. Non-routine events must be diligently identified, documented, and accounted for during reported savings estimation.
6. Measure lives/persistence assumptions vary widely by program and region.

C2014 – C&I Lighting Saturation and Remaining Potential

The *C2014 C&I Lighting Saturation and Remaining Potential* study addresses the question, “How much potential remains for lighting measures in the Connecticut C&I market today and over the next ten years?” The study objectives are (1) understand the current C&I lighting market saturation by technology, application, and building type for both participant and non-participant customers; (2) forecast Connecticut lighting potential over the next ten years; and (3) characterize current lighting purchasing behavior.

The study leverages a similar but larger effort in Massachusetts by using the same adoption curves and measure costs, savings and lives, modified for the Connecticut market. Data collection methods include customer surveys, on-site surveys, and market actor interviews. In addition to reporting current and forecast C&I lighting saturation of lighting technologies including LED penetration the study will deliver a proprietary Connecticut lighting market model in Excel to forecast 2020-2029 lighting fixture counts including control status. The output is like the Massachusetts model providing a record for each unique combination of year, lighting system application (six types), technology (ten types), facility (seven types), and control type.

R1973 - Retail Non-Lighting Evaluation.

The *R1973 Connecticut Retail Non-Lighting Evaluation* covered two program groups run by Eversource and United Illuminating (Connecticut Utilities): the ENERGY STAR® Retail Products Platform (ESRPP) and E-commerce platform. The study had two main objectives; (1) develop improved impact parameters for ESRPP and the E-commerce platform programs, and (2) recommend improvements to the design and implementation of each program.

The ESRPP and E-commerce programs are part of the Connecticut program administrator’s (PA’s) efforts to provide additional energy efficiency opportunities to residential customers in the face of recent declining savings opportunities from lighting. This research supports the Connecticut PA’s expansion of energy efficiency opportunities to residential customers.

Key Findings and Recommendations

Table 1 and Table 2 below summarize our recommendations out of the engineering review for each of the ESRPP and E-commerce measures, including the original and updated savings values, the source(s) of the recommended update.

Table 1. Summary of PSD Recommendations – Electric Savings

Measure	Updated Value (kWh)	Existing Value (kWh)	Source for Updated Value (with Year ^{1,2})
ESRPP Measures			
Refrigerator Tier I	64	64	PSD, 2017
Refrigerator Tier II	96	96	PSD, 2017
Freezer, Upright	50	45	Supplemental PSD documentation, 2017
Freezer, Chest	32		
Clothes dryer, Gas	36	93	VT TRM, 2015
Clothes dryer, Electric	194		VT TRM, 2015
Clothes Washer, Tier I	88.1	66	VT TRM, 2018
Clothes Washer, Tier II	120.3	117	VT TRM, 2018
Room AC	10.7	77.5	VT TRM, 2015
Dehumidifier	214	214	PSD, 2017
Air Cleaner/Purifier	214	227	VT TRM, 2004
Sound Bars ³	24	45	VT TRM, 2013
E-Commerce Measures			
Wi-Fi Thermostats	104	25 ⁴	MA, 2018
Smart Thermostats	Calculated Deemed		VT TRM, 2018
Adv. Power Strips, Tier I	48	48	PSD, 2016
Adv. Power Strips, Tier II	179		MA TRM, 2018

¹Year represents the date of the source information, not the date the respective TRM was updated.

²The research team has no reason to believe that a clothes dryer would operate differently in VT than in CT.

³A follow-up email was sent on 6/25/20 to confirm there is no additional documentation not shared with the research team. To date no additional documentation has been received for sound bars.

⁴The Connecticut PSD deemed savings for Wi-Fi/smart thermostats distributed through ESRPP or E-commerce is for cooling savings only.

Table 2. Summary of PSD Recommendations – Gas Savings

Measure	Updated Value	Existing Value	Source for Updated Value (with Year ¹)
ESRPP Measures			
Clothes dryer – gas ^{2,3}	1.215 therms	NA	New York, 2017
E-Commerce Measures			
Wi-Fi Thermostats	6.6 MMBtu	NA	MA, 2018

¹Year represents the date of the source information, not the date the respective TRM was updated.

²The research team has no reason to believe that a clothes dryer would operate differently in NY than in CT.

³The research team is aware that gas clothes dryers are not currently offered through the ESRPP program in Connecticut.

ESRPP Findings and Planning Recommendations

ESRPP is designed as a national, long-term market transformation program but most Program Sponsors, including the Connecticut Utilities, lack the regulatory framework to operate it as designed. Therefore, ESRPP is typically implemented as a short-term resource acquisition program in terms of the selection of products and the focus on midstream incentives. This shift causes modifications to program implementation, as Program Sponsors adjust the program structure and incentives to suit their individual needs for claiming short-term, cost-effective savings. Another outcome of this shift is a lack of Program Sponsor engagement (including the Connecticut Utilities) in long-term market transformation activities such as advocacy for equipment standards, participation in national working groups, and overall advocacy for the program and recruitment of peer utilities into the program. This lack of engagement in long-term activities limits the prospects for all Program Sponsors to deliver significant savings.

These modifications to ESRPP implementation also weaken the program because national retailers cannot rely on consistent incentive levels. Our analysis of retailer interviews indicated they make stocking decisions at a national level. Differing incentive strategies for the various Program Sponsors make it challenging for retailers to see the benefit of pre-purchasing efficient equipment. Retailers also make product decisions about a year in advance of products hitting the shelves, so having annual incentive levels at the start of the program year do not align with retailer decision-making timelines. Retailers also requested more centralized and specific product guidance; however, when Program Sponsors are offering different incentives on different products, this does not provide a clear signal to retailers on which products to purchase.

The Connecticut ESRPP program is not yet impacting retailer stocking and shelf assortment of energy efficient products. The Connecticut’s ESRPP has only been in place since 2018, so this result is expected, as market transformation programs can take up to three years to impact the market. Our high-level findings from the evaluation tasks and conclusions from the engineering review of the ESRPP measures result in the following recommendations for program planning to support the future success of the Connecticut Utilities ESRPP.

▶ **Begin tracking upright and chest freezer purchases separately (if not doing so already) to allow freezer type-specific savings estimates to be applied for upright and chest types.** The amount of potential energy savings is different for these specific products. More granular product tracking will allow for more specific savings claims and may result in higher overall savings depending on the distribution of sales.

▶ **Institute two-year incentive levels and budgets instead of current annual process to better align with retailer purchasing timelines.** Retailers make purchasing and marketing decisions one year, or more, in advance of stocking products.

▶ **Monitor key performance indicators (KPIs) to help identify where the program is having success in the shorter-term and where it is lagging.** The table below outlines suggested KPIs that can be developed using data that is already being collected by the Connecticut Utilities or other ESRPP stakeholders.

Table 3. Key Performance Indicators for ESRPP

Metric Description	Metric Calculation	Data Collection Activity
Total Deemed Savings	Monthly deemed savings overall, and by product category	ICF sales data portal
Net Benefit	ICF sales data portal	Program data
Number of Participating Store Locations	Total program spend (\$) per kWh or kW saved	Program data
Number of Product Categories	Number of Product Categories	Program data
Count of product categories incented overall	Count of product categories incented overall	Program data
Program data	Program data	Program documents
Total incentive dollars paid	Total incentive dollars paid	Program data review

▶ **Work with the national ESRPP collaborative to recruit regional peer utilities into the program.** Recruiting additional, regional Program Sponsors will enhance the impact of the program on retailer stocking and support greater savings for the Connecticut Utilities ESRPP program.

▶ **Provide specific directions to national retailers on purchasing and promoting specific products (e.g., marketing strategies and content) and establish relationships with local retailers to ensure national guidance is implemented.** Retailers need help understanding why customers would be interested in different energy efficient (rebated) products. This will help staff better understand why it is important to stock high-efficiency products and how to actually market these products to customers. Some Program Sponsors have also had success expanding the scope of the program by signing up local retailers in addition to the national retailers.

E-Commerce Findings and Planning Recommendations

As more retail sales shift to online venues, utilities are establishing E-commerce (online) platforms as a way meet customers where they shop, educate customers on existing rebate products, and deliver energy savings. Program administrators (PAs) need to determine the specific goal of the platform – whether it will be a channel to deliver rebated products to customers or an educational platform to help customers discover energy efficient products and their features, or both. The design of the platform should match the selected objective. For example, if educating customers is the priority, the platform should be designed to share information about long-term cost and energy savings.

Utilities’ E-commerce platforms feature both rebated and non-rebated products, with some including non-energy related products as well. Literature review indicates that consumers “broader online digital

experiences are continually refining and resetting” their expectations, and product design should enable an “effortless customer experience.”⁹ Therefore, including as many product categories as possible, as well as product information on both rebated and non-rebated efficient products offers a better, more integrated customer experience. Our high-level findings from the evaluation tasks and conclusions from the engineering review of the E-commerce measures result in the following recommendations.

▶ **Continue to review the design and user experience of E-commerce platforms.** The Connecticut Utilities have made recent updates to their E-commerce platforms including additional products and product information that enhances the customer experience. The Connecticut Utilities’ should continue to use non-utility E-commerce platforms that customers are familiar with as a benchmark for platform design.

▶ **Add educational information to help customers understand the benefits of buying efficient products.** Eversource recently updated their site to include educational information, but the UI platform focuses on products and information about other energy efficiency programs. The more robust utility E-commerce sites clearly show users which products receive incentives, specific information on the efficiency of both rebated and non-rebated products, buyers guide information, and customer ratings and reviews to give products more credibility.

▶ **Track Wi-Fi and Smart (learning) thermostat purchases separately, as well as Tier I and Tier II purchases separately (if not doing so already).** Results from our engineering review of E-commerce impact parameters indicate the amount of potential energy saved is different for these specific products. This level of product tracking will allow for more specific savings claims which may result in higher overall savings depending on the distribution of sales.

▶ **Leverage direct email for effective marketing outreach.** Peer utilities noted this was their primary and most successful marketing channel to drive traffic to their sites. The Connecticut Utilities should put in place a direct marketing campaign (if they are not doing so already).

▶ **Continue to increase the number of product categories available on E-commerce platforms.** Any products that have existing prescriptive rebates that can be sold through the E-commerce platform should be included. Further, non-rebated efficient products should also be featured. Eversource recently expanded their products to include appliances.

R1959 - Single-Family Renovation and Addition Potential Analysis.

Renovations and additions to homes may represent a larger opportunity for energy savings than new construction, but neither the current RNC or retrofit program in Connecticut is set up to address the needs of renovations and additions. It is unclear how large the market is, how much of the work has the potential for improvements in energy efficiency, nor how equipped current home repair contractors are to deliver energy efficiency. This study is designed to 1) estimate the size of the market using permit data, 2) characterize the scope of renovation and addition projects, 3) gain insight on standard practices used in these projects to inform future baseline efforts, 4) estimate the energy saving potential that

⁹ Accenture. The New Energy Consumer: Unleashing Business Value in a Digital World. 2015. <https://www.accenture.com/acnmedia/accenture/next-gen/insight-unlocking-value-of-digital-consumer/pdf/accenture-new-energy-consumer-final.pdf>

currently exists in this sector, 5) identify key barriers in this market, 6) make recommendations for program planning and updates to the Connecticut Program Savings Document (PSD) and 7) provide a limited process evaluation of the RA program in Connecticut and compare with other programs nationally/regionally to identify best practice improvements. The study will use a specialized calculation algorithm to estimate market size using Census data, information from contractor and homeowner surveys and other data to characterize the scope of renovation and addition projects. Resulting energy simulation models will estimate the potential savings for the variety of renovation and addition scenarios, and the savings will be scaled up to estimate the potential savings for the entire state. The study will also gather baseline information on market effects indicators so that market effects can be measured and tracked in future evaluations.

R1965 - HP/HPWH Baseline and Potential Assessment.

With the Connecticut Utilities considering a shift in the residential market toward efficient heat pump systems, it is critical to gain a full understanding of these markets in terms of their size, the key market actors, and the drivers and barriers that affect adoption. How many of these systems are sold, and into what supply chain channels? Do market actors see a value proposition for these products? Is the air source heat pump (ASHP) market trending toward ductless mini-splits, or is there increasing interest in less-visible distribution systems that use ducts or in-ceiling cassette blowers? Will the efficiency of heat pump water heaters (HPWHs) compensate for their complex installation requirements? Do mini-split ASHPs and ground source heat pumps (GSHPs) meet the needs of the retrofit market? The study will incorporate multiple primary and secondary data sources to estimate the size of the market in Connecticut. Secondary sources include previous baseline studies, purchased sales data, as well as shipment data. Primary data collection work will solicit feedback from manufacturers, distributors, and installers through interviews and interactive surveys to better understand the future of the market for heat pumps, as well as system configurations that are dominating the market. The project will provide results from cost effectiveness testing at the measure level, focusing on particular system configurations of interest to identify the most cost-effective systems and system installation configurations for the Utilities to consider in order to meet the C&LM goals for heat pumps. This study will take an in-depth dive into the state of the Connecticut market for heat pumps and heat pump water heaters, investigating the size and state of the market, what market actors think about these technologies, real-world factors affecting heat pump installations in homes, and how the Utilities can best promote cost-effective heat pump programs, given the rapid change in heat pump technologies.

R1982 - HVAC / DHW Performance & Potential Evaluation

This project is focused on getting up-to-date performance measurements for two emerging technologies: mini-split heat pumps and heat pump water heaters. This project will install metering equipment in 150 homes in Connecticut to provide detailed energy use and load shapes for prevalent HVAC and DHW equipment types. This data will update the PSD values for efficiency, annual use, seasonal peak and off-peak loads.

The project will install end-use metering equipment on major energy-consuming equipment in 150 single-family homes across Connecticut. Emphasis will be on selecting homes with heat pumps or heat pump water heaters, though the sampling plan includes homes that have furnaces, boilers, or other

types of water heaters. Meters will remain in place for at least one year so that data from summer and winter periods will be collected. When possible, other large electric equipment will be metered. Together this project will update baseline and efficiency assumptions in the PSD. It will also provide better load shape data for use in demand-response studies and as inputs to the New England ISO.

R1983 HES & HES/IE Process, Impact and Profiling Evaluation

R1983 HES & IE Process and NTG Evaluation And Impact Evaluation (R1984)

This project is conducting a comprehensive process evaluation and impact evaluation of the single-family portions of the Home Energy Solutions (HES) programs and HES-IE (income-eligible) program. The HES and HES/IE Programs are the biggest programs in Connecticut’s residential portfolio. The process evaluation focuses on program process and efficiency, document and performance review and a substantial customer profiling / data mining effort. The impact evaluation quantifies gross and net savings, NTG, and realization rates at the end use and measure level – with a drill-down on drivers for unexpected results.

The process component uses document review, interviews, and hundreds of surveys to examine: workforce needs, marketing and customer /engagement, recruitment, program delivery, quality assurance and vendor performance, vendor business models and viability, costs assessment, data collection and management, the role of financing including coordination with the Green Bank, and customer satisfaction. The program tracking database review is examining: performance, performance by contractor and utility (and possibly region or other factors), backlogs, percent with deeper measures, and other statistics.

The data-centric residential market assessment / customer profiling effort is examining what areas and customer types have been served by the residential efforts and where opportunities lie to improve participation, assess equity issues, and inform program refinement, with results stratified by renters, low and moderate- income households, households that have limited English proficiency, distressed areas, and other subgroups.

The impact evaluation is very important to Connecticut’s update of the PSD values for this program and uses surveys and statistical analysis to provide measure- and end-use related consumption, savings and realization rates, and include a detailed drill-down of drivers for the results. A comparison to recently-completed work using Recurve will also be conducted.

The major parts of the project are expected to be completed by Summer 2021, with additional research results delivered in late 2021 and early 2022.

R2027 – Heat Pump and Heat Pump Water Heater Reliability Study

This study is assessing the reliability, repair costs, satisfaction, and perceptions associated with heat pumps (HPs) and heat pump water heaters (HPWHs). HPs include the three types supported by CT programs: ductless split air-source heat pumps (DSHPs), central ducted air-source heat pumps (central

ASHPs), geothermal (ground-source) heat pumps (GSHPs). The study is collecting information on contractor callbacks, customer satisfaction, perception, and cost of repairs, and the goal is to provide recommendations for program planning. The project is being coordinated with two other studies (X1942 and R1965) for efficiencies.

The project's efforts include:

- Detailed literature review to compile data and literature providing baseline information on topics that address HP/HPWH reliability and customer satisfaction and perceptions, well as costs associated with HP/HPWHs. The literature review is also being used to benchmark and enrich the study's results.
- Installer Surveys and In-depth interviews . These surveys will gather data on service frequency and type of service and repair calls, operational issues, repair costs, skepticism among customers, and customer complaints.
- Surveys of participants installing HP and HPWH. These web-based surveys are gathering information on satisfaction with measure, frequency and type of issues, repair costs, experience in cold weather. It will also gather baseline details of replaced equipment and other mechanical configurations as well as non-energy impacts.
- The report is focused on concise results, and actionable recommendations for HP/HPWH program planning.

The study is expected to be completed in Summer 2021.

R2029 – Single Family Weatherization Metric and Update

This study's goal is to develop and estimate a quantitative indicator of progress toward the Legislature's Weatherization Goal that can be estimated and reviewed on a regular periodic basis, be reasonably inexpensive to measure, and reflect the progress over time. The goal is to leverage available secondary data, potentially from the HES / HES-IE program and from CT participants in the national Weatherization Assistance Program (WAP) to create this metric.

In 2011, the CT legislature established a goal of having 80% of homes weatherized by 2030; however, the legislature was mute on the definition of weatherization. The 2014 R5 Study developed housing "types" and inspected 180 homes to assess the performance of homes relative to EEB's draft weatherization standard. The weatherization definition used was based on presence of various measures on-site, some of which could be validated on-site, and some of which ultimately could not be inspected in a practical / reliable way. The study found a significant shortfall in meeting the goal, but also cost a great deal to conduct, so it is not a feasible source for frequent updates monitoring progress.

These findings are out of date at this point, but a progress metric toward the Legislative goal of 80% Residential Weatherization is a priority to DEEP. This study is tasked with:

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- Identifying one or more feasible, workable, replicable weatherization definitions, with recommendations for best metric
 - Quantification of the metric based on readily-available data to be reviewed by EM&V, DEEP and potentially a public process,
 - Revisions as needed, and instructions (and data sources) for implementation of the metric into the future, and
 - Coordinating with / supporting DEEP on aspects of the public process.

Researchable Questions:

- What progress is being made toward the 80% weatherization goal? How much progress is still needed?
- Is this a workable definition for “weatherization”? What other definitions may be appropriate and/or feasible and measurable? Can this (or another reasonably-feasible) method be used to track progress going forward in-between larger field inspection-based studies of weatherization progress?

Methods:

As mentioned, this analysis is a “desk study” rather than a primary data study with on-site data collection. The study will provide results and recommendations.

The study is expected to be completed in Summer 2021.