Large Commercial & Industrial Research: Participant Trend Analysis (Draft Final)

Submitted To:

Kim Oswald
Evaluation Consultant
Connecticut Energy Efficiency Board

Submitted By:

EMI

Energy Market Innovations, Inc.
83 Columbia Street, Suite 400
Seattle, WA 98104
T 206.621.1160
www.emiconsulting.com

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Introduction

This report describes the aggregation and analysis of energy efficiency program-tracking data from the large commercial and industrial (C&I) programs being operated by the two major energy utilities in Connecticut. As requested by the Connecticut Energy Efficiency Board (EEB), Energy Market Innovations, Inc. (EMI) examined four years of program-tracking data from Connecticut's two major C&I energy efficiency programs: Energy Conscious Blueprint (ECB) and Energy Opportunities (EO). These two programs are each operated independently by The United Illuminating Company (UI) and Connecticut Light & Power (CL&P), and their subsidiary natural gas companies: Yankee Gas, Southern Connecticut Gas, and Connecticut Natural Gas (together, the Companies). The ECB program is primarily directed toward maximizing electric and natural gas savings during a facility's initial construction or major renovation, while the EO program focuses on encouraging electric and natural savings in existing facilities through incentives supporting qualified efficiency improvements. Combined, these two programs account for 59 percent of electric energy savings and 87 percent of natural gas energy savings that are attributed to Connecticut's C&I program portfolio.

In addition to this Executive Summary, this report contains an overview of the study, a brief explanation of the methodologies employed, and the key results and recommendations. Detailed tables supporting the results are included as Appendix A: Detailed Tables.

Purpose of the Study

The purpose of this study was to provide program staff and the EEB with an understanding of the most important participation trends and developments in the EO and ECB programs in recent years, viewed on an aggregated, statewide basis. Based on these findings, the study is also intended to provide guidance to EO and ECB program staff to help them more effectively target the remaining savings opportunities and to encourage additional comprehensive energy efficiency projects among their customers. The results of this study compliment more exhaustive research activities currently underway by the evaluation team.

In conducting this trend analysis, the team reviewed program-tracking data for completeness and consistency across programs and Companies. Based on this review, the evaluation team also provides recommendations for how the Companies can improve the usability of their program-tracking data to better inform future marketing efforts and allow for more in-depth reporting and evaluation.

Methodology

As part of the project-planning process, the evaluation team requested and received copies of the Companies' C&I EE program participation databases. As a necessary first step in data analysis, the EMI evaluation team checked, cleaned, and merged the relevant data fields from the databases provided by the Companies into one consistent format. Once merged, this database contained records of all incented energy efficient equipment installed by participants under the ECB and the EO programs between the years 2008 and 2011. This provided the foundation for the evaluation team's analysis and highlighted any gaps in the Companies' data. In order to identify participation trends in each program, EMI produced detailed summary tables.

The measure or end-use categories tracked by each company were not identical, so the team had to define common types of, or "harmonize" project attribute definitions in the data analysis process to produce one statewide database. As detailed in Section 2, the evaluation team recoded measure descriptions into 11 commonly used categorical measure types that were identified as consistent across the Companies and programs. Likewise, the team recoded facility-type information (e.g., office, retail, warehouse) into 10 consistent facility groups across companies and programs, again using standard industry definitions. EMI then applied these harmonized measure and facility categories in all follow-up analysis of data.

Recommendations

Based on the evaluation team's analysis of the program-tracking data, we provide the following recommendations.

The evaluation team recommends that the Companies should focus on adding improvements to HVAC systems and motors and drives in addition to any cost-effective lighting improvements (including lighting controls). Per the program-tracking database, improvements to lighting and HVAC are most likely to be installed at the same facility in both the ECB and EO programs. Our analysis revealed that between 2008 and 2011, 55% of all ECB comprehensive projects and 25% of all EO comprehensive projects contained at least improvements to both lighting and HVAC end-uses (some projects contained a third or fourth end-use). It is likely that these equipment combinations present the most cost-effective energy efficiency opportunities across the widest segment of C&I customers.

The evaluation team recommends that the Companies encourage industrial and manufacturing facilities to complete additional comprehensive projects as apart of the ECB program. The Companies should increase efforts at engaging these facilities and investigate what types of comprehensive projects will be valuable for them. EMI's research identified that these facilities account for a large portion of the overall program participation and energy savings impact but that comprehensive projects are relatively infrequently; only 20% of the industrial and manufacturing facilitates that participated in the ECB program improved more than one end-use between 2008 and 2011.

The evaluation team recommends that the Companies encourage institutional facilities to complete projects as part of the ECB program. The ECB program has been very successful in gaining participation of educational facilities and health care facilities, and staff should expand their engagement of these sectors. While these segments account for a smaller proportion of the ECB program participation, these customer types achieved higher-than-average kWh savings per account between 2008 and 2011. This suggests that they present additional opportunities for the program to achieve cost-effective savings by maximizing the energy savings per account. In addition, given that these facilities typical have long operating hours, high and predictable occupancy rates, and high construction and remodeling standards, they are prime candidates for comprehensive project investment.

The evaluation team recommends that the Companies target retail outlets and office buildings as part of the comprehensive initiative within the EO program. EMI's research found that the EO program frequently engages both retail outlets and office buildings and that these segments account for a significant portion of the program's energy savings. However, comprehensive projects are less frequent in both of these market segments. While it is possible that that there are limited opportunities given the nature of retail and office building operations, both segments account for a significant portion of the participating projects and therefore, present an opportunity for growth.

While retail and office spaces provided frequent opportunities for participation, the EO program should also focus on increasing participation among industrial and manufacturing customers. While these

facilities make up only 14% of the participating accounts, they represent 28% of the overall kWh savings. Likewise, the average kWh savings at each account is double the program's average. Increasing participation among this sector should allow the program to run more cost-effectively by increasing the energy savings per customer.

The evaluation team recommends that the Companies agree upon and use a single, consistent system of data classes for program tracking. Aggregation, analysis and comparison of the utilities' efficiency project databases were substantially limited by a lack of consistent reporting methods and practice, both within each program and across them. An agreement to adopt a common classification scheme and lexicon across the State for projects, measures, customers, and facility types, etc. would be very valuable in helping the EEB evaluate program outcomes and allow the Companies to market the programs more effectively. The evaluation team suggests the following improvements to consistency:

- Use consistent US Postal Service addressing standards including separate fields for facility name, street address, city, and zip code. Another option is to incorporate a premise number into the program databases that uniquely identifies facilities. This addition would eliminate the need to aggregate and manage the program data based on address information and instead, provide a clear method for aggregation and analysis of specific locations for both program managers and evaluators. However, this addition may be cost-prohibitive due to the need to alter existing database structures.
- As much as possible, collect phone number, first name, last name, position, and email addresses of an appropriate contact for all projects.
- Record common project milestone dates including application, installation, and closed dates (as applicable).
- Consistently record a NAICS code or similar code to provide a clear, consistent, and comprehensive presentation of the nature of the facility for each project.
- Ensure quantities reflect the actual number of units of a particular measure installed.
- Present consistent measure-level information including measure or product descriptions and "measure type" classifications such as lighting equipment, lighting controls (e.g., daylight sensors, occupancy sensors), building controls, HVAC equipment, compressors, motors & drives, refrigeration equipment, building envelope improvements, process improvements, and hot-water heating equipment. This consistency might be practically implemented via data-entry lexicon controls such as the use of "pick-lists." Currently, the project tracking databases often grouped like measures together as part of the same record (e.g., both lighting equipment and lighting controls are recorded as part of the same record). This grouping artificially limits the level of detail possible for analysis of individual equipment attributes such as energy savings, quantities, and incentives. An alternative method of tracking projects would include equipment detail at the line item level as based on the application paperwork. This level of detail would allow for more detailed analysis of the project tracking data which would in turn support more targeted program marketing and more robust evaluation research.

The evaluation team recommends that the Companies and the EEB pursue a full market assessment. EMI's analysis of these market characteristics of both the ECB and EO program is intended to provide high-level recommendations to guide future marketing and customer engagement efforts and will expand on these results as part of the process evaluation research currently underway. However, EMI believes that a full market assessment would provide greater insight by highlighting gaps in market penetration and additional potential for program savings. In addition, a market assessment could include primary research that would explore the energy efficiency needs of program non-participants.

1.   INTRODUCTION

This introduction provides an overview of the purpose of the participant trend analysis research, including the intended use of the research. This section also includes a brief overview of the design and goals of ECB and EO programs. This information provides the necessary context for interpreting the results presented in the following chapters.

1.1.   Purpose of the Study

The purpose of this study was to provide guidance to program staff on future implementation strategies based on the participation trends within the EO and ECB C&I programs that emerged as part of the evaluation team's examination of the program-tracking data. This guidance will allow the EO and ECB program staff to target remaining savings opportunities in a more focused manner and encourage additional comprehensive energy efficiency projects among their customers. The results of this study compliment more exhaustive research activities currently underway by the evaluation team.

In addition, the team reviewed program-tracking data for completeness and consistency across programs and Companies. As a result of this review, the evaluation team also provides recommendations for how the Companies can improve the usability of their program-tracking data to better inform future marketing efforts and allow for more in-depth reporting and evaluation.

EMI conducted this research from both a technological and market perspective with a focus on comprehensive projects. In addition to broad trends, EMI's research focused on the following research questions:

1. Which measure combinations have been successful for each program and therefore, can serve as the focus for future efforts?
2. Based on past participation, in which markets should the Companies focus future efforts?
3. What are the possible drivers (e.g., market demand or program activities) for some of the key trends that emerged from the program-tracking data?
4. How can the Companies improve data consistency and completeness across programs and Companies?

1.2.   Description of Programs

Energy Conscious Blueprint

Per the 2012 Conservation and Load Management Plan, the objective of the ECB program is *"to maximize electric and natural gas energy savings for 'lost opportunity' projects, at the time of initial construction/major renovation, or when equipment needs to be replaced or added."* The program accomplishes this by working closely with new construction trade allies (e.g., contractors, architects, engineering firms) to raise awareness of energy efficiency technologies and whole-building design practices and assist these allies in illustrating the benefits of energy efficiency during initial construction to property developers and owners. In addition, based on the scope of the project, the program offers a variety of incentives for the following systems:

- Lighting and lighting controls
- HVAC systems
- Hot water heating equipment
- Motors
- Process equipment

The proposed 2012 budget for the ECB program was $10,889,221 (23 percent of the overall C&I proposed budget).

Energy Opportunities

Per the 2012 Conservation and Load Management Plan, the EO program "*encourages customers and their contractors or Energy Service Companies (ESCOs) to save energy in existing commercial, industrial, and municipal facilities by offering incentives, financing and other resources to replace existing, inefficient equipment with energy-saving options.*" In addition, the program seeks to increase the overall performance of buildings by encouraging a "holistic" or whole-building approach to energy efficiency. To accomplish this, the program encourages "comprehensive" projects that encompass multiple measures.

To achieve these goals, the program works closely with trade allies (primarily contractors and ESCOs) in addition to offering financial assistance to encourage the replacement of inefficient equipment with high efficiency models. The program offers additional "bonus" incentives for projects that are considered comprehensive. For large-scale energy-saving projects, the program primarily provides custom incentives, where energy savings estimates and attendant incentives are calculated using standard engineering practices. The following traditional types of energy efficiency improvements are targeted with prescriptive rebates:

- Lighting and lighting controls
- HVAC systems
- Vending equipment
- Kitchen equipment
- Laundry equipment

The proposed 2012 budget for the EO program was $16,198,999 (35 percent of the overall C&I proposed budget).

2. METHODOLOGY

EMI performed its analysis of participation trends using data extracted from the Companies' program-tracking databases produced by the ECB and EO programs. Before conducting this analysis, EMI prepared the data to ensure they contained consistent information across the Companies. This preparation included identifying common fields of data and appropriately merging the two company databases, consistently classifying measures for each project, and consistently classifying facility type for each project.

2.1. Database Merge

Both Companies provided the evaluation team with program-tracking databases. UI provided files for each program, while CL&P provided a single file for both. For this study, the evaluation team selected projects from the ECB and EO programs only and identified essential fields, which included:

- Project number
- Project name
- Measure description
- End-use code
- Installed quantity
- Annual electrical savings (kWh)
- Lifetime electrical savings (kWh)
- Peak demand savings (kW)
- Annual natural gas savings (therms)
- Rate code
- Facility type
- Installation date
- NAICS and/or SIC code.

EMI merged the database files to create a combined database containing all measures completed by ECB and EO program participants from 2008 to 2011.

Once merged, EMI removed measures with no recorded electric or gas savings and measures completed outside of the 2008 to 2011 time frame. In addition, EMI also removed records of project bonuses, design incentives, and administrative adjustments, which had no associated savings recorded [1]. While these types of "measures," most notably design incentives, may be critical in enabling other measures that do include savings, the evaluation team's research focused on projects and equipment. After excluding these cases, the database contained 11,843 cases.

Of the aforementioned data fields, only the facility type textual description field had a large number of cases with missing data. The evaluation team used NAICS and SIC codes to assign a facility type to projects with missing data, as detailed in Section 2.2. In order to ensure measures were categorized

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[1] Of the 1,978 cases removed, 192 were bonuses for comprehensive projects and 22 were design incentives. Administrative adjustments totaled 72 cases. "Incentive cap" made up 1,034 cases. The remainder was associated with specific measures but listed zero or missing savings values.

consistently and with an increased level of detail, the evaluation team also developed a methodology for assigning measure categories, detailed in Section 2.3.

2.2. Facility Type Classification

Based on the available data, the evaluation team elected to use facility type as a proxy for the customer type analysis described in the research objectives. A harmonized facility type classification was developed to aid in the analysis and comparison across programs and companies. Facility types present in the program tracking databases were recoded into the harmonized classification of 10 facility types, detailed in Table 2-1. Of the 1,541 measures without a facility type in the tracking database, 1,367 had a NAICS code. The evaluation team merged in NAICS descriptions for these measures and assigned these facilities with a facility type based on the NAICS descriptions; these 1,367 measures represented 170 different NAICS codes. The evaluation team reviewed each NAICS code and description and assigned that code to one of ten harmonized facility types. A total of 212 measures had facility type of "OTHER" or "UNABLE TO CLASS" in the program-tracking database; the evaluation team also reclassified these measures based on NAICS descriptions when available.

EMI assigned the remaining 174 measures without a tracking database facility type or a NAICS code a facility type based on SIC code and description using the same protocol as with NAICS codes. The 174 measures represented 18 SIC codes.

Table 2-1. Harmonized Facility Type Classification

Harmonized Facility Type	Example Tracking Database Facility Types
Education	Education, schools
Grocery	Convenience stories, food stores
Health Care	Hospitals
Lodging	Motel/hotel, nursing homes
Office	Communications, construction, government
Food Service	Fast food restaurants, restaurants
Retail	Apparel, entertainment
Warehouse	Warehouse, wholesale
Industrial/Manufacturing	Industrial, chemicals, food processing, paper, primary metals, rubber/plastics, textiles
Other Facilities	Agricultural, transportation, sports arena

2.3. Measure Classification

The evaluation team developed automated data sorting rules based on text strings in the Companies' database measure description fields and end-use codes to assign measure categories. This effort also ensured that measures were classified consistently in the cases where equivalent equipment was found in multiple use codes. Examples of measures included in the 11 measure categories are detailed in Table 2-2.

The rules for measure classification were order-sensitive, applying more specific rule tests on program records before less specific ones. The rules fell into two groups: the more specific rules searched for text strings within the measure descriptions (i.e. particular words indicating a type of measure, such as the occurrence of "air" and "compressor," or "LED" and "cooler" in a measure description), while the less

specific rules were based solely on use codes. In the event that text in a measure description did not pass any of the rule tests related to measure descriptions and so be classified accordingly, it was classified based on its end-use code. Two separate analysts reviewed all the assigned measure categories for accuracy after coding.

Table 2-2. Harmonized Measure Categories

| Measure Category	Example Measures and Use Codes
Lighting	Lighting retrofit, exterior lighting, occupancy sensors, daylight controls
Controls (*non-lighting*)	CO2 controls, energy management systems (EMS), HVAC occupancy controls
Process	Process cooling tower fans, steam trap replacement, plastic injection molding machines, laser upgrades
Compressors	Air compressors, cycling air dryers, air receiver and regulators
Refrigeration	Water chillers, freezer evaporators, anti-sweat heater controls, night covers, oversized condensers
HVAC	Heat pumps, radiant heaters, condensing furnaces, condensing boilers, differential enthalpy controls, cool roofs, air cooler chillers, RTU's or roof top units
Building Shell	Wall and roof insulation, low-emissivity windows, window film, piping insulation
Motors/Drive	Standard motors, variable frequency drives (VFDs) for HVAC fan motors, hot water pump VFDs, ECM motors
Hot Water	High efficiency domestic hot water heaters
Other	Transformers, vending misers
Custom	Custom projects

3. RESULTS

The remainder of the report presents the results of EMI's analysis of the combined program-tracking databases, representing a statewide perspective of the recent participation and near-term opportunities associated with these important programs. This analysis focuses on four areas: (1) program participation drivers, (2) comprehensive projects, (3) program participant market characteristics, and (4) database consistency and completeness. For each area, we present results by program.

3.1. Program Participation Drivers

In order to establish a historical context for each program, the evaluation team first examined participation in the programs over time. This examination included a review of program participation by expenditure, by project type, and by customer type. While our research provides insight into what may be driving the trends observed, it also provides a foundation for the reminder of the analysis regarding comprehensive projects and market characteristics.

First, participation in the program of both the ECB and EO program was generally tied to program budgets as would be expected. However, in several significant ways, participation levels did *not* track investment, as discussed below. The general trends across the programs are likely in response to external economic conditions and customers' reaction to those conditions. As expenditures increased or decreased, the number of projects generally varied the same way, although not by a constant ratio. Over time, participation in the ECB program decreased slightly while the EO program expanded significantly. The decline in ECB program activity may be attributed to the slowing of new construction starts due to the economic downtown, while the increase in EO program activity may be attributed to renewed interest in retrofitting existing facilities as customers are hesitant to invest the capital funds associated with new construction. Figure 3-1 below illustrates participation in each program and the annual program budgets.

Figure 3-1. Program Participation and Expenditure by Year
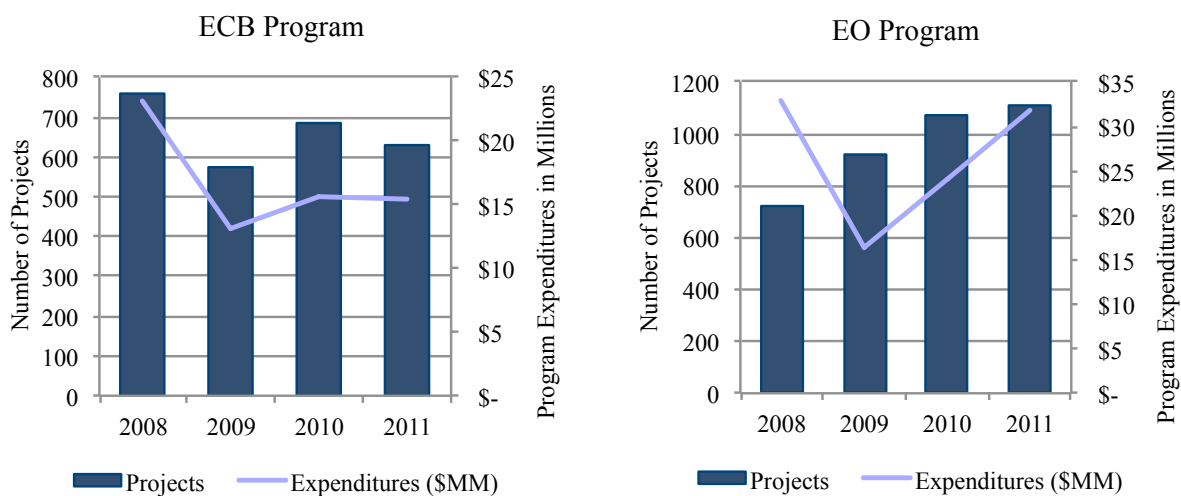
Second, the projects completed as part of the ECB and EO programs both compromised a unique mix of measures with some end-uses installed more frequently than others. For the ECB program, the most frequently incented measure type was HVAC equipment followed by lighting. By comparison, the EO program consisted overwhelmingly of lighting projects. However, while the number of lighting projects in the EO program has steadily increased, the percentage of overall program energy savings associated with lighting has decreased significantly (75 percent in 2008 to 59 percent in 2011). This trend suggests that while the program continues to focus on lighting projects, the market for large lighting replacement projects (typified by large office building T-12 to T-8 retrofits) is becoming saturated and the program is seeing diminished returns from a shift to smaller lighting projects that tend to require more effort and cost per lighting-kWh of savings. Given new federal lighting standards, this shift is likely to continue in the near term and so supports the program's increased focus on encouraging projects that include more than just lighting equipment. Figure 3-2 below illustrates the distribution of projects across time and measure type for each program.

Figure 3-2. Project Type by Year
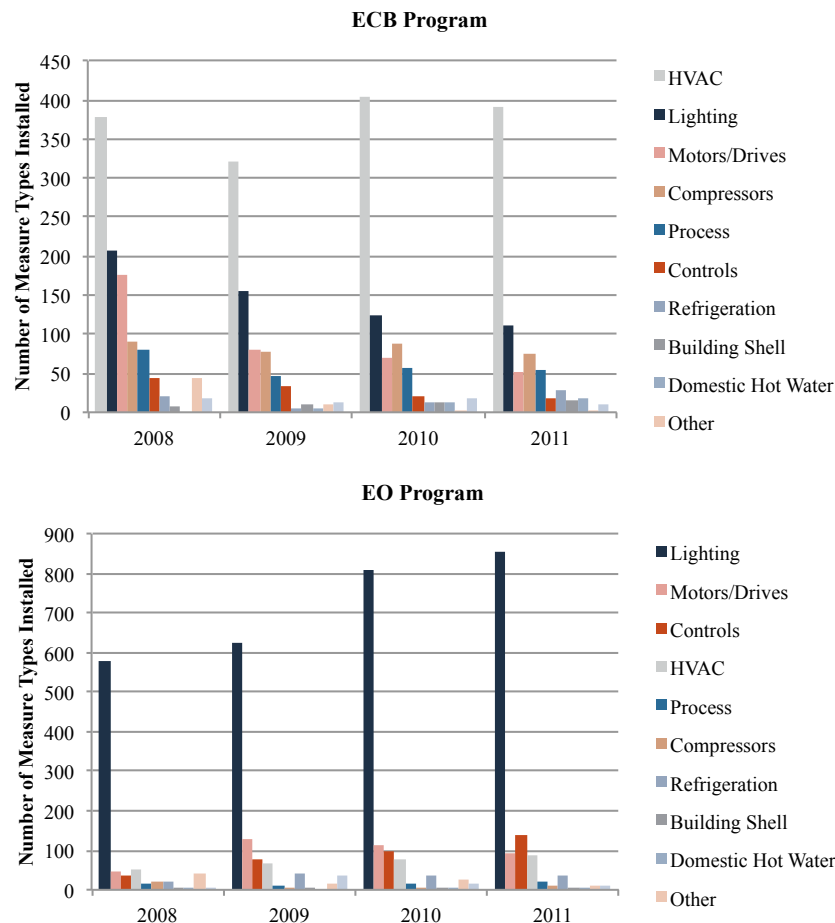
Finally, for the ECB program, industrial, office, and retail facilities have historically accounted for a majority of program projects. However, over time, the number of industrial facilities participating has decreased. This trend is likely a result of reduced economic activity (new construction and other major capital investments) among the industrial sector. Conversely, in the EO program, the number of participating retail facilities has significantly increased (134 projects in 2008 to 438 in 2011). Again, this

increase may be the result of economic trends as retail outlets attempt to reduce energy costs amid reduced consumer demand. Figure 3-3 illustrates program participation by customer type of each program between 2008 and 2011.

Figure 3-3. Participating Customer Type by Year
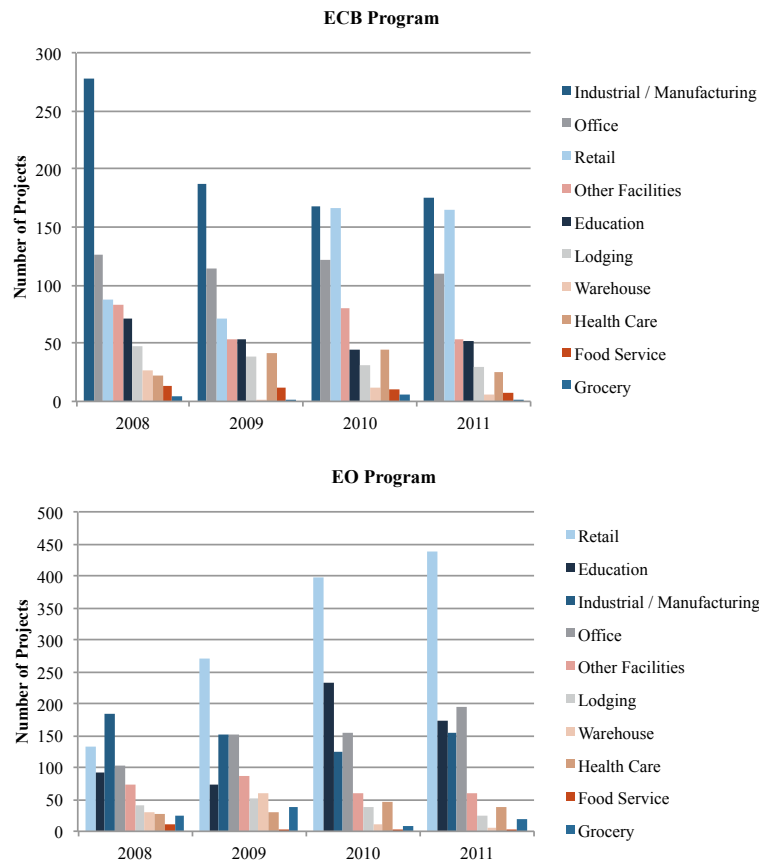
3.2.   Comprehensive Projects

Currently, one of the goals of both the ECB and the EO program is to encourage customers to complete comprehensive energy efficiency projects, defined as those that include improvements to more than one energy end-use. The rationale for this goal is to move the programs beyond the current predominance of projects that include only lighting measures to achieve deeper, whole-building energy efficiency. To support these efforts, EMI examined the program-tracking database from both a technological and market perspective.

Technological Perspective

From the technological perspective, some types of equipment are more likely to be installed together. Based on our analysis, EMI recommends that the Companies should continue to encourage comprehensive projects that focus on improving not only the lighting equipment (including lighting controls) but also the HVAC system and any motors and drives at a facility.

Per the program-tracking database, improvements to lighting and HVAC are the most likely combination of different energy end-use types to be installed at the same facility in both the ECB and EO programs. Our analysis revealed that between 2008 and 2011, 55% of all ECB comprehensive projects and 25% of all EO comprehensive projects contained at least improvements to both lighting and HVAC end-uses (some projects contained a third or fourth end-use). It is likely that these equipment combinations present the most cost-effective energy efficiency opportunities across the widest segment of C&I customers. The evaluation team is currently exploring likely causes (drivers) of these combination choices as part of the EO process evaluation during in-depth interviews with program participants and vendors.

Other end-uses that were frequently installed together included lighting and motors/drives (30% and 25% in the ECB and EO programs respectively) and HVAC equipment and motors/drives (32% and 20% in the ECB and EO programs respectively). The proportion of HVAC-related measures is expected to be even higher than the data reveals, due to limited detail and consistency in measure end-use typing. In most cases, motor and variable speed drive end-uses in commercial buildings are likely parts of HVAC systems, typically comprising drive-power for HVAC circulation pumps or fans.

Table 3-1 and Table 3-2 list the top ten types of comprehensive projects within each program between 2008 and 2011.

Table 3-1. Top 10 Types of Comprehensive Projects within ECB program (2008-2011)

Type of project	Number of projects (N=555)	Percent of projects (N=555)
Lighting and HVAC equipment	124	22.3%
Lighting, HVAC equipment, and motors/drives	67	12.1%
Process improvements and air compressors	30	5.4%
Lighting, controls, HVAC equipment, and motors/drives	22	4.0%
HVAC and hot water equipment	20	3.6%
HVAC equipment and motors/drives	19	3.4%
Lighting, HVAC equipment, motors/drives, and other equipment	17	3.1%
Lighting and motors/drives	16	2.9%
HVAC and building envelop improvements	14	2.5%
Lighting and air compressors	14	2.5%

Table 3-2. Top 10 Types of Comprehensive Projects within EO program (2008-2011)

| Type of project	Number of projects (N=458)	Percent of projects (N=458)
Lighting and HVAC equipment	44	9.6%
Lighting and motors/drives	43	9.4%
HVAC equipment and motors/drives	39	8.5%
Lighting and building controls	31	6.8%
Lighting and refrigeration equipment	25	5.5%
Lighting and custom projects	23	5.0%
Lighting, HVAC equipment, and motors/drives	22	4.8%
Building controls and HVAC equipment	21	4.6%
Building controls and motors/drives	16	3.5%
Lighting and other equipment	16	3.5%

Market Perspective

From a market perspective, comprehensive projects are concentrated in certain market segments during the period investigated. For each of those segments, EMI identified several trends within each program.

First, by comparison, the ECB program shows a significantly higher proportion of comprehensive projects than the EO program (24% vs. 14% comparatively). This difference is likely due to the greater opportunity to incorporate multiple energy efficiency measures in one process with less organizational resistance and lower overhead per measure in a new construction project. Thus, the evaluation team does not believe the difference is the result of any specific program mechanism.

Second, within the ECB program, EMI's research identified that education facilities, groceries, retail outlets, and health care facilities contain an above-average percentage of accounts that have improved more than one energy end-use. This finding suggests that the program has engaged these market segments more successfully than other segments. However, EMI recommends that the Companies should increase efforts at specifically engaging industrial and manufacturing facilities and investigate what types of comprehensive projects will be valuable for them. This is important, because although these facilities account for a large portion of the overall program participation and energy savings impact, comprehensive projects are relatively uncommon; only 20% of the industrial and manufacturing facilitates that participated in the ECB program improved more than one end-use between 2008 and 2011. Potential comprehensive projects in the industrial sector will likely be different from those in the commercial sector, and often unique in composition. While commercial customers can naturally expand energy efficiency projects to include HVAC equipment, industrial customers are more likely to be interested in compressed air equipment, refrigeration systems, controls, process improvements, or some combination of these in addition to lighting.

Figure 3-4 below illustrates the percentage of comprehensive projects by customer type for the ECB program.

Figure 3-4. Percentage of ECB Program Comprehensive Projects by Customer Type (2008-2011)
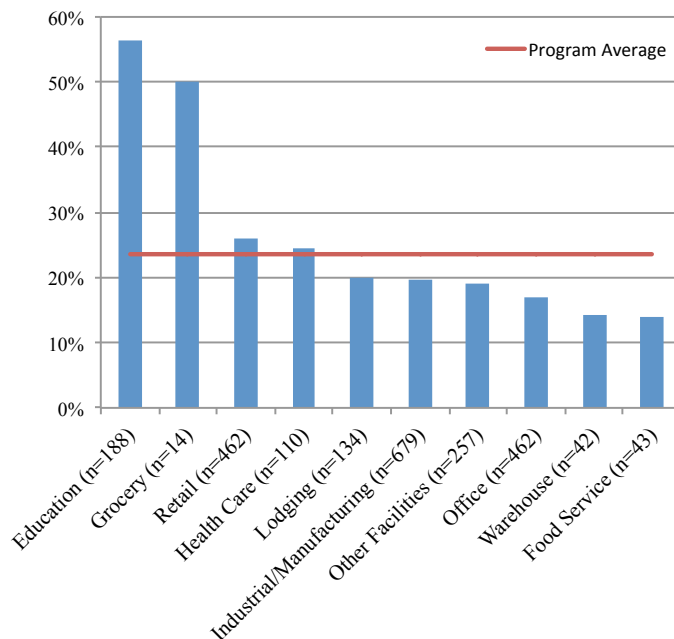
Within the EO program, the Companies should continue to engage groceries, warehouses, health care facilities, and educational facilities. Again, for each of those segments, the percentage of accounts that has improved more than one energy end-use is above the program's overall average. However, comprehensive projects are less frequently found in both office buildings and retail outlets. As of this report, it is difficult to determine whether this trend is the result of the program not leveraging existing opportunities or if, at offices and retail outlets, there are limited opportunities for cost-effectively retrofitting any systems beyond the lighting. Figure 3-5 below lists the percentage of comprehensive projects by customer type for the ECB program.

Figure 3-5: EO Program Comprehensive Projects by Customer Type (2008-2011)
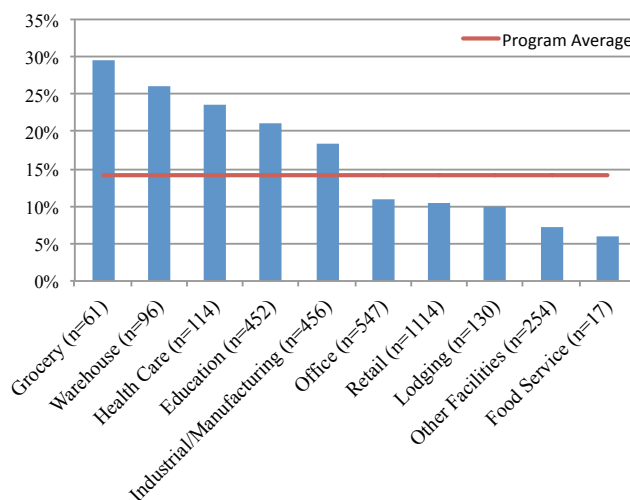
# 3.3. Program Participant Market Characteristics

Historically, both the ECB and EO programs are mature programs that have an established record of engaging a wide variety of Connecticut commercial and industrial customers. Therefore, a continued goal of both the ECB and EO programs is to reach a "broad" set of C&I customers. To support this effort, EMI conducted a cross-sectional analysis of the program-tracking databases to identify successful trends among market segments for each program.

ECB Program Market Characteristics

Between 2008 and 2011, the ECB program most successfully engaged industrial and manufacturing facilities (29%), retail outlets (19%), and office buildings (18%). A cross-sectional analysis of kWh savings confirms this analysis; a majority of the savings also occurs within the industrial and retail market segments. These findings suggest that these C&I market segments are receptive to assistance offered by the ECB program and present an opportunity for further investment by the program. The evaluation team recommends that the program should continue its efforts to work with them.

Figure 3-6 and Figure 3-7 below illustrate the distribution of customer types by both participation counts and kWh energy savings.

Figure 3-6. ECB – Percentage of Participating Accounts by Customer Type (2008-2011)
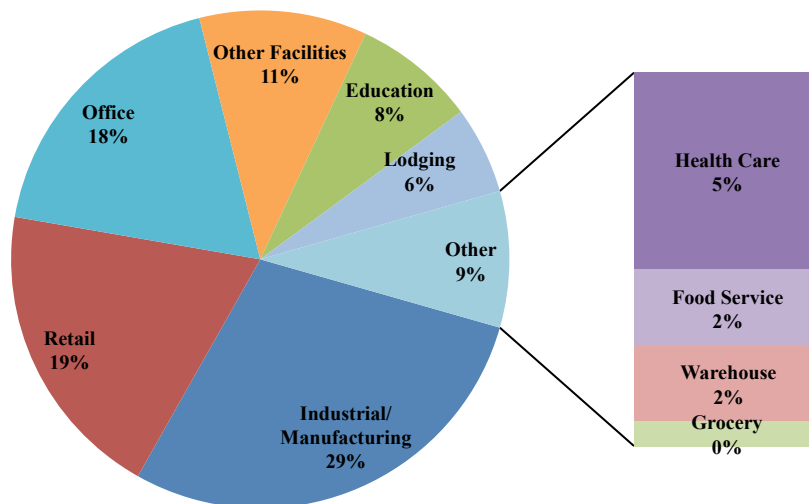
Figure 3-7. ECB – Percentage of Gross kWh Savings by Customer Type (2008-2011)
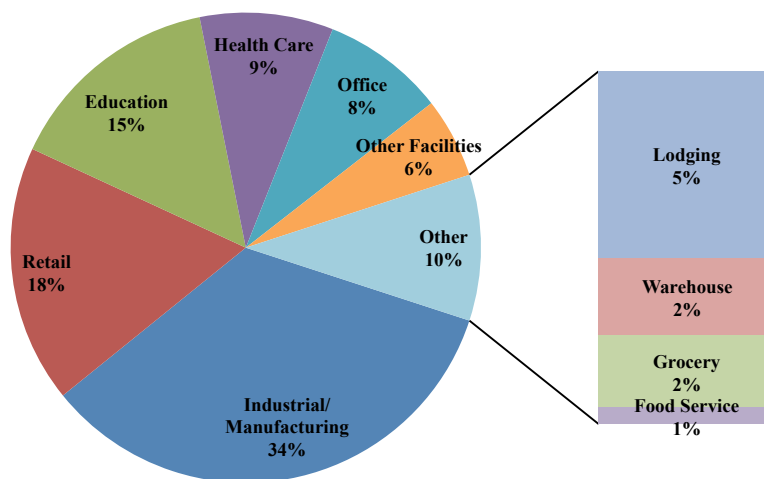
Other market segments (e.g., educational facilities, health care facilities) account for a smaller proportion of the ECB program participation. However, this finding does not suggest that the program's assistance is not attractive to these customers. Instead, these proportions reflect that there are a limited number of customers in these market segments and therefore, fewer opportunities for program participation. Likewise, as these customer types achieved higher-than-average kWh savings per account between 2008 and 2011, they present additional opportunities for the program to achieve cost-effective savings by maximizing the savings per account.

Figure 3-8 below illustrates the average kWh savings per account (groceries should be considered an outlier as only 14 groceries participated in ECB program between 2008 and 2011).

Figure 3-8. ECB - Average kWh Savings per Account (2008 -2011)
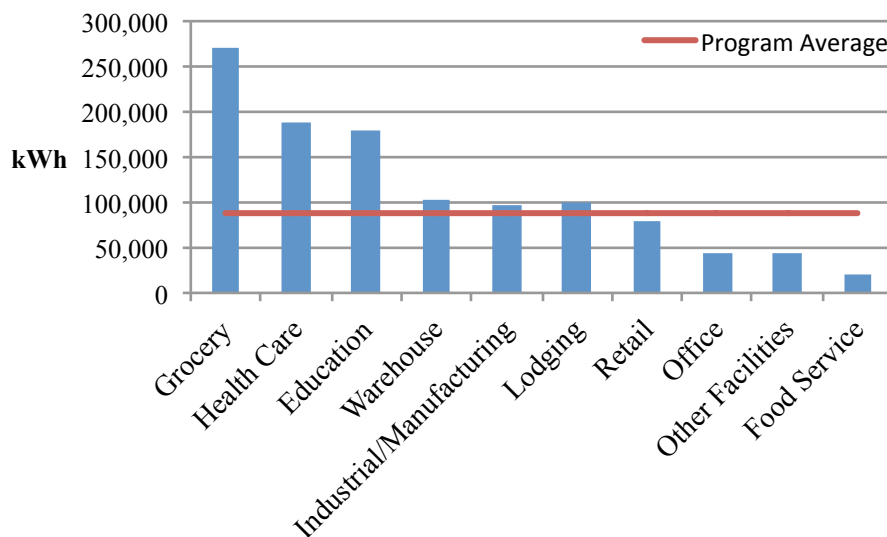
EO Program Market Characteristics

Between 2008 and 2011, the EO program successfully engaged retail outlets (34%) and office buildings (17%). A cross-sectional analysis of kWh savings confirms this analysis; a majority of the program savings also occurs within these two market segments. These findings suggest that both retail outlets and office buildings are receptive to improving their energy efficiency via retrofits and present an opportunity for further investment by the program. The evaluation team recommends that the program should continue its efforts to work with them. Figure 3-9 below lists the number of accounts from each market segment that has participated in the ECB program between 2008 and 2011.
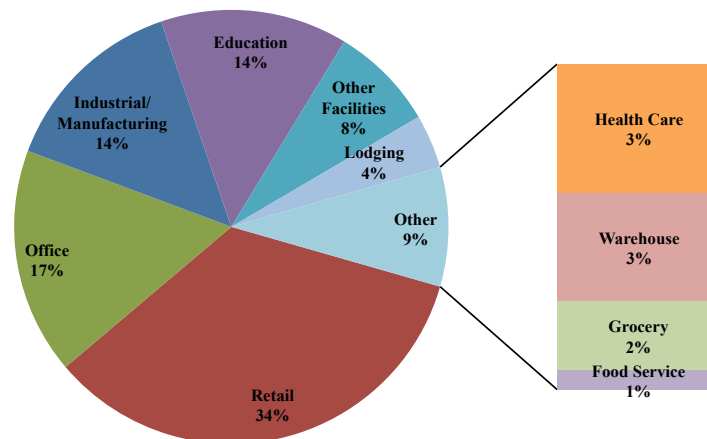
Figure 3-9. EO – Percentage of Participating Accounts by Customer Type (2008-2011)

While retail and office spaces provided frequent opportunities for participation, the EO program should also focus on increasing participation among industrial and manufacturing customers. While these facilities make up only 14% of the participating accounts, they represent 28% of the overall kWh savings. Likewise, the average kWh savings at each account is double the program's average. As mentioned above, this trend is likely the result of the types of energy efficiency projects that are available at industrial and manufacturing plants and health care facilities such as comprehensive projects that address multiple end-uses that provide deep energy savings.

Figure 3-10 below illustrates the distribution of kWh savings by customer type and **Figure 3-11** illustrates the average kWh savings per account by customer type.
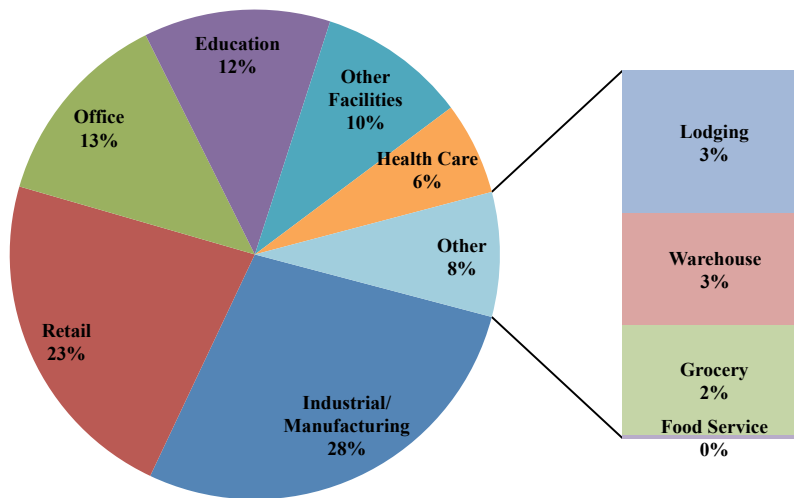
Figure 3-11. EO Average kWh Savings per Account (2008 -2011)
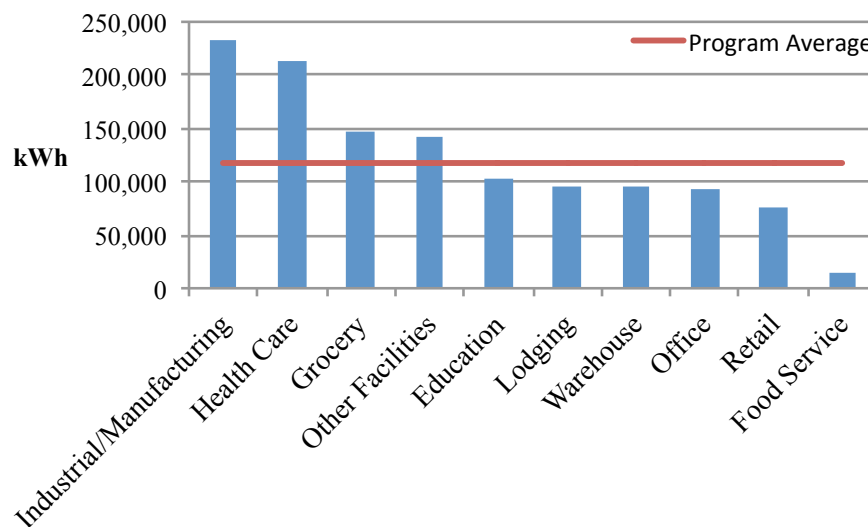
Possible Additional Market Characteristic Research

EMI's analysis of these market characteristics of both the ECB and EO program is intended to provide high-level recommendations to guide future marketing and customer engagement efforts. For the EO program, the evaluation team will expand on these results as part of the process evaluation research currently underway. However, EMI believes that the Companies and the EEB could gain additional insight from a full market assessment study. A full market assessment would compare program participation against the population of eligible customers to highlight gaps in market penetration and additional potential for program savings. In addition, a market assessment could include primary research that would explore the energy efficiency needs of program non-participants (i.e., those that have not

participated in a program during the past ten years). EMI recommends that the Companies and the EEB consider this type of research for future program years and consider this study as the first phase in that effort.

3.4.   Database Consistency and Completeness

While the files from each Company contained the data needed to conduct the analyses for the evaluations, the comprehensiveness, completeness, quality, and consistency varied. Ideally, in addition to knowing what utility and program the data represent, the minimum data needed to most effectively, efficiently, and accurately conduct the evaluations consists of:

- Detailed information on the measures that were installed using a limited standardized lexicon to describe measures, so that measures can readily be compared and classified
- Energy savings for each of the measures
- Information on the facility where the equipment was installed
- Contact information for conducting surveys

The evaluation team was ultimately able to compile this information from the data that was provided by the Company, but significant effort and resources needed to go into data management in order to do so. Also, various data quality, completeness, and consistency issues necessitated the use of extensive data cleaning and editing, as well as the use of assumptions to reclassify certain cases – all of which can detract from the overall accuracy of an evaluation and therefore, the usefulness of its results.

The following section outlines the information needed to conduct the evaluations, including the status of the provided data and data-related recommendations that can improve the efficiency and accuracy of future evaluation efforts.

Unique project identifier: Both utilities' files contained complete, consistent, and unique project identifiers. While not an evaluation issue, each utility uses different formats (UI: 4-character alpha-numeric; NU: 8-character alpha-numeric).

Account number: The UI file contained complete and consistent 13-digit account numbers. The CL&P file contained various 4 to 11-digit numeric and text entries, missing, and clearly erroneous account numbers (e.g. 999999999, 123456, "CNG Gas", "New", etc.).

> *Recommendation:* While consistency across Companies is not necessary, ensuring account numbers are complete, consistent, and accurate within each Company's database is important for allowing identification and aggregation.

Project address (street, town, and zip code): The UI file contained complete and consistent addressing. The NU file contained complete but inconsistent addressing (e.g. use of Avenue, AVE, Ave, Ave.).

> *Recommendation:* Use consistent US Postal Service addressing standards.[2] Often, because account numbers do not identify unique facilities, addresses are needed to aggregate data. When dealing with thousands of cases, editing and cleaning addresses in order to conduct an aggregation is greatly hampered by typographical inconsistencies. Another, more effective option is to incorporate a premise number into the program databases which uniquely identifies facilities.

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[2] US Postal Service addressing standards: (http://pe.usps.com/text/pub28/welcome.htm)

However, this addition may be cost-prohibitive due to the need to alter existing database structures.

Project contact information: In general, both utilities collected first name, last name, position, and email. However, both utilities also presented projects missing critical phone numbers.

> *Recommendation:* As much as possible, collect phone number, first name, last name, position, and email addresses for all projects. At a minimum, a contact phone number is needed to include a project in any evaluation-related sampling effort (though comprehensive email addresses could be used for a web-based survey). In addition, tracking a project contact name (first and last) and their position allows the evaluation team to easily contact the appropriate decision-maker and including email addresses makes inexpensive and efficient web-based surveys a feasible research method.

Project completion or closing date: The CL&P file contained only the "AFP Date" at the measure level. The UI files contained 12 different dates tracking the progress of measures; for the evaluation EMI used the installation date.

> *Recommendation:* Record common project milestone dates including application, installation, and closed dates. Comprehensive and detailed project (or measure) tracking information can be useful for informing the improvement of project implementation by highlighting stages where projects are consistently delayed.

Energy savings (where applicable, kWh, KW, and Therms): Both Company data files contained measure level energy savings values reported in the same units. While not critical for the evaluations, UI reported these as negative values savings; NU reported them as positive values.

Facility type: The UI data contained specific facility type descriptions. The CL&P data did not present easily accessible facility type descriptions, but the file did include SIC, NAICS, and an industry-type variable describing the facility.

Table 3-3 presents some of the data inconsistencies present in the CL&P data in terms of the variables used to define facility type. Overall, the NAICs codes provided the greatest level of resolution and were the preferred method for determining facility type, however, as shown in Table 3-3, 620 cases did not have NAICS codes. For 446 of these 620 cases, the SIC code was used in conjunction with the industry-type code to categorize the facilities as best possible; for 174 cases only the SIC code was available to inform the categorization.

Table 3-3. Summary of CL&P Variables Used for Defining Facility Type

Data Present in File	*N*
Valid FacilityType	3,121
Only SIC	174
IndustryType & SIC	446
NAICS & SIC	1,367
IndustryType & NAICS & SIC	9,147
TOTAL	**14,255**

> *Recommendation:* Because much of the evaluation work occurs at the facility level, a clear, consistent, and comprehensive presentation of the nature of the facility use should be readily available in the data files.

Measure Descriptive Information: The UI data contained variables representing the measure code, a measure description, measure type, and quantity installed. The CL&P data contained variables for the measure description and measure type (i.e. benefit type). For both Companies, this information was complete. However, the information was not consistent across Companies and measure description detail varied greatly in quantity and quality. In many cases, a project measure description consisted of simply a model number or a general term like "RTU." Also, the quantities reported by both Companies are not adequate for evaluation purposes (e.g. at the measure type level, lighting entries always reported a quantity of "1" regardless of the number of bulbs or fixtures installed).

> *Recommendation:* Present measure level information consistently. Ideally, use consistent measure or product codes and measure type classifications (e.g. lighting, lighting controls, other controls, HVAC, compressors, motors & drives, refrigeration, building envelope, hot-water heating, etc.). Ensure quantities reflect the actual number of units of a particular measure installed. For example, including an indication of the number of bulbs actually installed would allow for more accurate reporting and evaluation.

4. RECOMMENDATIONS

The evaluation team recommends that the Companies should focus on adding improvements to HVAC systems and motors and drives in addition to any cost-effective lighting improvements (including lighting controls). Per the program-tracking database, improvements to lighting and HVAC are most likely to be installed at the same facility in both the ECB and EO programs. Our analysis revealed that between 2008 and 2011, 55% of all ECB comprehensive projects and 25% of all EO comprehensive projects contained at least improvements to both lighting and HVAC end-uses (some projects contained a third or fourth end-use). It is likely that these equipment combinations present the most cost-effective energy efficiency opportunities across the widest segment of C&I customers.

The evaluation team recommends that the Companies encourage industrial and manufacturing facilities to complete additional comprehensive projects as a part of the ECB program. The Companies should increase efforts at engaging these facilities and investigate what types of comprehensive projects will be valuable for them. EMI's research identified that these facilities account for a large portion of the overall program participation and energy savings impact but that comprehensive projects are relatively infrequently; only 20% of the industrial and manufacturing facilitates that participated in the ECB program improved more than one end-use between 2008 and 2011.

The evaluation team recommends that the Companies encourage institutional facilities to complete projects as part of the ECB program. This program has been very successful in gaining participation of educational facilities and health care facilities, and staff should expand their engagement of these sectors. While these segments account for a smaller proportion of the ECB program participation, these customer types achieved higher-than-average kWh savings per account between 2008 and 2011. This suggests that they present additional opportunities for the program to achieve cost-effective savings by maximizing the energy savings per account. In addition, given that these facilities typical have long operating hours, high and predictable occupancy rates, and high construction and remodeling standards, they are prime candidates for comprehensive project investment.

The evaluation team recommends that the Companies target retail outlets and office buildings as part of the comprehensive initiative within the EO program. EMI's research found that the EO program frequently engages both retail outlets and office buildings and that these segments account for a significant portion of the program's energy savings. However, comprehensive projects are less frequent in both of these market segments. While it is possible that that there are limited opportunities given the nature of retail and office building operations, both segments account for a significant portion of the participating projects and therefore, present an opportunity for growth.

While retail and office spaces provided frequent opportunities for participation, the EO program should also focus on increasing participation among industrial and manufacturing customers. While these facilities make up only 14% of the participating accounts, they represent 28% of the overall kWh savings. Likewise, the average kWh savings at each account is double the program's average. Increasing participation among this sector should allow the program to operate more cost-effectively by increasing the energy savings per customer[3].

The evaluation team recommends that the Companies agree upon and use a single, consistent system of data classes for program tracking. Aggregation, analysis and comparison of the utilities' efficiency project databases were substantially limited by a lack of consistent reporting methods and practice, both within each program and across them. An agreement to adopt a common classification scheme and lexicon across the State for projects, measures, customers, and facility types, etc. would be very valuable in helping the EEB evaluate program outcomes and allow the Companies to market the programs more effectively. The evaluation team suggests the following improvements to consistency:

- Use consistent US Postal Service addressing standards including separate fields for facility name, street address, city, and zip code. Another option is to incorporate a premise number into the program databases that uniquely identifies facilities. This addition would eliminate the need to aggregate and manage the program data based on address information and instead, provide a clear method for aggregation and analysis of specific locations for both program managers and evaluators. However, this addition may be cost-prohibitive due to the need to alter existing database structures.
- As much as possible, collect phone number, first name, last name, position, and email addresses of an appropriate contact for all projects.
- Record common project milestone dates including dates for application completion, installation, and closed dates (as applicable).
- Consistently record a NAICS code or similar code to provide a clear, consistent, and comprehensive presentation of the nature of the facility for each project.
- Ensure quantities reflect the actual number of units of a particular measure installed. Present consistent measure-level information including measure or product descriptions and "measure type" classifications such as lighting equipment, lighting controls (e.g., daylight sensors, occupancy sensors), building controls, HVAC equipment, compressors, motors & drives, refrigeration equipment, building envelope improvements, process improvements, and hot-water heating equipment. This consistency might be practically implemented via data-entry lexicon controls such as the use of "pick-lists." Currently, the project tracking databases often grouped like measures together as part of the same record (e.g., both lighting equipment and lighting controls are recorded as part of the same record). This grouping artificially limits the level of detail possible for analysis of individual equipment attributes such as energy savings, quantities, and incentives. An alternative method of tracking projects would include equipment detail at the

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[3] This recommendation assumes that the program administrators'' costs of enrolling customers is relatively similar across customer type.

line item level as based on the application paperwork. This level of detail would allow for more detailed analysis of the project tracking data which would in turn support more targeted program marketing and more robust evaluation research.

The evaluation team recommends that the Companies and the EEB pursue a full market assessment. EMI's analysis of these market characteristics of both the ECB and EO program is intended to provide high-level recommendations to guide future marketing and customer engagement efforts and will expand on these results as part of the process evaluation research currently underway. However, EMI believes that a full market assessment would provide greater insight by highlighting gaps in market penetration and additional potential for program savings. In addition, a market assessment could include primary research that would explore the energy efficiency needs of program non-participants (i.e., those that have not participated in a program during the past 10 years).

Appendix A: DETAILED TABLES

Table A-1. Number of Projects and Expenditures by Program by Year

Program	Year	Number of Projects	Expenditures ($MM)
Energy Conscious Blueprint	2008	761	$23,171,577
	2009	574	$13,076,152
	2010	683	$15,655,660
	2011	627	$15,384,314
Energy Opportunities	2008	719	$32,811,449
	2009	920	$16,391,765
	2010	1,071	$24,125,529
	2011	1,112	$31,710,409

Table A-2. Annual MWh and Expenditures by Program by Year

Program	Year	Annual MWh	Expenditures ($MM)
Energy Conscious Blueprint	2008	67,626	$21,882,500
	2009	41,372	$11,093,483
	2010	35,418	$13,303,304
	2011	34,781	$11,406,295
Energy Opportunities	2008	114,529	$32,684,705
	2009	77,064	$15,020,713
	2010	87,753	$23,224,314
	2011	87,447	$28,602,910

Table A-3. Coincident kW and Expenditures by Program by Year

Program	Year	Annual kW	Expenditures ($MM)
Energy Conscious Blueprint	2008	12,268	$21,882,500
	2009	7,831	$11,093,483
	2010	6,078	$13,303,304
	2011	5,881	$11,406,295
Energy Opportunities	2008	18,986	$32,684,705
	2009	10,067	$15,020,713
	2010	11,026	$23,224,314
	2011	10,462	$28,602,910

Table A-4. Annual Therms and Expenditures by Program by Year

Program	Year	Annual Therms	Expenditures
Energy Conscious Blueprint	2008	96,598	$1,289,077
	2009	181,701	$1,982,669
	2010	418,107	$2,352,356
	2011	533,079	$3,978,019
Energy Opportunities	2008	74,746	$126,744
	2009	732,385	$1,371,052
	2010	408,363	$901,215
	2011	611,002	$3,107,499

Table A-5. Comprehensive Projects (Projects with >1 Measure Type) by Program by Year

Program	Year	Number of Projects with One Measure Type	Number of Projects with Two Measure Types	Number of Projects with Three Measure Types	Number of Projects with Four or More Measure Types
Energy Conscious Blueprint	2008	601	69	54	37
	2009	454	79	27	14
	2010	590	63	18	12
	2011	521	73	24	9
Energy Opportunities	2008	653	43	11	12
	2009	844	64	8	4
	2010	980	60	20	11
	2011	991	96	17	8