CONNECTICUT ENERGY EFFICIENCY BOARD

EVALUATION STUDIES AND RESULTS, 2012

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

November 1, 2012

CONNECTICUT ENERGY EFFICIENCY FUND

The Energy Efficiency Board (EEB) Evaluation Committee is proud 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. The EEB EM&V evaluation process provides funding, leadership, and data, and also reviews studies managed by Northeast Energy Efficiency Partnerships (NEEP).

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

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.

The Connecticut Energy Efficiency Board Evaluation Committee;

Amy Thompson, Chair

Connecticut Energy Efficiency Board Evaluation 2012

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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. Since that time, 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 which 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 and totally responsible for all aspects of the evaluation process.

Since that time, the evaluation process and oversight have changed through additional Department of Public Utility Control (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 EEF's 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 $3.38 million dollar 2012 budget for all evaluation and related research studies represented 2.7% of the program costs of $124.69 million.

Research completed within the evaluation group provides many types of information. Impact and process evaluations form the bulk of 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
- New end uses and equipment that may be included cost-effectively, including assessment of the associated barriers for inclusion of each
- Customer segmentation and market research, including research into ownership patterns, and
- 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 enables the Companies and EEB to use savings estimates and Evaluator recommendations to improve and advance programs with full confidence.

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

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 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.

Baseline Studies provide direct impact support by assessing pre-conditions that will no longer be measureable after program interventions have occurred.

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.

Evaluation Protocols are produced within the Regional EM&V Forum to provide direction to states new to the evaluation process and to ensure consistency to all of the states within the Forum. Cost-effective regional evaluations are coordinated through the Forum. The EEB is an active participant in the EM&V Forum, providing leadership, quality control, data and funding to its efforts.

Collectively, these types of studies are sometimes referred to as Evaluation, Measurement and Verification (EM&V). 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 program 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.

ORGANIZATION OF THE REPORT

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

Section 1 Completed Studies includes descriptions, costs and summary results from completed studies that were filed in the last 12 months. Findings and recommendations are summarized; links to the full reports are found at the end of each study description.

Section 2 Ongoing Studies includes study descriptions and costs for projects currently being completed. For most of these studies, reasonable estimates of completion dates can be provided as well.

Section 3 Studies in Development provides study goals, descriptions of the methods to be employed and costs to the extent these items are available. The studies in Section 3 will be initiated as soon as contracts are executed. The uncertainties around contracting impact the dates the projects can start, the length of time required to complete the study and, sometimes the methods that can be employed.

Section 4 EM&V Forum offers descriptions of studies completed within the regional EM&V Forum (Forum). Within the Forum, participating states pool monetary, data, and manpower resources to complete evaluation and other studies under the general management of the Northeast Energy Efficiency Partnerships (NEEP). For these studies, descriptions and results are available. However, individual project costs are not available because the Forum charges each state's energy Companies a yearly fee based on anticipated study costs across all studies and a management fee to fund the Forum. In Connecticut, these charges are paid through the Energy Efficiency Fund.

SECTION 1: COMPLETED STUDIES

HOME ENERGY REPORTS EVALUATION – UI PROGRAM

NMR GROUP/TETRA TECH, $81,400

In order to gauge the extent to which participating residential customers understand, participate in, and appreciate the services of the United Illuminating Home Energy Reports program (HERs or the Program), EEB Evaluation Committee retained the NMR/Tetra Tech team to conduct a market awareness study. A market awareness study uses interview, survey and focus group techniques to find out how people perceive the program or process of interest.

HERs is a program that is intended to cause changes in energy use behavior, resulting in usage reduction. Program participants received monthly Home Energy Reports (HERs) describing their household electricity usage and presenting comparisons to 100 virtual "neighbors" (residences with similar household characteristics located in the same general area. These homes are not necessarily nearby). Participants were auto-enrolled in the program; that is, they were selected to receive HERs and were not volunteers.

The objectives of the evaluation focused specifically on participating customers' acceptance and satisfaction with the Program. The evaluation did not examine changes in energy use attributable to the Program. The objectives of this evaluation were to assess the following:

- Level of awareness and customer engagement with the HER reports (HERs) and other program-supplied information
- Degree to which customers found the HERs, Program website, and Program-supplied information to be useful
- Level of customer satisfaction with the Program
- Changes in the Program that could increase the level of customer engagement and satisfaction
- Whether the Program creates or increases participants' positive impressions of UI

This study used two primary research tools to assess these objectives. In September/October of 2011, approximately 8 months after participants received their first HERs, a survey was conducted with 100 participants. In December 2011, about 11 months after receiving their first report, the evaluation team fielded 3 focus group sessions. [1]Therefore responses to some questions, such as readership of the HERs, are biased upwards because customers who are unaware that they receive the HERs at all are much less likely to have read the report regularly than are those who are aware of the reports. Those unaware customers were, of necessity, excluded from the study.

Study findings were developed using the information gathered as a whole, rather than on a piece-by-piece basis. This allows the strengths of each method be used to provide more complete and unified conclusions and recommendations. The combined analysis of the survey results and focus group discussions yielded the following key findings and conclusions related to the five objectives.

1 Because customers had to be aware that they were receiving reports in order to express opinions about the program, households that were not aware they were receiving HERS reports were not eligible for the research activities.

LEVEL OF AWARENESS AND CUSTOMER ENGAGEMENT WITH HERS:

Although respondents report high levels of report awareness (see cautionary note above), there appears to be only a moderate level of customer engagement and readership of the HERs.

More than 40 percent of respondents could not recall any specific energy saving tips from the HERs. The two most frequently recalled energy saving tips were installing energy efficient light bulbs and shutting off appliances when not in use, actions which are widely known by most consumers.

When presented with an example HER, nearly all focus group participants quickly noticed key pieces of information they had not noticed previously, especially on the second (back) page. In each focus group discussion, some participants reported they had not realized there was a second page for the HER.

USEFULNESS OF THE HER INFORMATION

A majority of survey respondents find the information presented in the HERs only somewhat useful or less (not very or not at all useful). Twenty-three percent indicated the HER provided no useful information. For respondents who rated the HER information as 'Not at all' or 'Not Very' Useful, the perceived inappropriateness of the neighbor comparison was the most frequently cited reason (43%). One quarter of those who rated the HER information as "Somewhat' or 'Very' useful also believed the neighbor comparisons were inappropriate.

Most focus group participants were not aware of the definition of "neighbor group" provided on the HER and believed the neighbor comparison group for their household was not comparable. Both focus group and survey respondents indicated that the neighbor comparison information is not useful without more specific diagnostic information about why their household's level of electricity usage is high or low.

About one-quarter of respondents find the HERs very useful for their household. Respondents were most likely to cite the last-month consumption comparison with neighbors (19%) and the energy-saving tips (17%) as the most useful HER information.

SATISFACTION WITH THE HER PROGRAM

Respondents report a moderate level of satisfaction with the Program. Slightly less than one-half (47.9%) of respondents report a positive overall satisfaction rating (a rating of 4 or 5 on a 5-point scale) for the HER. More than half (52 percent) report a rating of 3 (neutral or indifferent) or lower.[2]

Participants cited increased awareness of household electricity use as a positive program outcome by some survey respondents.

However, some participants in each focus group discussion indicated the neighbor comparisons were discouraging or demotivating because their energy use was consistently higher than the "average of all neighbors." A small number of participants in each focus group believed they had been singled out by UI as "high energy users," because they were not aware of any other households in their area who received the HERs.

[2] For the 5-point overall satisfaction scale, where a score of 5 is labeled "Very Satisfied" and a score of 1 is labeled "Very Unsatisfied," the evaluators interpret scores of 4 and 5 as positive or high satisfaction, a score of 3 as neutral or indifferent, and scores of 1 and 2 as low or negligible satisfaction.

ACTIONS PARTICIPANTS REPORT TAKING IN RESPONSE TO HERS

Almost one-half of survey respondents believe they are using less electricity than they did for the same time period last year. A majority of these respondents attribute the perceived decrease in electricity use to greater awareness of their household electricity use and changes they have made in energy-using behaviors. Forty-four percent of respondents reported implementing one or more of the energy efficiency and conservation actions provided in the HERs.

Changing to energy-efficient light bulbs (39%) and shutting off or unplugging unused appliances (27%) were the actions participants most frequently mentioned as having taken. About 38% indicated that they did not intend to make more efficiency improvements; of those who indicated they planned additional actions, 47% had no specific improvements in mind.

RECOMMENDATIONS TO INCREASE CUSTOMER ENGAGEMENT AND SATISFACTION

The most common suggestions for making the program more useful and engaging include the addition of more information about how the neighbor comparison group is selected and more specific information tailored to their household about how to reduce electricity use.

Some participants in each focus group discussion indicated the HERs presented more information than they wanted to read. Some participants described the presentation of information as 'too impersonal' or 'generic.' This perception was particularly true for the energy saving tips which were not perceived to vary from one month to the next. These participants wanted more detailed information, specifically tailored to their household, and historical comparisons of their energy use, rather than neighbor comparisons.

Even though the HERs indicate more tailored information is available to customers who access the Program website and set up an online account, more than one-half of respondents had not even noticed that there was a Program website at all. The program administrators should develop a strategy that will motivate (and perhaps reward) customers for visiting the Program website and establishing an on-line account. Customers who establish an on-line account will provide additional information about their household and electricity use and may enable program implementers to provide more tailored energy saving tips and analysis.

Please see http://www.ctenergyinfo.com/UI%20Behavior%20Report%20FINAL(1).pdf .

Connecticut Home Energy Solutions Stage 1 Performance Measures and Financing Focus Groups

RESIDENTIAL RESEARCH AREA TEAM $45,950

The EEB Evaluation Committee requested that the Residential Research evaluation team (led by NMR Group) examine reasons why participants in the Home Energy Solutions are less likely to install Home Performance (HP) Measures than anticipated. In particular, the program administrators wanted to understand how better to motivate customers using incentives such as rebates and financing to encourage action. The study used 4 focus groups located in CL&P and UI service territories to examine the issues.

The focus groups were conducted to provide information on the following objectives:

- Identify barriers to adopting Home Performance measures—especially insulation and heating measures—recommended during the initial HES energy assessment
- Understand why HES participants are not taking greater advantage of rebates and, especially, low-interest financing to offset the initial cost of HP measures, again emphasizing insulation and heating systems
- Outline steps the Companies may take to increase installation of Home Performance measures, particularly insulation and heating systems, with or without low-interest financing

The evaluation team chose to hold groups in four locations throughout Connecticut to obtain opinions of participants across the state, thereby increasing the diversity of housing types and participant demographic profiles represented in the groups. To provide insight into barriers to installation of HP measures, three of the four groups were held with customers who received home energy assessments but reported on the phone that they did not install heating systems or insulation utilizing program rebates or financing. The fourth group included only participants that installed heating systems or insulation with program rebates or financing. This final participant group provided information on customers' motivations to use the program opportunities as well as the challenges these participants experienced that may illustrate the barriers for other participants considering the installation of HP measures.

CONCLUSIONS AND RECOMMENDATIONS

NMR makes the following recommendations stemming from the key findings.

FINDING:

Lack of awareness and understanding of low-interest financing serves as the most critical barrier to greater use of the option. The focus groups suggest that auditors spent very little time discussing the financing options with attendees. Overall a general wariness about borrowing money also served as an important barrier to greater use of the financing option. The focus group discussion also demonstrated that terminology matters. Attendees expressed more comfort with the idea of "payment plans" compared to "financing" and especially "loans" even though these terms refer to the same process. However, each term is still synonymous with "borrowing money," an action that many attendees said they were unwilling to take.

RECOMMENDATION 1*:* The program should proceed with its efforts to offer zero-percent financing and approval of financing during the audit. Given attendees' generally more negative response to the word "loan," the program should take a cue from retail stores and adopt language such as "payment plans" or "zero-interest" or similar phrasing when describing the opportunity. Vendors should be directed to avoid the word "loan" so as not to deter customers from choosing the financing option. On-bill financing may be preferred by some participants, but not universally so. These households may install more measures through the financing program than they would with rebates alone.

RECOMMENDATION 2: The program should instruct HES Vendors to discuss the financing option in more detail with all eligible participants. Vendors must describe the financing package accurately and enthusiastically to all eligible participants, rather than relying solely on printed program materials to promote the option.

FINDING:

In contrast to low-interest financing opportunities, study attendees expressed greater awareness of rebates, although the discussions also made clear that not all attendees fully understood the rebate amounts, structures, or processes. The primary barriers impeding greater rebates included the perception that the rebates were not deep enough to offset costs, that the attendee could not get the work performed before rebate deadlines, or that the rebate process was a hassle.

Six of the 14 rebate users had originally had their rebate applications denied, with the rebate vendor informing them that they needed to correct something on the form. The most frequent correction involved the contractor not supplying the correct or adequate documentation to the attendee. Other times the attendees made mistakes on the forms.

Rebates served to allow some attendees to install additional measures. However, some users who took advantage of heating rebates noted that they likely would have installed the heating equipment without the rebate because, from their perspectives, the rebate amount relative to the cost of the heating system was negligible. Attendees generally perceived the insulation rebates as being deeper and, therefore, more attractive.

RECOMMENDATIONS: To increase rebate participation, the auditors must make certain that they are explaining the rebate process thoroughly and emphasizing the depth of measures, particularly of insulation which in many cases can cover up to 50% of the entire cost of installing the measures. Given the significance of payback in rebate users' decision-making process (as evidenced in the discussion of the relative 'depth' of rebates for insulation relative to HVAC systems), the program should emphasize payback through program materials and the auditor wrap-up dialogue. Moreover, every effort should be made to inform participants of likely energy savings they could expect, providing realistic ranges of savings for major measures from comparable households.

The program should provide additional training to qualified HP contractors on how to supply the correct information to participants for filling out the rebates. The program may also want to provide online or other forms of assistance to help participants understand the application. The program may consider identifying ways to streamline the rebate application process.

FINDING:

Customers reported being distracted and confused during the HES visit. They reported that it was difficult to focus on what they could do next.

RECOMMENDATIONS: Customers may be more likely to select HP measures if given more information both before and after the HES visit. Customers suggested

The program might benefit from providing more detailed information to participants prior to the initial visit regarding the scope of program offerings and to alert them on what to expect the day of the HES visit.

Program Administrators or auditors should conduct follow-up communication with participants after the audit to discuss rebate opportunities and procedures. A call could provide the participant an opportunity to ask questions about rebates and financing and clarify information provided in the audit report. Follow-up calls *after* the home assessment to discuss financing options and payback periods. Such follow-up may serve to increase use of rebates and financing to install HP measures.

FINDING:

Some participants made additional suggestions on ways to increase participation in HES.

See full report:
http://www.ctenergyinfo.com/120828%20FINAL%20CT%20HES%20Financing%20Focus%20Groups%20Report.pdf

SINGLE FAMILY, RESIDENTIAL NEW CONSTRUCTION BASELINE

NMR GROUP, KEMA, CADMUS, AND DOROTHY CONANT, $209,400
The Residential New Construction Baseline study was conducted to establish the overall level of efficiency of new homes currently being constructed in Connecticut.

Resulting information will be applied to estimation of the net effects of the RNC Program on efficiency improvements. Additionally, these results are used to establish preliminary estimates of User Defined Reference Home (UDRH) inputs to be used as baseline characteristics against which construction within the RNC Program can be compared. Findings are based on the results of on-site inspections, including Home Energy Rating System (HERS) ratings, of 69 homes that were not part of the RNC program, were completed from November 2009 through July 2011, and whose owners agreed to have their home inspected. The statistical sample of 69 inspected homes are a mix of custom and spec single-family homes located in 61 different cities and towns across Connecticut, with the percentage of inspected homes in a county matched to the percentage of statewide single-family building permits issued in that county.

In the body of the report, information is also provided on the percentage of homes that exceed or fall short of specific insulation levels. Information on the percentage of homes with low insulation levels in different areas (e.g., walls, ceilings, and floors) helps identify those areas in new homes where there may be the most opportunity for increasing energy savings. The specific insulation levels to which homes are compared are the insulation levels required if a builder chose to comply with IECC prescriptive requirements. These prescriptive requirements provide a consistent and widely accepted basis of comparison.

SUMMARY RESULTS

The User Defined Reference Home is a composite set of energy characteristics that can be used to model typical homes. The UDRH doesn't refer to, for example, a specific style or size of home. Rather UDRH values refer only to energy features and can be used to calculate savings in a broad range of new homes. The Table below provides a summary of UDRH characteristics, comparing the results of this study with the UDRH inputs currently in use in the program.

Table ES 1 shows that efficiency levels in inspected homes are higher than current UDRH inputs for conditioned/ambient walls, cathedral ceilings, air infiltration, heating systems, cooling systems, and propane, natural gas, and oil conventional (stand-alone) tank water heaters. Efficiency levels in inspected homes are lower than current UDRH inputs for flat ceilings, floors and duct leakage.

Table ES 1: Study Findings Compared with 2011 UDRH Inputs

UDRH Input	2011 UDRH Input	Study Homes	Study Homes More or Less Efficient than 2011 UDRH
Building Information			
Wall Cavity Insulation (Uo or U-value)	0.070	0.068	Study Homes More Efficient
Flat Ceiling Insulation (Uo or U-value)	0.0384	0.0441	Study Homes Less Efficient
Cathedral Ceiling Insulation (Uo or U-value)	0.0534	0.0417	Study Homes More Efficient
Floor Insulation Cond/Basement (Uo or U-value)	0.070	0.074	Study Homes Less Efficient
Average Air Infiltration (ACHnat)	0.32	0.29*	Study Homes More Efficient
Air Infiltration (ACH50)	n/a	5.8	n/a
System Information			
Oil-Fired Heating Systems (AFUE)	83.3	84.5	Study Homes More Efficient
Natural Gas Heating Systems (AFUE)	90.0	92.4	Study Homes More Efficient
Propane Heating Systems (AFUE)	87.1	92.1	Study Homes More Efficient
Cooling System Efficiency (SEER)	13.0	13.4	Study Homes More Efficient
Propane Conventional Water Heater (Energy Factor)	0.56	0.60	Study Homes More Efficient
Natural Gas Conventional Water Heater(EF)	0.58	0.62	Study Homes More Efficient
Oil Conventional Water Heater (Energy Factor)	0.61	0.63	Study Homes More Efficient
Electric Conventional Water Heater (Energy Factor)	0.90	0.90	Study Homes and UDRH the Same
Duct Leakage (CFM25/100 Sq. Ft.)	17.3	17.7	Study Homes Less Efficient
Duct Insulation R-value (supply)	4.6	7.4 (attic7.7)	Study Homes More Efficient
Duct Insulation R-value (return)	4.6	6.8 (attic7.4)	Study Homes More Efficient

In addition to the home inspection and measurement, homeowners were asked to complete a short survey. Questions addressed participation in utility-sponsored energy efficiency programs, how homes were purchased, if energy efficiency was discussed between the homeowner and the real estate agent or builder, how important energy efficiency was in the decision to purchase the home, and homeowners' perception of the energy efficiency of their homes.

The results of the homeowner survey suggest many home buyers may want an energy-efficient home, but do not know what to look for or ask about to ensure they get an energy-efficient home. Fewer than one-half (40%) of homeowners say their builder or sales agent talked to them about energy efficiency or the benefits of energy-efficient windows, heating and cooling equipment, insulation, etc. Just over one-half (34 or 52%) of homeowners say they asked their builder or the sales agent about energy efficiency, which suggests there is a need for additional consumer education to encourage home buyers to ask builders and real estate agents about energy efficiency.

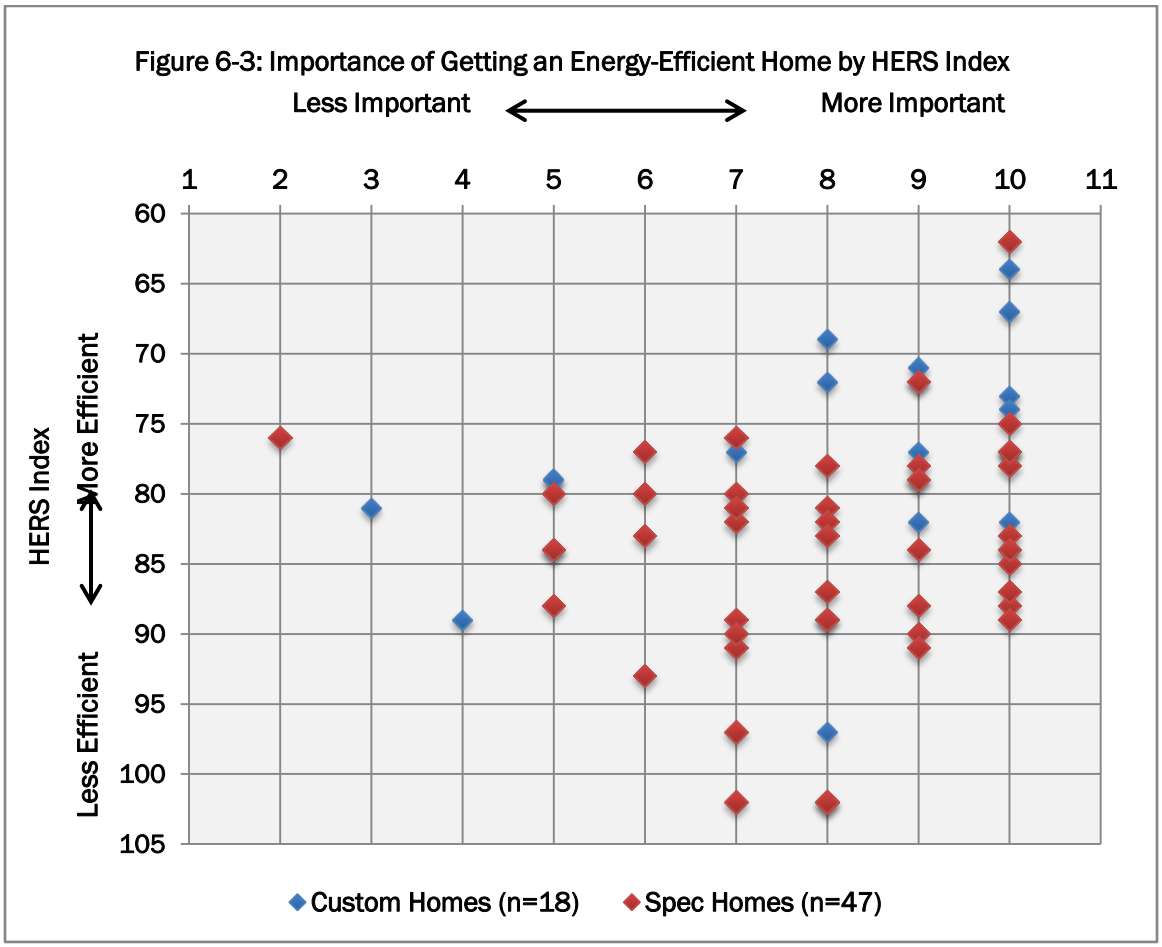
Comparisons Between Customer Intention and Efficiency Result

Discussion of the actual energy efficiency of homes is based on HERS ratings—the lower the HERS rating, the more energy-efficient the home. The homes of owners who said getting an energy-efficient home was important in their decision to buy or build their home have an average HERS rating of 81, which is only slightly more energy efficient than the average HERS rating of 82 for all inspected homes. Roughly two-thirds of owners (42 of 65) rated the importance of getting an energy-efficient home 8 or higher on a scale of 0 to 10, but only half of these owners think their home is much more or somewhat more energy efficient than other new homes. These 42 homes include the most energy-efficient home inspected (HERS 62) and two of the three least energy-efficient homes inspected (HERS 102).

In most cases, owners who said they specified components of their home important to efficiency did not specify an energy-efficient or ENERGY STAR-labeled component. Of the 65 owners who did not build their own home, 77% (or 50 owners) said they specified aspects of one or more of the following components of their home: heating system, cooling system, water heater, windows, kitchen appliances, or lighting. Seventy percent of these 50 owners (35 owners) also ranked the importance of getting an energy-efficient home in their decision to build or purchase their home an 8, 9 or 10 on a scale of 0 (not important) to 10 (very important). However, when it came to specifying components of their home, it appears energy efficiency was not really a high priority for many of these owners. For most components, fewer than half of the owners who specified the component specified an energy-efficient or ENERGY STAR-qualified option: 8 of 18 (44%) who specified aspects of the heating system, 4 of 16 (25%) who specified aspects of the cooling system, 7 of 19 (37%) who specified aspects of the water heater, and 11 of 37 (30%) who specified aspects of the lighting. Owners were more likely to specify energy-efficient or ENERGY STAR-qualified windows (17 of 22 owners or 77%) and kitchen appliances (32 of 49 owners or 65%). Some owners indicated only that they specified a component of their home, without indicating what aspects of that component they specified. Owners who did identify the aspects of the components they specified, but did not specify energy-efficient or ENERGY STAR-labeled components, said they specified one or more of the following: the heating or water heating fuel; the type of heating, cooling or water heating system; whether or not to install central air conditioning; appliance fuel (gas or electric), style, brand, and/or color; the style of lighting fixtures.

Almost half (43%) of these 42 homes have HERS ratings that are higher (less energy efficient) than the average HERS rating for all inspected homes. Homeowners who said getting an energy-efficient home was important did not necessarily get an energy-efficient home.

Figure 6-3 (shown below) displays the HERS ratings achieved by how homeowners rated the importance of getting an energy-efficient home. As shown, it seems clear that features other than energy efficiency are driving new construction—regardless of how "important" homeowners say getting an energy-efficient home was in their decision to buy or build their home. The four homeowners who acted as the builders for their own homes are not depicted but have HERS ratings of 74, 76, 85, and 91, respectively.



Please see the full report http://www.ctenergyinfo.com/ConnecticutNewResidentialConstructionBaseline-10-1-12.pdf

CONNECTICUT EFFICIENT LIGHTING SATURATION AND MARKET ASSESSMENT

RESIDENTIAL RESEARCH AREA TEAM $212,700

This impact support and market assessment study examined the level of efficient lighting current in homes across Connecticut. The residential lighting market in Connecticut is facing a period of rapid change. Consumers are now faced with a greater number and diversity of bulb choices for general service lighting—compact fluorescent lamps (CFLs), A-line incandescent halogens, and A-line light emitting diodes (LEDs)—than in the past. Moreover, state regulatory authorities laid a challenge before the electric distribution companies – to reach 36% efficient lighting saturation by the end of 2011.

This report summarizes the results of a study that relied on telephone surveys and onsite visits to residents' homes to determine saturation rates and market characteristics of efficient lighting choices. It also compares the current findings to those from the focus groups, which addressed similar topics in a more qualitative manner.

STUDY GOALS AND METHODS

This second stage of the exploration of the residential lighting market in Connecticut had the following objectives:

- Determine the current rates of use and storage for various lighting technologies and the reasons that underlie current lighting choices
- Identify ways in which the Companies could assist consumers in making more efficient lighting choices, including exploring issues related to incentives, education, and program design, among others

In order to meet these objectives, the evaluation team relied on a telephone survey of 551 residential customers of CL&P and UI and onsite visits to a subset of 100 survey respondents' homes. The telephone survey primarily provided information on customers' current awareness and knowledge of various lighting technologies and of the EISA legislation as well as their opinions about and reactions to those technologies and the incandescent phase-out. The onsite visits served to describe the use, saturation, and storage of various lighting technologies in the home through a detailed lighting inventory; a follow-up survey delivered onsite also explored how respondents make decisions about lighting their home, their commitment to purchasing efficient lighting, and their willingness to pay for CFLs and LEDs at various price points.

The evaluation team also presents relevant results from the Stage 1 lighting focus groups performed in the fall of 2011 throughout this report. However, because the focus groups were qualitative in nature, their findings provide insights that complement and inform the results from the more quantitative and statistically representative telephone survey and onsite visits.

KEY FINDINGS

AWARENESS OF LIGHTING OPTIONS AND CHANGES IN MARKET

- Three-fourths of respondents were familiar with standard CFLs, but typically no more than one-half of respondents were familiar with specialty CFLs, A-line LEDs, and A-line halogen bulbs.

- Only thirty-nine percent of respondents reported that they had heard something about changes to lighting standards, and just 30% had specifically heard about the incandescent phase-out resulting from EISA.
- When asked what they had heard about the changes in lighting efficiency standards, 78% said that some light bulbs would not be available, and 17% thought they that they would be required to use CFLs or LEDs.

CURRENT AND LIKELY CONSUMER REACTIONS TO EISA

- About 30% of all respondents had noticed changes in the availability of light bulbs in the past three months, but this increased to 50% among those respondents who had actually shopped for light bulbs in the past three months. Those who had noticed changes typically cited a greater availability of CFLs and LEDs, a lower availability of incandescents, or an overall increase in the variety of bulbs on store shelves.
- When asked which type of bulb they would most likely purchase to replace a 100 Watt incandescent, 39% of respondents chose a lower wattage incandescent and 34% chose a CFL. Common reasons for choosing an incandescent included familiarity and preferences for the light quality. Many respondents choosing CFLs noted their energy or bill savings. Focus group results suggest that more exposure to A-line (covered) CFLs through light displays or demonstrations could sway incandescent purchasers to buy covered CFLs instead of incandescent or A-line halogen bulbs.
- Households in the onsite saturation sample stored an average of 11 incandescent bulbs versus five CFLs. None of the households storing incandescents reported doing so in reaction to EISA, respondents who said that they were "very likely" to stockpile incandescent bulbs also had more 100-Watt incandescent bulbs — as well as more incandescent bulbs of any wattage — in storage than those who indicated that they were less likely to stockpile.

SATURATION, STORAGE, AND PURCHASE

- The average number of total sockets per home was 62 (or a total of 84.3 million statewide). Among these sockets, CFL saturation stood at 27% in spring 2012. In addition to CFLs, LEDs filled another two percent of sockets, and still another 11% of sockets were filled with pin-based fluorescent tubes. Together, the saturation of these three efficient bulb types was 40%. The remaining sockets are filled largely with incandescent and halogen bulbs, such that the remaining potential for efficient lighting is 61% (rounding).
- Saturation of CFLs was four percentage points higher compared to the last measurement (23%), taken in 2009. LED saturation went from less than one percent in 2009 to two percent in 2012, and the saturation of fluorescent tubes went from 7% to 11% in the same time period. This means that the saturation of efficient lighting in homes was nearly 10 percentage points higher in 2012 than in 2009.
- Saturation of incandescent bulbs decreased from 64% in 2009 to 49% in 2012, as sockets have been converted to CFLs, LEDs, and fluorescent tubes as well as halogen and other types of bulbs.
- Although the data suggest that CFL saturation has increased, the team believes that the suggested increase seems small compared to the 12.6 million program-supported CFLs sold in Connecticut between 2009 and 2011 (based on data in the annual plans). Evidence from this study (see storage below) and forthcoming in a report for another New England state suggests

that households are increasingly buying CFLs to replace other CFLs, which limits increases to saturation while also preventing saturation from backsliding; in other words, households like CFLs enough to keep using them when they burn out.

- Other possible explanations for the disposition of program-supported and market-level sales include bulbs returned to stores, purchases by commercial customers at retail stores, leakage to other states, and measurement error.
- Research conducted over time in Massachusetts suggests that it has also seen a leveling of CFL saturation following the substantial increases achieved after the state moved to an upstream approach. Data comparing saturation in New York State and New York City between 2009 and 2010 show larger increases in saturation of 5% and 10%, respectively. Importantly NYSERDA also changed its program design during that time period from a marketing-based program to one that included a greater number of upstream incentives and rebates, particularly targeting the New York City market.
- Almost all homes (94%) in Connecticut used at least one CFL, a change of 9 percentage points from 2009 when 85% of homes used CFLs. It is likely that many of these households using CFLs for the first time between 2009 and 2012 were "hard-to-reach" or reluctant to try CFLs, but the current study did not explicitly test this hypothesis.

Light Bulb Use

- Bedrooms and bathrooms were the most popular places to install CFLs, with CFLs accounting for 39% of bedroom lighting and 37% of bathroom lighting. LEDs were most commonly installed in the kitchen (5% of kitchen sockets), but they were typically the under-the-cabinet, pin-based lights and not the A-line screw-in type. Among the five room types with the greatest number of sockets overall (i.e., bedrooms, kitchens, bathrooms, living rooms, and the exterior of the home), 55% or more of the sockets could be filled with CFLs or LEDs.
- When asked an open-ended question about how they decide to light a room, respondents most frequently mentioned price, brightness, energy efficiency, wattage, and a preference for a particular bulb type. Close-ended questions about the preferred characteristics for a room revealed that brightness was most important in all rooms, typically followed by price; the exceptions were bedrooms and dining rooms, where price was more important than brightness.
- When asked why they did not have CFLs installed in some rooms, most respondents indicated that they were waiting for an installed bulb to burn out or had not gotten around to it. However, 13% of respondents indicated that CFLs did not fit properly.
- Only 10% of all sockets in homes were dimmable, and just 6% of these dimmable sockets were filled with CFLs.
- Dining rooms have the highest remaining potential for CFLs and LEDs (87%), and only 12% of sockets in dining rooms were filled with CFLs, LEDs, or fluorescent tubes at the time of the onsite visit. More than any other rooms in the home, respondents who did not use CFLs in the dining room noted that the bulbs did not work with dimmers, that they did not like the appearance of CFLs in the dining room, or that they could not find a bulb for the application.
- Satisfaction with CFLs and LEDs was high, with 77% of CFL users and 83% of LED users rating themselves as "somewhat or very satisfied" with the products. Consumers appreciated the energy savings of CFLs and the light quality of LEDs. Persistent concerns about CFLs included light quality and brightness, being slow to brighten, and mercury content, while LED users also cited price and the appearance of the bulb itself.

- Households in the onsite study collectively stored 1,657 bulbs of which 64% are incandescents and 29% are CFLs.
- By and large, consumers are not *changing out* inefficient bulbs for CFLs. Instead, they fill whatever sockets need replacing at that moment and then store the remaining CFLs until another bulb—which may or may not be an incandescent—burns out. In fact, respondents reported that 63% of stored CFLs would likely replace another CFL, 30% will replace whatever bulb type burns out first, and 5% would replace incandescent bulbs. As mentioned above, the large percentage of CFLs expected to replace other CFLs is part of the likely explanation of where the program-supported CFLs have gone—many, perhaps most, have replaced other CFLs that burned out.

Assisting Consumers to make Efficient Lighting Choices

Along with understanding respondents' likely reactions to EISA and determining their current usage of efficient lighting technologies, a final objective of the current study was determining how to assist consumers in making more efficient lighting choices.

- A willingness-to-pay analysis reveals that consumers are sensitive to price changes in standard and specialty CFLs, suggesting the continued need for incentives, the amounts of which are discussed in the conclusions and recommendations.
- Consumers will balance upfront costs with bill savings and operating costs if they believe the upfront cost is reasonable. At this time, most telephone survey respondents (77%) said they were likely to buy a six dollar bulb that lasts seven years and saves $10 a year, but less than half thought they were likely to purchase a $20 that lasts for 20 years and saves $10 a year (46%).
- A majority of telephone survey respondents reported being familiar with the terms "lumens" (56%) and "warm white and cool white" (62%) in reference to lighting. Most respondents familiar with the term lumens correctly identified it as a measure of light output or brightness (62%), but 27% admitted that they really did not know what the term meant. A similar percentage of respondents familiar with the terms "warm white and cool white" knew that they referred to color appearance. However, 27% thought those terms referred to brightness or the amount of light, and 17% admitted they did not really know what the terms meant.

Recommendations

- A reasonable incentive amount for standard CFLs would reduce the shelf price of the bulbs to approximately $3.50; the extent to which this price may already be available on the market *without* incentives would need to be determined through a pricing study. Reasonable incentive amounts for specialty bulbs would approach $5.25 to $6.00, and NMR particularly recommends the lower amount for A-line covered CFLs, which are likely the most attractive to consumers who avoid standard CFLs for aesthetic or fit in fixture reasons. The evaluators were not able to obtain an estimate of a reasonable incentive for LEDs, but the consumer survey suggests that only about one-half of consumers would purchase LEDs at $20 per bulb. Therefore, it may be reasonable to reduce the price to approximately $12 to $15 per bulb, tracking sales to see if they increase at the lower price points.
- The program should continue its efforts to raise awareness of the diversity of energy efficient lighting products available to consumers through lighting displays in stores. Such displays could include bulb comparisons, end-cap promotions, and pamphlets and signs that demonstrate the range of products available and allow consumers to see the products "in action."

- The A-line covered CFL is intended to fill the same applications as a standard A-line incandescent bulb. Therefore, NMR recommends treating the A-line covered CFL as a "standard" bulb offering in promotional materials.
- The Companies should continue to educate consumers on new lighting terminology, through in-store displays and promotional efforts. Home improvement stores and hardware stores are particularly good candidates as they appear to be the "go to" stores for efficient lighting in Connecticut.
- The Companies should continue giving away bulbs—particularly A-line, covered CFLs—through such programs as Home Energy Solutions and Home Energy Solutions – Income Eligible as well as during in-store promotions, fairs, and special events. Because of their higher price, it may not be cost-effective to give away LEDs, but individuals who take part in an HES or HES-IE audit or visit a lighting promotional event or a booth at a fair could receive coupons for LEDs that would lower the price of the bulb beyond even the incentive price. Another strategy could involve including LEDs in raffles held at promotional events or fairs.
- The Companies should continue working with manufacturers and retailers to improve the quality of CFLs and LEDs that would be likely choices for dining room lighting (e.g., dimmable candelabra bulbs). This could involve supporting continued research and development into these products as well as testing the quality of such bulbs.
- In addition to continuing their efforts to change out inefficient lighting during HES and HES-IE audits, the Companies should also continue to explain to consumers how much money they can save by getting rid of inefficient lighting now rather than waiting for the products to burn out. Additional information about the positive impacts of changing bulbs out on resource availability, the environment, and greenhouse gas reduction may also sway a portion of consumers to switch their bulbs out sooner rather than later. The Companies may also want to consider the feasibility and advisability of bulb buy-back and neighborhood blitz change-out programs.

Please see the full report at:
http://www.ctenergyinfo.com/FINAL%20EISA%20Lighting%20Saturation%20and%20Market%20Assessment%20Report%20100212_pdf.pdf

SECTION 2: ONGOING STUDIES

CL&P HOME ENERGY REPORT (HER) PROCESS AND IMPACT EVALUATION

NMR GROUP, $252,700 YEAR 1 / $163,335 YEAR 2

The CL&P HER program is a multiyear pilot behavioral awareness program, proprietary to OPower. In this Pilot, customers were randomly selected to be part of either a treatment group (participants) or a control group (non-participants). Participants receive an energy report, either monthly or quarterly, describing the customer's energy usage compared to those of households with similar characteristics within a 5-mile radius. The report provides suggested actions participants can take to improve their ratings. The recommendations may include suggestions to replace inefficient appliances, alter how equipment is used, or participate in other EEF programs. A third participant group was been designated to stop receiving energy reports after 8 months, to test whether behavior changes persist after reminders cease.

The second year Pilot eliminates quarterly customer groups and introduces a group with electricity-consumption characteristics more similar to those of 'typical' customers.

The multiyear study will assess direct impacts of the program and determine strengths and weaknesses of its operations.

The goals of the study are to determine:

- Savings accruing to customers over the course of the pilot
- Actions customers take to achieve those savings
- Types of messages and ways of communicating those messages that are most likely to result in significant savings
- Whether customers continue social marketing after they are no longer reminded to do so
- Extent customers in the persistence group maintain program-induced savings when they no longer receive energy reports.

An initial process assessment was completed for Year 1 and additional assessment focusing on customer actions and reactions will be developed for Year 2. The impact assessment uses statistical techniques to relate billing data with customer characteristics, savings recommendations and the actions of the non-participant group to determine overall savings. The Year 1 report will be filed by the end of 2012. The Year 2 report will follow in mid-2013.

IMPACT EVALUATION OF THE OPERATIONS AND MAINTENANCE (O&M) SERVICES/RETROCOMMISSIONING (RCX) PROGRAM AND BUSINESS SUSTAINABILITY CHALLENGE (BSC) INITIAL IMPACT ASSESSMENT

MICHAELS ENERGY, $375,000

The O&M Services program offers electric and natural gas incentives for C&I customers to improve operation and maintenance of their facilities to make them more energy efficient. RCx and BSC are both parts of the O&M Services program. The electric and natural gas Companies provide O&M evaluations and recommendations upon request, with the C&I customer being responsible for implementing the O&M improvements. Examples of such improvements include, but are not limited to, compressed-air system

leak studies and repairs; retro-commissioning, additions, corrections, repairs to building management system control components, software programming to maximize operational efficiency, and system modifications to optimize performance.

The RCx program conducts an in-depth investigation of a facility's systems operations, focusing on integrating more efficient and effective instructions for the building management systems. The main objective of RCx is to find low-cost/no cost, non-capital, energy-efficient measures that will quickly and effectively result in energy savings for the building owner or tenant. The program targets Connecticut's larger C&I facilities, and the large institutional segments.

One of the primary components of the program's move toward helping customer take the lead in setting goals and managing actualization is the Business Sustainability Challenge (BSC). Initiated as a pilot in 2008, the BSC training and educational initiative provides an opportunity for customers to not only address their energy-management practices and investments, but also their long-term social, environmental and economic sustainability objectives through formal and informal education, plan development and implementation, and continuous improvement practices. The BSC trains, and educates medium-size to larger customers to integrate sustainability into their business practices and manage energy, carbon, waste and water resources.

The Companies offer different versions of BSC. CL&P offers a classroom approach and UI provides information to a smaller number of customers in more interactive cohorts. While the approaches differ, both follow the steps outlined below, using shared tools and resources:

- Obtain a commitment.
- Assess performance and set goals.
- Create a plan.
- Implement the plan.
- Evaluate the plan's progress.
- Recognize achievements.
- Re-assess the process.

This impact study focuses on engineering approaches. It will provide savings data to quantify savings benefits, including avoided capacity and energy costs resulting from energy savings during seasonal and on/off-peak periods, of efficient measures and processes developed in C&I facilities through the RCx/O&M Services programs. Because operations adjustments may not be maintained, persistence is a particular concern for this study. This study will inform the evolution of the program through BSC. For BSC, this project will examine the impacts made and the assistance C&I customers need to develop a culture of efficiency improvements. The study will use interview approaches to determine the extent to which participants have established attributes and practices that provide for culture change and long-run savings. The extent to which participating C&I customers have established savings metrics and completed benchmark analysis is an important component of the study.

Since many measures are weather sensitive, both winter and summer seasons must be incorporated into the study. The project will collect data through March of 2012 and will be complete November, 2012.

Residential Research Area

Ground Source Heat Pump Impact Evaluation Study $338.000 ($169,000 CEEF Share)

CL&P estimates they have helped install, or have in the pipeline, upwards of a 1,000 units; UI has a lesser number. This study will entail working with CEFIA to do an impact analysis for HVAC and water heating applications and carbon impact analyses.

This impact analysis is measuring net savings from all fuels that result from installation of efficient geothermal ground source heat pumps (GSHP). Savings measurement is complicated in the case of GSHPs because savings from the units can be offset by new air conditioning capability and/or by source of back-up heat.

The study is using spot and long-term metering to assess energy usage and water flow in a sample of new and retrofit applications. The sample was selected to reflect both the mix of different size GSHP systems as well as the types of backup heating systems. That metered information is combined with other efficiency characteristics to create models (DOE2) of the GSHP across the program population. Savings wills then also be translated into non-energy terms to provide measurements or air quality, resource use and carbon reduction savings from the program.

The completed study is expected to be filed by April, 2013

HES-IE Process and Persistence Evaluations

Earlier research pointed out that income eligible and non-income eligible customers make decisions about retaining installed measures in different ways and with different results. Most existing research focuses on measure persistence in non-income eligible customers. Less is known about income eligible customers and thus, this is the focus of this study.

The primary approach for the persistence portion of this study is a set of site visits in which evaluation contractors will speak with customers about their program experiences, determine whether measures are still in place and examine reasons that measures may no longer be installed. These may include preferences, performance issues, functionality or removal, among others.

The process evaluation will examine where program processes are relative to the long term objectives of the program. The evaluators will interview program administrators, EEB consultants and interested Board members to identify long range objects (perhaps the ability to install all cost effective measures, for example). Once the goals have been established the evaluation contractor will develop a plan to assess current program progress towards each goal. Finally recommendation on increasing the trajectory to the goals will be developed.

The process evaluation will likely include interviews or surveys with participants, landlords serving income eligible populations, vendors and advocates.

This study will begin late in 2012 with the bulk of the study occurring in 2013

Residential Central Air-Conditioning – Impact and Process Evaluation – $280,000

This 2-year project will quantify the electric energy and peak demand savings of CAC installations through either a regular incentive or the Home Energy Solutions (HES) Program. This study will also provide CAC load shapes and a characterization of CAC units installed. Finally, this study is expected to provide an understanding of the process by which customers decided whether to take advantage of incentives or financing, with particular emphasis on exploring program methods that might induce more frequent early retirement of inefficient CAC units. Through the customer-oriented research, the study is also expected to produce recommendations on ways that might better induce early replacement of inefficient CAC units.

The study will employ on-site measurement and verification of installed units in 91 residences. The contractor will compare assumed and planned conditions with those found in the sample. More importantly, the metering will provide inputs to a model that estimates CAC demand and energy use. Load shapes will also be produced.

During the site visits, customers will be asked about their program experience and decision processes regarding efficiency of their AC systems. Four focus groups will be held to gain in-depth information on customer decision making, early retirement, and Home Performance incentives. Finally, surveys will further explore issues raised in the focus groups in a quantitative way. Two hundred eighty telephone surveys will be completed with HES customers who received recommendations to replace their CAC units. Half of these will be addressed to households that made that replacement within the program. The other half will be directed towards customers who did not do so.

This study is expected to be complete by November of 2013.

Characterization of Existing Residential Building Stock - $30,000

The objective of this project is to characterize the Connecticut single-family housing stock on key features related to the efficiency of the home. To meet this objective, the Contractor will obtain a database of properties in Connecticut from a third party vendor and analyze data the subset of the data for single-family homes on such characteristics as home size, home age, heating-fuel type, number of rooms, number of stories, and framing type, among others.

Analysis will rely on descriptive statistics such as cross tabulation.

Baseline Weatherization - $876,900

The state of Connecticut has set the ambitious goal to have 80 of all homes in CT weatherized by 2030. That goal is made more ambitious because of lack of information on the weatherization status of homes at this time.

This study contributes

- Provides a measurement of the challenge:
    - How many and what percentage of residences in Connecticut are currently weatherized?
    - How does this measurement differ for fuel oil users versus other heating types; for home owners vs. renters; for low income versus non-low income customers? Essential to go on-site to collect this information.
- Points to solutions:

    - In Connecticut, what levels of wall insulation, floor insulation, air infiltration, etc. are found?
    - What levels of efficiency do you find in residences' HVAC and water heating systems?
    - What other change-outs should be made in residence (mainly appliances) to save energy?
- Data and support for the 2014 IRP (due in January 2014) and future IRPs
- About 170 additional homes getting HES services and savings
- An initial potential study for oil heat and natural gas customers at very low incremental cost
- Hybrid approach – by delivering HES concurrently, reduced the study costs by 1 person's time per site (about 90 person-days labor) and the costs of maintaining infiltration detection equipment. The approach also is capturing savings, some from customers who would not otherwise seek out HES.

The weatherization study will estimate baseline efficiency of single family homes across the state. The study will conduct a detailed inspection and measurement process (called HERS, and which requires specialized training and certification) in 180 homes. HERS inspections requires qualified technicians to collect all of the data necessary to model the energy usage of each building in REM/Rate. At every home, an HES vendor and NMR HERS rater will take detailed measurements in order to calculate conditioned floor area, conditioned volume, and all thermal boundary areas. Absent any problematic or unsafe conditions (such as the presence of asbestos insulation), the HES vendors, under NMR supervision, will conduct blower door tests at all homes, and will perform duct leakage tests in all homes with ducts. HES vendors will then provide all core services in HES-eligible homes.

While the NMR rater collects other information necessary for determining the weatherization status of the home. The NMR HERS rater will identify the key efficiency-related characteristics of the building. These include, but are not limited to, insulation types and R-values for key shell measures, mechanical equipment types and efficiencies, and lighting fixture and appliance characteristics. Data on mechanical equipment, lighting fixture and appliance characteristics are necessary to model each home in REM/Rate and therefore are an important piece of the weatherization assessment.

Models comparing the 180 homes with reference homes will be statistically assessed to extrapolate the data collected to the full population of single family homes in Connecticut.

Cross Sector Research Area

Free rider & spillover (FR/SO) study in C&I programs $165,400

The primary objective of the 2011 program year Free-ridership and Spillover Study is to assist the Connecticut Energy Efficiency Fund in quantifying the net impacts of their commercial and industrial electric and natural gas energy efficiency programs by estimating the extent of:

- Program free-ridership
- Early participant "like" and "unlike" spillover
- Nonparticipant "like" spillover

The study assessed program free-ridership and spillover for the Energy Conscious Blueprint, Energy Opportunities, and Small Business Energy Advantage programs.

The SRA approach for determining free-ridership involves asking one or more key decision makers a series of closed and open-ended questions about their motivations for installing the program-eligible equipment, about what they would have done in the absence of the program incentive and other services, as well as questions that attempt to rule out rival explanations for the installation. This method walks survey respondents through their decision process with the objective of helping them recall the program's impact upon all aspects of project decision-making. To improve the reliability of the NTG determination, Tetra Tech also asked questions that serve as consistency checks for prior responses. Finally, Tetra Tech asked about the influence of past participation in other Company energy efficiency programs on their decision to participate in the program in 2011. Past program participation may have had a positive impact on a customer's decision to install equipment through the program again. The SRA approach included not only interviews with end-use customers but also vendors who were identified by customers as being influential in the decision to participate in the program. Depending on the responses to this series of questions, a free-ridership score is calculated.

For programs that offer monetary incentives for multiple measure categories (E.g., lighting, HVAC), it is important to estimate free-ridership by specific measure type. Category-specific estimates produce feedback on the program at the level at which it actually operates and allows for cost-effectiveness testing by measure category. In addition, for commercial and industrial incentive programs, free-ridership has often been found to be highly variable among measure categories, making it essential to produce measure specific estimates.

Completion date is expected to be November 2012.

Small Business Research Area

Impact Evaluation of Small Business Energy Assistance Program (SBEA) - $289,000

The objectives of the SBEA study are to determine program impacts and to update the current PSD as appropriate with findings from the study. More specifically, the objectives include the following:

1. Provide SBEA Program level electric gross energy savings targeted to achieve +/-10 precision at the 90% level of confidence with provision of primary discrepancies in savings estimates between tracking savings estimates and final gross savings estimates, including the impact of documentation errors, technology adjustment, quantity adjustment, operation adjustment and interactive.
2. SBEA Program electric energy demand savings coincident with summer on-peak and seasonal peak periods targeted to achieve +/-10 precision at the 80% level of confidence with provision of primary discrepancies in savings estimates between tracking savings estimates and final gross savings estimates, including the impact of documentation errors, technology adjustment, quantity adjustment, operation adjustment and interactive effects.

Provide inputs to update the current PSD as appropriate with findings from the study, including metering results, installation results and other parameters.

The evaluation is primarily comprised of two evaluation activities; a billing analysis and an engineering study with monitoring and validation. Both study methods are empirical in nature, but can be expected to provide different outputs to help inform the study objectives, as discussed in the bullets below.

- The engineering study is expected to be the more rigorous approach to evaluating the SBEA Program. The engineering study will be a measure level approach that is based upon the performance of on-sites that have been statistically selected. This approach will incorporate M&V activities, such as metering time of use or consumption, of the measures installed in the businesses in our sample.
- The core billing analysis will provide an overall sense of the impacts of the SBEA Program through use of consumption data and the tracking data as a statistical variable. It should be noted that billing analysis results are at a high level (in this case at the treated premise level) and is typically not capable of findings on specific measures. This billing analysis will not estimate peak demand savings (only energy savings), although it is expected to provide a meaningful energy savings estimate.

Completion expected by September, 2013

MARKET TRENDS IN SMALL BUSINESS SECTOR -$ 47,330

The primary objective of this evaluation is to help program administrators make more informed decisions about how to garner deeper and more comprehensive energy savings through an examination of what has and has not been accomplished through the SBEA program over the years. To accomplish this, the evaluation will:

1. Assess which market sectors are highly represented among the SBEA participants over the last five years, which sectors are underrepresented and which are missing.
2. Determine how the market sector distribution of program participants compares to those of nonparticipants.
3. Characterize the mix of measures installed in the program, including an examination of the nature and frequency at which measures beyond lighting are installed (measure diversity).
4. Explore the levels of savings tracked in absolute and normalized terms (such per square foot, per rebate dollar, etc.) as available from the tracking system. This analysis will be performed by sector.
5. Provide a general profile of customer experience with the program; including information available on measures recommended but not installed.
6. Examine how often customers who engage with the SBEA Program engage for a single participation event versus participate multiple times and explore the nature of installed measures in those subsequent participation events.

Completion expected May, 2013

LARGE C&I QUICK-START MARKET ASSESSMENT $24,900

The objective of the initial participant trend analysis as framed is to conduct a high-level analysis of program participant data to identify participation trends. EMI presented this research from two perspectives, focusing on trends found regarding the installation specific measure categories (e.g., lighting, motors, custom projects) and the completion of projects in specific markets (e.g., offices, groceries, warehouses, industrial facilities). The objective of this additional analysis is to provide insight regarding comprehensive projects. Specifically, this additional analysis will answer the following questions regarding the EO and ECB programs between 2008 and 2011:

- What percentage of accounts participated in the EO or ECB program more than once?
- As lighting is often the first project due to its cost-effectiveness and ease of installation, how can programs best utilize lighting to “piggy-back” on to other projects? That is, after their first project, what are the most frequent follow-up projects?

- What percentage of accounts completed projects that include equipment from at least three different measure categories?
- What are the most frequent combinations of measure types among accounts that have completed projects that include equipment from at least three different measures categories?
- What types of facilities are most likely to complete projects that include equipment from at least three different measure categories?
- How has energy reduction intensity varied by project (i.e., energy savings per square foot or demand reduction per square foot) across time?
- How does the energy reduction intensity for projects and accounts vary by facility type in the EO program? How does it vary by facility in the ECB program?
- What type of projects result in the highest energy reduction intensity?

To answer the proposed research questions, EMI will examine the analysis database. This database is the result of merging and harmonizing program-tracking data provided by both companies. First, projects were assigned consistent measure categories at the greatest level of detail available between the two Companies. These categories included:

- Lighting equipment (including lighting controls)
- Non-lighting controls
- Process equipment
- Refrigeration equipment
- HVAC equipment
- Building envelope improvements
- Motors & drives
- Custom projects
- Other equipment

Using time-series and cross sectional analysis, the report will highlight programmatic opportunities.

Completion anticipated December 2012

ENERGY OPPORTUNITIES IMPACT AND PROCESS EVALUATION $503,000 2012/$501,000 2013

The impact study focuses on measuring direct results of the program's activities, evaluating both energy and demand savings against values reported from the program-tracking system estimates to determine overall realization rates and areas where *ex ante* assumptions and ascribed savings values differ from those measured in the field. The process evaluation will review program policies and procedures in practice, the adequacy and design of the program-tracking database, and gather perspectives from representative program and market actors. Objective qualitative and quantitative research and analysis methods will be applied to represent predominant themes and issues, identifying strengths and areas for enhancement to help the program reach its goals.

The overall objective of the process evaluation is to determine how the program is performing in relation to its goals and assess the adequacy of the program-tracking database and its integration with the program. After a detailed review of program materials, the team conducted in-depth interviews with the PAs and the EEB Technical Consultant to clarify the goals and objectives of the EO program and review program experience to date, including specific program process challenges and barriers to the attainment

of both short- and long-term goals as perceived by its practitioners. Based on these information sources, the evaluation team identified the following goals for the program:

- Increase the number of "comprehensive" projects.
- Increase the number of projects that engage in energy savings performance contracts (ESPCs).
- Increase the number of customers that utilize utility-sponsored financing.
- Include additional cost-effective equipment as part of the EO program.
- Identify and develop effective and targeted marketing approaches for key market segments.
- Encourage customers to develop and adopt strategic energy plans.
- Encourage customers to participate in ENERGY STAR building benchmarking.
- Effectively integrate the program into customers' day-to-day business operations.

Based on these goals, the team will provide the following as part of the process evaluation:

- An assessment of where the program is relative to each of these goals
- Analysis of the major barriers to achieving these goals, which could include program administrative processes and marketing approaches, customer preferences, perceptions and behaviors, and trade ally engagement
- Recommendations that will assist program staff overcome these barriers and achieve the above goals

For the impact evaluation, the necessary analysis of the collected on-site data will vary by project. However, in general, the evaluation team will develop an 8760-hour per year profile of lighting equipment operation for both the pre/base case and the post-installation case using a combination of metered data and scheduling information collected from the site contact. This profile will include documentation, technology, and quantity adjustments. Using the annual operating hours and the percentage of lighting that is on during the peak period, the evaluation team will calculate both lighting energy and peak demand savings based on the difference between pre- and post-measure fixture counts and wattages (e.g., the operational and coincident adjustment). In addition to direct lighting savings, the evaluation will also estimate the HVAC interactive effects (both the air conditioning savings and the heating penalty), using lighting measure data and HVAC system information collected during the site visit. This adjustment is known as the "interactive adjustment."

Once the site level results are calculated, the evaluation team will apply appropriate weighting factors (e.g., weights to correct for disproportionate sampling) to these results to develop an evaluated savings estimate at the program level. By comparing this estimate with the aggregate savings from the program-tracking database, the evaluation team will create a lighting measure realization rate and provide explanations of what factors and adjustments are driving that rate. In addition, the team will calculate and recommend "forward-looking" realization rates using any changes between the 2011 PSD and the then-current PSD to calculate savings as they would have been expressed if the measure had been installed today.

Completion expected June 2013.

SECTION 3: STUDIES IN DEVELOPMENT

For late 2012 and primarily 2013, the following studies are planned. Table 3.1 that follows summarizes the planned studies.

Table 3.1: Preliminary Evaluation Plan 2013

Residential Research Area	**Study Type**
HES Impact Evaluation	Impact
HES-IE Impact	Impact
Residential Measure Life	Impact
Lighting Hours of Use (regional)	Impact Support
CFL Net to Gross*	Impact Support
Free Rider/Spillover Net to Gross*	Impact Support
Small C&I Research Area	
SBEA Barriers to Project Completion (2013)	Impact
Barriers to Reaching Low Income/Limited English Businesses	Market – Program Support
Small Business Measure Persistence	Impact
SBEA Process Assessment*	Process
Large C&I	
Methods to Capture All Cost-Effective Savings	Market/ Impact Support
Other	
EM&V Forum	Procedures/ Impact Support
FCM Measure Life	Impact Support
Evaluation Planning and Management	Evaluation Consultant
IRP-Related Studies	Efficiency Potential
TOTAL	$3,678,000 - $3,803,000

* Could be deferred to 2014

TOTAL w/o Starred Studies	$2,748,000

Residential Research Areas

HES/HES-IE Impact Evaluation

This study is intended to establish the energy savings from each of HES and HES-IE programs. Information on savings will be approached using billing methods, engineering methods or both with results developed for each program separately. Particular attention will be paid to the extent Home Performance Measures are found.

Residential Measure Life

Measure life is made up of persistence (how long the measure remains in place) and time to failure, which can also include performance degradation over time. Current studies include an examination of persistence in the limited income program. However, overall measure life makes more sense to discuss within the full range of residential programs. This study will provide that assessment.

Lighting Hours of Use

With substantial savings created by replacing inefficient for efficient lighting, reliable, up-to-date information on lighting usage is essential. This regional study (coordinated with Massachusetts, Rhode Island and possibly New York) is intended to capture hours of use information that would support modeling operating hours for a wide range of programs and markets, based on the assumption that there is little variation in operating hours by bulb types within specific locations in the home.

Small C&I Research Area

Barriers to SBEA Participation in Under-Represented Markets

This project may begin before the end of 2012. Small businesses in the under-represented low income and limited-English markets face special difficulties with investing in efficiency on their own and even with investing through the CEEF programs. The purpose of this study is to examine those barriers and assess what customers need to be able to take advantage of efficiency opportunities. The EEB and Program Administrators will be able to use these results to develop program strategies

Barriers to Project Completion in SBEA

This project may begin before the end of 2012. In many cases, small businesses begin program participation, but do not complete the projects they have presented. Sometimes this occurs even after the customer has invested significant time to the design, development, and financial planning. This study will examine why customers abandon their projects and assess how these causes can be ameliorated. The results will be used to develop program strategies and enhancements.

Small Business Measure Persistence

Measure persistence has been a concern for Program Administrators due to frequent turnover in that sector. This study will examine frequency of turn-over by commercial sector to determine where turnover most frequently occurs and what happens to the measures installed after the building changes hands.

Large C&I Research Area

Methods to Capture All Cost-Effective Savings

Following completions of the Energy Opportunity Impact and Process evaluation, the contractor team for the Large C&I Research Areas will conduct a study to examine in more detail how to increase participant and vendor willingness to install or adopt all measures that are cost-effective when installed simultaneously.

Other Requirements

EM&V Forum

The EM&V Forum coordinates efficiency support studies for a regional group encompassing 10 states and the District of Columbia (not all of which participate in any given study). The Forum concentrates on studies that are high level, rather than program-specific, and are costly for states to provide individually.

The EEB has been an active participant in all relevant Forum studies since its inception. In addition to annual study fees, the participating states provide leadership on each study, data from programs and pre-existing studies to support Forum studies.

Future Capacity Market Measure Life

By policy, ISO New England discourages use of studies more than 5 years old in applications for Future Capacity Market. Current measure life estimates are over 5 years old. This study is incremental to the previously identified study of residential measures.

Total Integrated Resource Potential Studies

A number of limited studies of savings potential will be required to support development of the upcoming IRP report development. The numbers and types of studies are not yet known.

Studies Dependent on Budget Availability

CFL Net to Gross

The efficient lighting saturation study found that it was likely that far fewer CFLs were installed in homes than were provided by the programs and through retail sales. There are several hypotheses about what happened to the bulbs, ranging from diversion to commercial customers to unusual bulb failure. This study will examine

HES Free Rider/ Spillover

The simplest definition of Free Ridership results when a customer participates in a program in order to receive incentives for purchases/installations that would have been made regardless of program intervention. Pure Spillover results when a program participant adopts more of the same measures as were installed during participation without further program intervention or incentive. Pure spillover may also occur when another part installs measures or equipment without participating in a program because of another person's participation.

Degrees of free ridership and spillover are more common than the 'pure' form defined above. Both free ridership and spillover impact – in opposite directions - the effectiveness and cost effectiveness of programs. This study will measure the degree to which free-ridership and spillover have affected program savings.

SBEA Process Evaluation

The overall objective of the process evaluation is to determine how the program is performing in relation to its goals and assess the adequacy of the program-tracking database and its integration with the program. The Contractors will interview program administrators, EEB consultants, and Board members to determine long term goals for the program. Based on these goals, the team will provide the following as part of the process evaluation:

- An assessment of where the program is relative to each of these goals
- Analysis of the major barriers to achieving these goals, which could include program administrative processes and marketing approaches, customer preferences, perceptions and behaviors, and trade ally engagement and overall performance
- Recommendations that will assist program staff overcome these barriers and achieve the above goals

SECTION 4: REGIONAL EM&V FORUM

EM&V FORUM EVALUATION 2012

The EM&V Forum provides several types of research has not yet completed any studies since the last report, but has several ongoing studies. Basic descriptions follow.

EVALUATION, MEASUREMENT AND VERIFICATION METHODS FOR EMERGING TECHNOLOGIES

The Emerging Technologies project is intended to develop savings assumptions and methodological algorithms for a set of technologies and usage practices that are currently less developed. In the 2012 study, limited metering has been initiated for considered technologies. These are:

- Ductless heat pumps – in New York and Maine
- Advanced Power Strips – in two office buildings in Vermont

Additional sites are being considered. Completion of these metering efforts is expected in the first quarter of 2013, after completion of the winter season.

LOADSHAPE DEVELOPMENT - VARIABLE FREQUENCY DRIVES (VFD)

The VFD Study has the goal of collecting load shape data to inform development of coincidence factors in HVAC applications. The evaluation contractor, Cadmus, has selected a sample and begun metering VFD projects. Monitoring individual VFDs within the sample projects is being considered. Development of protocols for developing load shapes is also under consideration.

INCREMENTAL COST STUDY

The EM&V Forum has conducted incremental cost studies since 2010. The 2012 Incremental Cost Study focuses on researching the additional costs associated with installing efficient measures and technologies. These costs are those incremental to the cost of added efficiency and include such factors as additional installation costs or costs of premium features that may be bundled with the more efficient equipment. During 2012, the measures examined were:

- Residential Insulation
- Residential Combined Heat and Hot Water Systems
- Condensing On-Demand Tankless Water Heaters

Additional measures are under consideration for 2013

EM&V FORUM EVALUATION 2013

Projects initiated within the Regional EM&V Forum also affect Connecticut evaluation activities and budgets in 2013 and beyond. The Forum determines, in consultation with its membership, the studies that will be completed and the budgets for each project. This planning process is not expected to be completed until November. Ten states and the District of Columbia participate in the Forum, but not all subscribe to every study commissioned by the Forum.

New Studies

The slate of studies under consideration for 2013 remains in development. Some of the studies described above will continue into 2013. One new study has been selected.

Residential Lighting Market Lift

The EM&V Forum plans to complete a study comparing sales of residential lighting products using two alternate systems. Sales results using the current lighting program model (where the cost for lighting products is subsidized at the retailer level) will be compared with those from an alternate model that incents retailers for additional sales. The retailers are free to use any methods suitable to the store and its market to achieve the sales increases.

Connecticut has been an active participant since the Forum's inception and intends to continue doing so. Participation in the Forum can provide cost-effective solutions for projects that might be too costly to do without regional support.