Energy Smart Grocer Impact Evaluation

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Prepared for
Bonneville Power Administration

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Executive Summary

Bonneville Power Administration (BPA) has been running the Energy Smart Grocer (ESG) Program through a third-party implementation contractor, Portland Energy Conservation, Inc. (PECI), since 2007. Through the ESG Program, BPA provides utility end-user grocers, restaurants, and convenience stores with refrigeration system energy audits, technical expertise, and financial incentives to install energy-efficiency measures.

The program offers:

1. ***No-Cost Energy Audit.*** Businesses participating in the ESG Program receive a no-cost energy audit from PECI field energy experts.
2. ***Prescriptive Measures.*** Owners participating in the ESG Program receive an incentive for any ESG program measures that are implemented. Over 88 unique ESG program measures in 14 measure categories are offered through the program (the measure categories are summarized in Table 2).
3. ***Custom Projects.***[1] In some instances, more complex projects require a custom analysis to quantify energy savings for measures not covered within the prescriptive measures. The program provides technical assistance to customers pursuing these types of projects.

BPA implemented a multiphase evaluation of the ESG Program in order to assess how the program has evolved since 2007. Most recently, BPA contracted with Cadmus to evaluate the impacts of the program from March 18, 2010, through September 27, 2012, for Unit-Energy Savings (UES) and standard protocol measures. The key objectives for this evaluation involved:

- Estimating a realization rate for the verification sample
- Extrapolating the verified savings and realization rate to the population
- Compiling recommendations for program improvement, future verification improvement, and evaluation improvement

Key Findings

Cadmus estimated that the evaluated first-year program savings were 78,071,868 kWh, with a 98% realization rate. These savings estimates are statistically significant at a 90% confidence level with ±1.4% precision. Table 1 summarizes the results of this evaluation at the program level.

[1] Custom projects were not included in the scope of this evaluation.

Table 1. Program Evaluation Results

ESG Program	Reported Savings (kWh)	Verified Savings (kWh)	kWh Realization Rate (%)	Precision at 90% Confidence Level
First Year Savings	79,448,975	78,071,868	98.3%	1.4%
Three Year Savings (persistence)	79,448,975	76,409,512	96.2%	2.0%

Key findings from the evaluation are summarized below:

- 5,018 ESG Program measures were installed in 2,080 sites between March 18, 2010, and September 27, 2012. Program participants received energy audits from PECI, implemented measures recommended in the audit reports, and BPA claimed 79,448,975 kWh of savings, or 9.07 aMW.
- Cadmus verified that eleven out of the total sample of 290 stores were out-of-business or had experienced a major ownership change since participating in the program. To account for the resulting degradation of savings from store closures, Cadmus reported a savings persistence realization rate in addition to a first-year savings realization rate.
- Cadmus observed that for most measures, persistence was high over the three years evaluated.

Summary and Recommendations

For the ESG Program, PECI maintains a robust tracking database that covers a wide-range of different measures and site types. Cadmus found the program realization rate, and in many instances the measure-level realization rates, to be well within what is considered reasonable; this is a strong indicator that PECI has applied appropriate protocols to ensure data integrity and quality. Based on Cadmus' observations, we have the following recommendations to facilitate future evaluation of the ESG Program:

1. ***Review final savings to ensure that measure application assignments are appropriate***. Review the program quality control process to determine if any changes can be made to help prevent data reporting errors, such as measures being assigned to the incorrect application (e.g., in a few instances, we reviewed rebate applications indicating that anti-sweat heater controls were installed in a medium temperature application, while the reported savings database indicated that the measure was low temperature).
2. ***Improve the rebate documentation archiving process***. In several instances, BPA was missing rebate documentation and it was difficult to retrieve rebate details for each project and each measure, which made evaluating these measures challenging. While there does appear to be improved program documentation over time (i.e., 2012 project documentation was easier to obtain than 2010 project documentation), we recommend creating a system for archiving project documentation to ensure that it is consistent between PECI and BPA.
3. ***Consider accounting for business closures in savings estimates and forecasting.*** Because site closures and major ownership changes impacted 11 out of the total sample of 290 sites, BPA

should consider accounting for the degradation in savings that result from these occurrences. BPA should consider using the results of this evaluation to update any assumptions that are used to estimate measure degradation and measure life in savings estimates and forecasting.

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Introduction

Bonneville Power Administration (BPA) has been running the Energy Smart Grocer (ESG) Program through a third-party implementation contractor, Portland Energy Conservation, Inc. (PECI), since 2007. Through the ESG Program, BPA provides utility end-user grocers, restaurants, and convenience stores with refrigeration system energy audits, technical expertise, and financial incentives to install energy-efficiency measures.

PECI has installed measures in over 3,000 grocery stores and businesses with refrigeration systems across the Northwest since 2007, and the program is currently offered by 66 utilities.

Program Summary

The ESG Program has three main components:

- ***No-Cost Energy Audit.*** Businesses participating in the ESG Program receive a no-cost energy audit from PECI field energy experts. As part of the audit, PECI collects data on the lighting, refrigeration, and HVAC systems currently installed in the building and recommends energy-efficiency measures in an audit report. To help each business owner prioritize energy-efficiency measures for implementation, the energy audit report summarizes key metrics about the measure recommendations, such as estimated cost, annual energy savings, and simple payback.
- ***Prescriptive Measures.*** Owners participating in the ESG Program receive an incentive for any measures implemented. Over 88 unique measures in 14 measure categories are offered through the program (the measure categories are summarized in Table 2).
- ***Custom Projects.***[2] In some instances, more complex projects require a custom energy savings analysis to quantify energy savings for measures not covered within the prescriptive measures.

Table 2. ESG Measures

Measure Category	Measures included in Category
Auto Closers	Auto closers on glass and solid doors, coolers and freezers, and for walk-in or reach-in applications
Case Lighting (T8)	1) T10/12 to T8 lamp retrofits and 2) Magnetic to electronic ballast retrofits on T12s
Cases (new and retrofit)	1) Low or medium temperature open to reach-in case conversion; 2) Low temperature reach-in to high-efficiency reach-in; 3) Medium temperature open case to high-efficiency open case; 4) Standard doors to low/no anti-sweat heat doors; 5) Add doors to medium temperature walk-ins; and 6) Add doors to cases
Condensers and Compressors	1) High-efficiency multiplex compressors; 2) Oversized condensers; 3) Floating head pressure controls on multiplex or single compressors; 4) Floating suction pressure control; 5) Air-cooled to evaporative cooled condenser; and 6) Efficient low temperature compressors
Controls	1) Anti-sweat heater controls and 2) Walk-in evaporator fan control for electronically

[2] Starting in 2012, this Custom program offering was added to the program. Custom projects were not included in the scope of this evaluation.

Measure Category	Measures included in Category
	commuted motors (ECMs) or shaded pole motors
Food Services	1) ENERGY STAR® or CEE Tier 1 and Tier2 rated cooking equipment and 2) Pre-rinse spray valves
Gaskets	Gaskets for solid or reach-in glass doors
LEDs (open cases)	LEDs in existing or new open refrigerated cases
LEDs (reach-ins)	1) LEDs in existing or new reach-in cases and 2) LED motion sensors for reach-in cases
Motors	1) ECMs in cases or walk-in coolers or freezers; 2) ECMs for compressor head fans; 3) permanent-split capacitor motors in cases or walk-ins; and 4) variable frequency drives on condenser fans
Night Covers	Night covers on vertical or horizontal cases
Other	1) General interior and/or exterior lighting retrofits; 2) CFL retrofits in walk-ins; and 3) refrigerant piping insulation
Strip Curtains	Strip curtains in walk-in coolers or freezers
Vending Machine Controls	Vending machine controllers

Report Scope

BPA implemented a multiphase evaluation of the ESG Program in order to assess how the program has evolved since 2007. BPA conducted a process and impact evaluation of the ESG program in 2009, and performed a measure verification study in 2010-2011. Most recently, BPA contracted with Cadmus to evaluate the impacts of the program from March 18, 2010 through September 27, 2012. The results of this research are summarized in this report.

For this study, Cadmus addressed two types of Regional Technical Forum (RTF) approved measures: unit energy savings measures and standard protocol measures. This studies' sampling plan was consistent with the RTF Guidelines for the Estimation of Energy Savings,[3] and it exceeded the RTF suggested guidelines for relative savings estimates' error targets (±20% precision at an 80% confidence level).

Report Organization

This report presents the methodology, findings, conclusions, and recommendations from Cadmus' evaluation. These sections following this introduction are organized as follows:

- ***Energy-Savings Estimation.*** This section explains the methodology Cadmus used for estimating energy savings and presents the energy-savings results.
- ***Evaluation Results.*** This section explains both qualitative and quantitative findings related to the energy-savings results.

[3] Regional Technical Forum (RTF) Guidelines for the Estimation of Energy Savings. April 16, 2013.

- ***Conclusions and Recommendations****.* This section provides conclusions and recommendations drawn from our research.
- ***Appendices.*** The appendices include the site verification checklist and protocol, as well as screen shots from the final database.

Energy-Savings Estimation

For the ESG Program impact evaluation, Cadmus selected a sample of sites for site visits, developed a data collection database and site verification protocol, estimated energy savings for each measure, and extrapolated the results to the population. This section presents the methodologies and results of the energy-savings estimation.

Methodology

To estimate energy savings, Cadmus identified measure parameters requiring site verification, designed a sampling plan to select a representative sample of the population, and reviewed and analyzed the data collected from site visits and program documentation.

Cadmus estimated verified savings for each site visited. We based these estimates on data collected during site visits, which included verified measure counts, measure operating conditions, and verification notes. We used the verified savings and reported savings to calculate realization rates for each measure category. Finally, we estimated the precision of the realization rate estimates at the 90% confidence level.

Documentation Review and Implementer Interviews

Cadmus began this project's research by reviewing program materials and previous ESG Program evaluations to establish the structure of the program and the businesses and customer base it was designed to engage. We then interviewed the BPA and PECI staff involved with the ESG Program in order to understand programmatic processes, procedures, and verification challenges in detail. This interview information was used by Cadmus to develop an appropriate sampling strategy and refine the verification checklist. The staff interview guide is included in Appendix A.

Sampling Strategy

PECI reported 5,018 refrigeration measures installed in 2,080 sites through the ESG Program, totaling 79,448,975 kWh in annual energy savings, during the evaluation period (March 18, 2010, through September 27, 2012). Table 3 provides the program population details.

Table 3. Population from March 2010 – September 2012 by Measure Type

Measure Category	Number of Measures
Auto Closers	48
Case Lighting (e.g., T8)	7
Cases	59
Condensers and Compressors	78
Controls	811
Food Services	35
Gaskets	96
LEDs in Open Cases	16
LEDs in Reach-in Cases	1,197
Motors	1,716
Night Covers	143
Other	568
Strip Curtains	170
Vending Machine Controls	74
Total	**5,018**

The following steps describe Cadmus' sampling approach:

1. We mapped the PECI-designated measure names to the measure categories outlined in BPA's ESG Request for Offer, resulting in the 14 generalized categories listed in the table above.
2. We tabulated the estimated energy savings (kWh) within each measure category by site type. We designated savings expected to exceed 2% of the total program savings as coming from high-impact measures, and considered them eligible for the sample. We designated these site-type and measure category combinations as *high priority*. We did not sample measures that contributed less than 2% savings to the total program savings. This procedure produced 17 high priority measure category and site-type combinations (e.g., supermarket retail food stores >5,000 square feet with controls installed), with combined savings equal to 93% of total energy savings.
3. We estimated initial sample sizes for each measure category and site type combination assuming a 0.5 coefficient of variation at the 90% confidence level with a target of ±10% precision.
4. Next, Cadmus applied a finite population adjustment factor to adjust for small population sample sizes (i.e., when the ratio of the population to the sample size was less than 20), resulting in adjusted sample sizes for each high-impact combination.

Cadmus randomly selected sites from each of the measure category and site type combinations. We removed duplicates (i.e., we did not sample sites with measures in more than one measure category twice), reducing the overall sample size. The reduced sample did not provide adequate representation across site type and efficiency upgrades. Therefore, Cadmus randomly selected additional sites from the remaining high priority combinations to ensure representation of all site types.

Site Verification Checklist and Protocol

Cadmus developed two primary tools to ensure that we verified key parameters for each measure, and that we consistently verified measures across all site visits. Our final *Site Verification Checklist and Protocol* document is provided in Appendix B.

1. ***Site Verification Checklist***. The purpose of this checklist was to identify the key parameters for each measure that required field verification. This checklist summarizes all of the primary measures in the sample, identifies the key parameters that impact energy savings (e.g., measure count, lamp wattage), and identifies the terms and conditions (e.g., equipment warranty) required by the program.
2. ***Site Verification Protocol***. This protocol summarizes acceptable verification methods for each measure to ensure that all field verifiers use consistent data collection and verification methods. Cadmus designed the verification methods to confirm the installation and operation of each measure, while causing minimal disruption to the site. For each measure listed in the *Site Verification Checklist*, Cadmus outlined primary and secondary verification methods. BPA and PECI provided feedback on these verification methods as we were developing the protocols, and we incorporated these recommendations into the final protocol.

Site Visit Data Collection Database

Cadmus developed an online database to compile data collected in the field for each site in the sample. Prior to scheduling visits, we uploaded data for all 290 verified sites, along with measure checklists and verification protocol details. This central online database was used during site verifications, and in most cases, field verifiers entered data, in real time, through web-enabled iPads. Screen shots from the final database are included in Appendix C.

Cadmus senior staff reviewed the database weekly to mitigate the reporting of erroneous data. After completing the site visits, Cadmus created custom reports so we could export the data in the correct format for analysis.

Site Visits

Cadmus conducted over 290 site visits between June and August 2013. The large number of sites and short time period required advanced planning and coordination with field staff, utilities, and site owners to minimize setbacks and stay on schedule. The following steps describe the site visit process:

1. ***Field staff training***. Prior to scheduling any site visits, all field staff attended a one-day training, which included both hands-on verification exercises and classroom lessons. Cadmus field staff learned how to physically verify all grocery measures with the required verification methods and how to use the online database and enter site visit data using an iPad.
2. ***Utility and PECI coordination***. Because site visits were conducted in five states and 66 different utility territories, early coordination with utilities was required. Cadmus notified utilities one week prior to scheduling a site visit to alert them of the sites that would be contacted as part of the evaluation. Cadmus also provided a tentative schedule to PECI so that it could reach out to key accounts and let them know the evaluation was underway.

3. ***Utility ride-alongs***. Cadmus invited utility representatives to join field staff on site visits. Once a site visit was scheduled, Cadmus field staff e-mailed utility representatives to confirm their attendance and to request any additional contact information needed (e.g., cell phone numbers). Because field staff typically had a full schedule of site visits, we explained to the utility representatives that site visit times were not flexible. Overall, this process was successful. Field staff reported that utility ride-alongs went well and that it was helpful to have utility representatives present, as they often had an existing relationship with the site.
4. ***Site visit scheduling*.** We typically contacted key accounts two weeks prior to visiting a territory and often could schedule multiple site visits through one contact. PECI typically provided both phone numbers and e-mail addresses, and Cadmus schedulers used both to schedule these sites. For non-key accounts, we typically had only phone numbers, so these were more challenging to schedule as the store manager or owner was often not present during the initial call or was unresponsive to voicemail messages. If we were unsuccessful after several attempts, we followed up with a letter alerting the contact that field staff would be visiting the site within a set time.
5. ***Site visits***. In preparation for each site visit, Cadmus staff reviewed the program documentation (e.g., rebate application, invoices, lighting calculators) and the online database to determine the number and types of measures that required verification. In general, site visits went smoothly, and there were only a few challenges encountered, as follows:
    a. At one site the owner had a bad experience with the refrigeration contractor that installed EC motors, and he was resistant to participating in the verification. We explained the verification process and were able to conduct the site visit successfully.
    b. At one site, the store manager had not yet received notification from the corporate contact with whom we had scheduled this site visit. Approximately halfway through the site visit, the store manager requested that field staff leave the store. The store manager contacted Cadmus the next day after speaking to corporate management and asked Cadmus to return, but unfortunately field staff was already out of the region.
6. ***iPad data collection***. Whenever possible, field staff used an iPad to enter data directly into the database during the site visit, thus eliminating the need to take paper notes that had to be entered into the database later. Program documentation could also be stored directly on the iPad, thus minimizing the need for paper documentation.

    In addition to reducing staff time required to record data into the database, the use of the iPad database also meant more consistent data reporting and expedited the quality control process since it could be done in real time. It is worth noting that we did encounter a few challenges with the iPad, but overall we feel that the benefits outweighed the challenges. The challenges were:

    - ***Outside of cellular service territory***. Several sites were outside of a cellular service territory, and the iPad could not connect to the online database. In these instances, the verifier used paper documentation and recorded the notes into the database later.

- ***Difficult to use at sites with large measure counts***. Several field staff commented that the iPad was cumbersome to use at large stores that had large measure counts. For example, a large store can have over 400 linear feet of LED case lighting installed throughout the store, which made it difficult to track in the iPad without also taking paper notes.
- ***Field note data entry is time-consuming.*** For most projects, field notes were short and simple. However, for several projects where program documentation was not available prior to the site visit, field staff had to take lengthy field notes that are not easy to type into an iPad.
- ***iPad SIM card failure***. One iPad's SIM card failed, which prevented it from connecting to a cellular network. We were able to identify this issue and replace the SIM card within two days; meanwhile, field staff took paper notes.

Engineering Analysis and Data Review

After completing all 290 site visits and creating custom reports, Cadmus reviewed and processed the exported data in preparation for our energy-savings analysis. We performed the following activities:

1. ***Cleaned data***. We combined the data exported from the database with several fields from raw data we received from PECI, so that all variables required for the analysis (e.g., utility, installation date) were included in one workbook. We used these raw data fields from PECI in the verified savings analysis:
   a. Measure name
   b. Measure category
   c. Reported count
   d. Reported savings
   e. Verified count
2. ***Removed unverified sites***. Because of site ownership changes in which the new owner refused to allow the verification and site visit scheduling conflicts, Cadmus dropped 12 sites from the primary sample and replaced them with 12 backup sites. These sites were not removed from the database and, therefore, had to be removed in the analysis since they were not verified.
3. ***Removed unverified measures***. Field verifier notes indicated that seven measures could not be accessed. Because we could not collect field-verified data for these measures, we removed them from the sample analysis.
4. ***Calculated reported deemed savings***. PECI provided raw data that included reported count and reported savings for each measure. Using this data, we calculated the reported deemed savings for each of these measures using the following equation:

$$Reported\ Deemed\ Savings\ \left(\frac{kWh}{unit}\right) = \frac{Reported\ Savings\ (kWh)}{Reported\ Count\ (units)}$$

5. ***Calculated verified savings.*** Cadmus calculated the verified savings for all non-overhead lighting measures using the following equation:

$$Verified\ Savings\ (kWh) = Verified\ Count\ (units) \times Reported\ Deemed\ Savings\ (\frac{kWh}{unit})$$

6. ***Verified overhead lighting savings.*** PECI calculated reported savings for the overhead lighting measures using the BPA Lighting Calculator, in which savings depend on several project-specific variables (e.g., baseline fixtures, installed fixtures, site operating hours, heating and cooling system fuel-type). For this reason, the deemed savings equations above do not apply. For each overhead lighting measure in the sample:
   a. We reviewed the field verification notes in the database to identify any discrepancies between the BPA Lighting Calculator variables and verified conditions.
   b. Where significant differences were found (i.e., operating hours or fixture counts varied by more than 10%), we calculated savings based on the field-verified conditions using the BPA Lighting Calculator.
7. ***Calculated the realization rate.*** We then calculated energy-savings realization rates for each measure in the sample using the following equation:

$$Energy - Savings\ Realization\ Rate\ (\%) = \frac{Verified\ Savings\ (kWh)}{Reported\ Savings\ (kWh)}$$

8. ***Categorized discrepancies.*** We reviewed each measure with a realization rate greater than or less than 100%, identified the primary reason(s) for the discrepancy between reported and evaluated savings, and determined if the discrepancy resulted in an increase or decrease in savings. We categorized the discrepancies by:
   a. Measure count
   b. Control settings
   c. Business closure or change of ownership
   d. Equipment size
   e. Application (e.g., low temperature vs. medium temperature case)
   f. Operating hours
   g. Other
9. ***Conducted quality control.*** Throughout the data review and analysis, Cadmus investigated any measures with low or high realization rates to determine if the results were valid. We discovered a few instances when verifiers had incorrectly entered data into the online database. For example, in one case the field notes and rebate documentation indicated that an anti-sweat heater control measure was installed in a *medium temperature* application, yet the verifier incorrectly entered the installed measure count into the database in the *low temperature* field. Cadmus reviewed and updated these instances, where applicable.

Statistical Analysis

After reviewing the engineering analysis data, Cadmus performed a statistical analysis using the sample data (reported and verified savings) to estimate realization rates and total savings estimates for the population. We estimated the precision of the realization rate estimates at the 90% confidence level.

Weighting

In order to extrapolate the verified savings from the sample to the population, Cadmus weighted the sampled savings according to the probability of selecting each site from the population. In order to appropriately weight the savings to the sample size and the total population size, we categorized all sites in the population into one of five savings categories based on the average energy savings per site: high, medium-high, medium, medium-low, and low. Statistically, this is referred to as post-stratification weighting.

Alternative strata, such as individual site types could not be used because not all site types in the population were represented in the sample (e.g., hospital and lodging site types are included in the population but were not verified in the sample). Table 4 lists the site types and sample number with the range of savings per site within each savings category or stratum.

Table 4. Summary of Stratum in the Sample and Population

Site-Type Savings Category	Range of Savings per Site (kWh/site)	Quantity of Sites in Population	Quantity of Sites in Sample	Site Type(s) included in each Savings Category*
Low	<9k	353	47	K-12 School, Small and Medium Office, Health Care, **Restaurant**, University
Medium-Low	9-15k	1166	111	Large office, **Mini-mart**
Medium	15-20k	36	16	Big Box Retail, Grocery, **Small Box Retail**
Medium-High	20-35k	511	115	High end retail, Hospital, Lodging, **Supermarket Retail**
High	>35k	14	1	**Warehouse**

*Site types that are in **bold** text were present in the sample

The post-stratification weights are equal to the inverse of the selection probabilities and are determined by the sample size (n_h) and population size (N_h) within each savings category, or stratum (h):

$$Weight\ of\ Observations\ within\ Category\ h = \frac{N_h}{n_h}$$

The sample weights impact the realization rates as shown in the following formulas:

$$Realization\ Rate\ within\ Category\ h\ (\%) = \frac{\frac{N_h}{n_h}\sum_{i=1}^{n_h} Verified\ Savings\ (kWh)_i}{\frac{N_h}{n_h}\sum_{i=1}^{n_h} Reported\ Savings\ (kWh)_i} \times 100\%$$

$$Overall\ Realization\ Rate\ (\%) = \frac{\sum_{h=1}^{H} \frac{N_h}{n_h} \sum_{i=1}^{n_h} Verified\ Savings\ (kWh)_i}{\sum_{h=1}^{H} \frac{N_h}{n_h} \sum_{i=1}^{n_h} Reported\ Savings\ (kWh)_i} \times 100\%$$

Sampling weights also influence the precision estimates, which were calculated with 90% confidence. The precision indicates the width of the margin of error corresponding to the realization rate. Cadmus applied the weighted realization rate estimates to the reported savings totals to estimate verified savings for the population. We also applied the weighted realization rate estimates within each measure category, as displayed in the tables throughout the Evaluation Results section.

Difference of Means Test

During the engineering review, Cadmus determined that the primary reason for differences between verified and reported savings was due to differences in measure quantities. For example, for LEDs in reach-in case measures, the measure count is quantified in linear feet of LED lamp. We found several sites that reported to one-tenth of a foot (e.g., 437.4 linear feet of lamp), while other sites rounded to the nearest whole number. At most sites, the field verifier measured the exact linear feet of case, which was sometimes different than the reported quantity by a marginal amount. However, we also found that there were some instances where field staff rounded to the nearest linear foot.

Cadmus conducted a difference of means test to determine whether or not differences in Cadmus field staff measurements (e.g., some field staff rounded measurements rather than reporting the exact linear feet of case) were impacting the results. In this test, we compared the following estimates:

- The mean of the verified count for any measure that required a physical measurement on site
- The mean of the rounded (i.e., rounded to the nearest foot) verified count for the same measure

Based on this analysis, Cadmus determined that the measurement inconsistencies did not result in statistically significant differences, and therefore no adjustments were made to the verified measurement counts.

Evaluation Results

Cadmus estimated the evaluated first-year program savings were 78,071,868 kWh, with a 98% realization rate and ±1.4% precision at a 90% confidence level.

Table 5 presents the program evaluation results for both first-year savings and savings persistence at three-years. The savings persistence results account for major business changes over time (i.e., closings and ownership changes). During our engineering review of the sample data collected from site visits, we discovered that 11 of the total sample of 290 sites achieved zero verified savings due to business closures or ownership changes.

We reviewed the measure installation dates at these closed sites and determined that these business closures and major ownership changes did not occur during the first year of savings, and, therefore, were not included in the first-year evaluated savings estimates. However, to understand measure persistence and the impact that business closures and ownership changes have on the program savings, we also prepared a three-year savings estimate that includes sites that have closed or changed ownership. The realization rate for the savings persistence after three-years is 96%.

Table 5. Program Evaluated Savings and Realization Rate

ESG Program	Reported Savings (kWh)	Verified Savings (kWh)	kWh Realization Rate (%)	Precision at 90% Confidence Level
First Year Savings	79,448,975	78,071,868	98.3%	1.4%
Three Year Savings (persistence)	79,448,975	76,409,512	96.2%	2.0%

Program Results by Location and Site Type

Cadmus reviewed the analysis results at the program level, by urban and rural designation, state, and site type to determine if there were any regional or site type differences. BPA designates each utility as small, rural, and residential (SRR) or non-SRR (urban). We found no significant differences in savings between SRR and non-SRR utilities (Table 6).

Table 6. First-Year Evaluated Savings and Realization Rate by Urban and Rural Designation

Designation	Reported Savings (kWh)	Verified Savings* (kWh)	kWh Realization Rate (%)	Precision at 90% Confidence Level	Sample Size (sites)	Population Size (sites)
Non-SRR	67,276,891	66,113,919	98.3%	1.5%	243	1,756
SRR	12,172,084	11,874,487	97.6%	1.7%	47	324

* Verified savings is a population estimate, not a direct summary of what was observed in the sample

We also reviewed the first-year saving estimates by state. Table 7 shows that Idaho, Montana, and Wyoming had a combined realization rate of 95%, which was lower than Washington (98%) and Oregon (close to 100%).

Table 7. Program Evaluated Savings and Realization Rates by State

State	Reported Savings (kWh)	Verified Savings* (kWh)	kWh Realization Rate (%)	Precision at 90% Confidence Level	Sample Size (sites)	Population Size (sites)
Washington	65,766,057	64,589,131	98.2%	1.5%	234	1,688
MT/ID/WY	5,133,302	4,897,158	95.4%	5.1%	16	114
Oregon	8,549,616	8,510,442	99.5%	2.2%	40	278

* Verified savings is a population estimate, not a direct summary of what was observed in the sample

We reviewed the results by site type (Table 8**Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.**), and found that small box retail establishments had lower realization rates (97%) compar**Error! Reference source not found.**ed to other site types.

Table 8. Program Evaluated Savings and Realization Rates by Site Type

Site Type	Reported Savings (kWh)	Verified Savings* (kWh)	kWh Realization Rate (%)	Precision at 90% Confidence Level	Sample Size (sites)	Population Size (sites)
Mini Mart Retail (< 5,000 SF)	25,962,267	26,053,377	98.2%	0.9%	111	1,166
Supermarket Retail (> 5,000 SF)	49,090,131	49,090,131	98.1%	2.1%	115	511
Restaurant Retail	2,846,436	2,846,436	98.5%	3.4%	47	353
Small Box Retail (< 50,000 SF)	627,812	627,812	96.8%	2.1%	16	36
Warehouse	831,219	831,219	100.0%	0.0%	1	14

* Verified savings is a population estimate, not a direct summary of what was observed in the sample

Measure Category Results

In order to interpret the program evaluation results and provide more meaningful conclusions, we reviewed the realization rate results for each measure category. The results of this analysis are shown in Table 9.

Table 9. Measure Category First-Year Savings and Realization Rates

Category	Reported Savings (kWh)	Verified Savings* (kWh)	kWh Realization Rate (%)	Precision at 90% Confidence Level	Sample Size (measures)	Population Size (measures)
Auto-Closers	91,325	91,325	100.0%	3.3%	6	48
Case Lighting (e.g. T8)	29,560	29,560	100.0%	0.0%	4	7
Cases	3,488,835	3,889,102	111.5%	66.3%	19	59
Condensers and Compressors	5,586,305	5,656,699	101.3%	4.7%	39	78
Controls	10,935,895	10,581,510	96.8%	1.7%	150	811
Food Services	159,109	159,109	100.0%	5.7%	5	35
Gaskets	478,090	470,351	98.4%	2.6%	38	96
LED's in Open Cases	90,118	88,446	98.1%	3.6%	5	16
LED's in Reach-in Cases	13,043,700	12,408,804	95.1%	3.2%	181	1,197
Motors	27,599,518	26,941,899	97.6%	1.6%	269	1,716
Nightcovers	5,379,252	5,284,081	98.2%	1.6%	44	143
Other	9,917,718	9,952,716	100.4%	18.9%	124	568
Strip Curtains	2,496,494	2,318,585	92.9%	4.6%	45	170
Vending Machine Controls	153,056	94,755	61.9%	49.6%	7	74

* Verified savings is a population estimate, not a direct summary of what was observed in the sample

Cadmus identified only three measures with realization below 96%, as follows.

1. ***LEDs in Reach-in Cases (95%).*** The primary reason for this lower realization rate was differences between verified and reported measure counts. Out of 181 sampled LEDs in Reach-in Case measures, 77 had a measure count lower than the reported count, and 11 had a measure count higher than the reported count. The main reason that verified counts were lower than reported counts was because Cadmus field staff physically measured the linear feet of LED installed, while reported counts appear to be lengths that were rounded up and based on estimated case size for most installations. Another reason for differences in verified counts compared to reported were that the verified application (e.g., high power or low power) varied from the reported application.
2. ***Vending Machine Controls (62%)***. Only three sites had vending machine control projects in the sample, resulting in higher-than-average uncertainty. Of those three projects, there was one project that had removed the vending machine from the store (leading to a 0% realization rate).
3. ***Strip Curtains (93%)***. The primary reason for a lower realization rate for strip curtains was due to a difference in measure count. Verifiers measured the area of the door from the inside of the door frame (per the program terms and conditions), and for 11 of 45 sampled measures, the verified door area was less than the reported area. There were also four sites where the verified door area was higher than the reported area, resulting in realization rates greater than 100%.

Reasons for Variations Between Reported and Verified Savings

Some categories had measures with realization rates higher or lower than 100%. Table 10 lists the reasons for these variations with the number of measures for each reason.

Table 10. Instances of Differences Between Reported and Verified Savings

Measure Category	Measure Count	Control Settings	Measure Application*	Difference in Operating Hours	Other
Controls	54	1	5		
Motors	36				
LEDs in Reach-in Cases	88		2		
Other	11			10	
Vending Machine Controls	3				
Night Covers	16		1		
Strip Curtains	6		3		4
Condensers and Compressors	12	2			
Cases	1				
Gaskets	4				

* For example, anti-sweat heat controls are either installed in a low-temperature or medium-temperature refrigerated case application, and the energy savings associated with each application is different.

Cadmus found that the primary reasons for variations between reported and verified savings were:

- ***Measure count***. The verified measure count in the sample (e.g., linear feet of case for the anti-sweat heater control measure) was higher or lower than the reported measure count.
- ***Control settings***. In one instance, we verified an anti-sweat heater control sequence by reviewing the energy management system. Trend logs and control sequences revealed that the control settings did not meet the program terms and conditions, thus resulting in no savings. We also found two floating head and suction pressure controllers that were either not installed on all compressors or did not meet program requirements.
- ***Measure application.*** We found 11 instances where PECI had reported a different measure application than we observed during the evaluation. For example, at one site the reported savings documentation indicated that anti-sweat heater controls were installed in a low-temperature case, but we determined that they were installed in a medium-temperature case. In instances where rebate documentation also indicated that the verified amount was correct, we left the measure the same, but adjusted the deemed savings to reflect savings associated with the verified application.
- ***Operating hours***. This variance was observed only for overhead lighting measures, which are in the *Other* measure category. For several sites, the actual lighting operating hours varied significantly from the reported operating hours, which in most cases resulted in a savings increase.
- ***Other reasons***. There were four instances where strip curtains had been removed or were not creating a seal with the door. In these instances, Cadmus recalculated the effective area of the door that was covered by the remaining strip curtains.

Conclusions and Recommendations

Based on our impact evaluation, Cadmus offers the following conclusions and recommendations for improving energy-savings estimates.

Conclusions

There were 5,018 ESG Program measures installed in 2,080 sites between March 18, 2010, and September 27, 2012. Program participants received energy audits from PECI, implemented measures recommended in the audit reports, and claimed 79,448,975 kWh of savings, or 9.07 aMW.

The savings realization rate for the first-year program savings was 98%, after we removed any closed sites and change of ownership from the analysis. This realization rate has 1.4% precision at the 90% confidence level. The three-year realization rate (including sites that have since been closed or changed ownership) is 96%, with a 2% precision at the 90% confidence level. The error ratio was 0.54.

Recommendations

Based on our observations and the challenges encountered in estimating energy savings, we have the following recommendations for improving energy-savings estimations and future evaluations:

1. ***Review final savings to ensure that measure application assignments are appropriate***. Review the program quality control process to determine if any changes can be made to help prevent data reporting errors, such as measures being assigned to the incorrect application. For example, some rebate applications indicated that anti-sweat heater controls were installed in a medium-temperature application, while the reported savings database indicated the measure was installed in a low-temperature application.
2. ***Improve the rebate documentation archiving process***. In several instances, BPA was missing rebate documentation and it was difficult to retrieve rebate details for each project and each measure, which made evaluating these measures challenging. While program documentation has improved over time (2012 project documentation was easier to obtain than 2010 project documentation), we recommend creating a system for archiving project documentation to ensure consistency between PECI and BPA.
3. ***Consider accounting for site closures in savings estimates and forecasting***. Because site closures and major ownership changes impacted 11 of the total sample of 290 sites, BPA should account for the degradation in savings that result from these occurrences. BPA should consider using the results of this evaluation to update any assumptions that are used to estimate measure degradation and measure life in savings estimates and forecasting.

Appendix A: EnergySmart Grocer Impact Evaluation Interview Guide

Previous Verification Experience

1. Please walk me through the steps taken from the previous verification round.
2. What forms or templates did McKinstry and Energy Industries use to collect data from the field? Are those available for Cadmus to review?
3. What verification procedures did McKinstry and Energy Industries use to verify measures were installed and operating properly? Are those available for Cadmus to review?
4. Was there a sampling plan developed for the previous verification effort?
5. If yes, can BPA provide?
6. If no, can you walk me through how customers were selected?

Current Verification Project

7. Are there any other stakeholder thoughts or considerations we need to be aware of when working through the sample plan, analysis, or reporting?
8. Is there a master list of stores that participated in the previous verification? If yes, can BPA provide this list electronically?
9. Are there any particular measures or measure categories that you think should have a priority in the sampling? What and why?
10. What are your expectations for this project?

Appendix B: Site Verification Checklist and Protocol

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Low temp reach-in or coffin to new high efficiency reach-in	Confirm linear feet of case replaced	<input number>	Linear feet of case	Visually inspect and record linear feet of case. Work with store staff to identify which cases have been replaced, if it isn't clear from the documentation.	Use program documentation and invoices to locate and verify cases
	Confirm T8 w/electronic ballasts or LED lamps exist.	LED T8 with electronic ballast T8 with magnetic ballast Couldn't determine Unable to verify Other <specify>	n/a	Visual inspection. For T8's confirm electronic ballasts exist.	n/a
	Confirm whether or not ONE of the following has been installed: 1) Doors do <u>not</u> have anti-sweat heaters 2) Doors have low power (<0.39 amps/linear foot) anti-sweat heaters 3) Doors have anti-sweat heater controls	1) Doors do not have anti-sweat heaters 2) Doors have low power (<0.39 amps/linear foot) anti-sweat heaters 3) Doors have anti-sweat heater controls Can't determine Unable to verify		Determine what type of control strategy is being employed (stand alone ASHC or EMS) through program documentation. If EMS exists, auditor should work to contact store manager or facility manager to arrange a time to walk through the control setpoints. 1) If ASH's exist in EMS, record the amperage or status. 2) If an EMS is used to cycle ASH and the associated EMS points represent amperage, then determine the amperage installed based on the EMS readings and determine the linear feet of case installed. 3)Use the EMS to view the ASHC reset schedule indicating the minimum and maximum ON cycle setpoints. For example, when the dewpoint is 42 deg F, ASHC's cycle on 10% of the time and when the dewpoint is 58 deg F, ASHC's cycle on 80% of the time.	<u>Verifying presence of ASH's:</u> 1) If EMS access is not available or does not exist, a non-contact voltage pen could be held against the case door. If the voltage pen light is constantly ON or cycles ON, this indicates ASH is present. If the voltage pen light is OFF, this indicates that ASH does not exist or is not working. If EMS does not exist, check for standalone ASH controllers on cases. <u>Verifying low power ASH where EMS not accessible:</u> 1)Obtain case model number or ASH model number and review product specifications on site or online to determine the installed amperage of the ASH's <u>Verifying ASH controls where EMS not accessible or does not exist:</u> 1) A non-contact voltage pen could be held against the case door. If the voltage pen light is constantly ON, this indicates ASH's are continuously ON thus the controls are not working. If the voltage pen light cycles ON and OFF, this indicates ASH cycling is occurring. Contact with the door should be made in the center of the glass to avoid capturing any voltage associated with case lighting. Check for standalone ASH controllers on cases. 2)Obtain case model number or ASH controller model number and review product specifications on site or online to determine the installed amperage of the ASH's and controls setup
	Confirm the type of evaporator fan motor installed in cases. The program requires the installation of ECMs for this measure.	ECM Shaded Pole Permanent split capacitor Can't determine Unable to verify	motor type	The verification of ECM's should cause minimal disruption to store operation. If fan motors are accessible without removing large amounts of product, visually confirm the number and type of motors installed, similar to the walk-in motors. The procedure below should ALWAYS be followed before physical verification of a case ECM: - Ask store manager if it's okay to remove product and identify the cases you want to verify - Spot check ECM's in a sample of cases - Identify cases that will cause minimal disruption to verify (e.g. large beverage case will take less time to verify than frozen OJ case) - Before unstocking a case, ask store manager if there is any specific order for restocking and pay attention to what the case looked like BEFORE product was removed. - Don't forget to turn the fan back ON if that method of verification is used!! <u>Possible methods for physical verification include:</u> 1) Turn off the fans and watching them wind down. If they are ECM's, they won't stop smoothly; they are jittery and move 10-30 deg at at time when they slow down to stop. 2) Look for "EC Motor" sticker on the inside of the case 3) Look at the color of the motor. Green is a common color of ECM's, depending on the manufacturer.	<u>Option 1:</u> Review invoices or program documentation to determine the number of motors and type. <u>Option 2:</u> Locate any replacement case motors in the stock room and confirm the type of fan motor. Conversations with staff.

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Medium temp open case to new high efficiency open case	Confirm linear feet of case replaced	<input number>	Linear feet of case	Visually inspect and record linear feet of case. Work with store staff to identify which cases have been replaced, if it isn't clear from the documentation.	n/a
	Confirm T8 w/electronic ballasts or LED lamps exist.	LED T8 with electronic ballast T8 with magnetic ballast Couldn't determine Unable to verify Other <specify>	n/a	Visual inspection. For T8's confirm electronic ballasts exist.	n/a
	Confirm required evaporator saturated evaporative temperatures (SET) as follows: Produce >= 29 deg F, Dairy/Deli >= 26 deg F, Meat >= 22 deg F	Meets program requirements Does not meet program requirements Cannot determine Unable to verify	n/a	Review invoices or program documentation to determine planned set points.	n/a
	Confirm the type of evaporator fan motor installed in cases. The program requires the installation of ECM's.	ECM Shaded Pole Permanent split capacitor Cannot determine Unable to verify	motor type	The verification of ECM's should cause minimal disruption to store operation. The procedure below should ALWAYS be followed before physical verification of a case ECM: - Ask store manager if it's okay to remove product and identify the cases you want to verify - Spot check ECM's in a sample of cases - Identify cases that will cause minimal disruption to verify (e.g. large beverage case will take less time to verify than frozen OJ case) - Before unstocking a case, ask store manager if there is any specific order for restocking and pay attention to what the case looked like BEFORE product was removed. - Don't forget to turn the fan back ON if that method of verification is used!! Possible methods for physical verification include: 1) Turn off the fans and watching them wind down. If they are ECM's, they won't stop smoothly; they are jittery and move 10-30 deg at at time when they slow down to stop. 2) Look for "EC Motor" or "Arktik 59" sticker on the inside of the case or motor 3) Look at the color of the motor. Green is a common color of ECM's, depending on the manufacturer.	Option 1: Review invoices or program documentation to determine the number of motors and type. Option 2: Locate any replacement case motors in the stock room and confirm the type of fan motor. Conversations with staff.
Special Doors with Low/No anti-sweat heaters or Standard doors to low/no anti-sweat heat doors for low temp reach-in cases	Confirm linear feet of case replaced	<input number>	Linear feet of case	Visually inspect and record linear feet of case. Work with store staff to identify which cases have been replaced, if it isn't clear from the documentation.	n/a
	Confirm triple pane glass doors	Triple pane Double Pane Other _____ Can't determine Can't verify	n/a	Visual inspection. If it is difficult to determine, review invoices or program documentation to determine door construction type.	n/a
	Confirm whether or not ONE of the following has been installed: 1) Doors do not have anti-sweat heaters 2) Doors have low power (<0.39 amps/linear foot) anti-sweat heaters	Meets program requirements Does not meet program requirements Cannot determine Unable to verify		1) Use a non-contact voltage pen could be held against the case door to determine if heaters exist. If the voltage pen light is constantly ON or cycles ON, this indicates ASH is present. If the voltage pen light is OFF, this indicates that ASH does not exist or is not working. 2) Obtain case model number or ASH model number and review product specifications on site or online to determine the installed amperage of the ASH's	Use program documentation and invoices to verify the presence of low or no-anti sweat heaters
Add doors to medium temp Walk-in Reach-in	Confirm linear feet of case replaced	<input number>	Linear feet of case	Visually inspect and record linear feet of case. Work with store staff to identify which cases have been replaced, if it isn't clear from the documentation.	Use documentation to identify the affected cases
	Confirm that no-heat doors have been added to the associated cases.	Present Not present Unable to verify	n/a	Visually inspect doors. A non-contact voltage pen could be held against the case door. If the voltage pen light is constantly ON or cycles ON, this indicates ASH is present. If the voltage pen light is OFF, this indicates that ASH does not exist or is not working.	1) Obtain case model number or ASH model number and review product specifications to determine if ASH are present and the associated voltage.
	Confirm that the display case evaporator coil with shaded pole fan motors has been removed	Evap coil and motors removed Evap coil and motors present Cannot determine Unable to verify	n/a	Visual inspection. If it is difficult to determine, work with store staff to determine.	n/a

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Anti-sweat heater controls	Linear feet of low temp case controlled	<input number>	Linear feet of case	Visual inspection, work with on-site staff to determine which cases were retrofitted. "Low temperature" covers evaporator temperatures below 0°F. Product will be frozen.	n/a
	Linear feet of medium temp case controlled	<input number>	Linear feet of case	Visual inspection, work with on-site staff to determine which cases were retrofitted. "Medium temperature" covers evaporator temperatures between 1°F and 35°F. Product is not frozen and may be dairy, vegetable, etc related.	n/a
	General observations	<open ended?	n/a	Visually inspect the doors with ASHC's and note any findings such as condensation or frost build up observed.	n/a
	Determine what variable anti-sweat heater cycling is controlled by	Dewpoint Humidity or % RH	n/a	Visual inspection of sensor and current operating conditions through energy management system (EMS)	Review invoices or program documentation to determine the control variable for ASHC's.
	Determine % run time reduction resulting from ASHC's meets requirements as follows: • MT: Reduces ASH run time by at least 80%. • LT: Reduces ASH run time by at least 50%.	Meets program requirements Does not meet program requirements Cannot determine Unable to verify	n/a	Determine what type of control strategy is being employed (stand alone ASHC or EMS) through program documentation. If EMS exists, auditor should work to contact store manager or facility manager to arrange a time to walk through the control setpoints. 1) If ASH's exist in EMS, record the amperage or status. 2) If an EMS is used to cycle ASH and the associated EMS points represent amperage, then determine the amperage installed based on the EMS readings and determine the linear feet of case installed. 3)Use the EMS to view the ASHC reset schedule indicating the minimum and maximum ON cycle setpoints. For example, when the dewpoint is 42 deg F, ASHC's cycle on 10% of the time and when the dewpoint is 58 deg F, ASHC's cycle on 80% of the time.	<u>Verifying presence of ASH's:</u> 1) If EMS access is not available or does not exist, a non-contact voltage pen could be held against the case door. If the voltage pen light is constantly ON or cycles ON, this indicates ASH is present. If the voltage pen light is OFF, this indicates that ASH does not exist or is not working. If EMS does not exist, check for standalone ASH controllers on cases. <u>Verifying low power ASH where EMS not accessible:</u> 1)Obtain case model number or ASH model number and review product specifications on site or online to determine the installed amperage of the ASH's <u>Verifying ASH controls where EMS not accessible or does not exist:</u> 1) A non-contact voltage pen could be held against the case door. If the voltage pen light is constantly ON, this indicates ASH's are continuously ON thus the controls are not working. If the voltage pen light cycles ON and OFF, this indicates ASH cycling is occurring. Contact with the door should be made in the center of the glass to avoid capturing any voltage associated with case lighting. Check for standalone ASH controllers on cases. 2)Obtain case model number or ASH controller model number and review product specifications on site or online to determine the installed amperage of the ASH's and controls setup
Door gaskets for solid or reach-in glass doors	Confirm the number of walk-in cooler doors retrofitted with gaskets	<input number>	# of doors	Visually inspect and record the number of doors with gasket retrofits. Work with store staff to identify which gaskets have been replaced, if it isn't clear from the documentation.	Review invoices or program documentation to determine which gaskets were replaced.
	Confirm the number of walk-in freezer doors retrofitted with gaskets	<input number>	# of doors	Visually inspect and record the number of doors with gasket retrofits. Work with store staff to identify which gaskets have been replaced, if it isn't clear from the documentation.	Review invoices or program documentation to determine which gaskets were replaced.
	Confirm the number of reach-in cooler doors retrofitted with gaskets	<input number>	# of doors	Visually inspect and record the number of doors with gasket retrofits. Work with store staff to identify which gaskets have been replaced, if it isn't clear from the documentation.	Review invoices or program documentation to determine which gaskets were replaced.
	Confirm the number of reach-in freezer doors retrofitted with gaskets	<input number>	# of doors	Visually inspect and record the number of doors with gasket retrofits. Work with store staff to identify which gaskets have been replaced, if it isn't clear from the documentation.	Review invoices or program documentation to determine which gaskets were replaced.
	Condition of gaskets	Meets program requirements Does not meet program requirements Cannot determine Unable to verify	n/a	Note the condition of gaskets and installation. For example, are they cracked or torn? Are they aligned with door frame? Is there any unusual frost build-up around gaskets?	Review invoices or program documentation to determine which gaskets were replaced.

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Auto-closers for walk-in cooler or freezer solid doors	Confirm the number of low temp doors with auto-closers installed	<input number>	# of doors	Visual inspection and work with on-site staff to determine which walk-ins were retrofit. Review invoices or program documentation to determine which gaskets were replaced.	n/a
	Confirm the number of medium temp doors with auto-closers installed	<input number>	# of doors	Visual inspection and work with on-site staff to determine which walk-ins were retrofit. Review invoices or program documentation to determine which gaskets were replaced.	n/a
	Confirm that the perimeter of each door with an autocloser is >= 16 ft	Door perimeter greater than 16 feet Door perimeter less than 16 feet	ft	Measured from inside of door frame	n/a
	Confirm door type	Glass door Solid door Can't determine Unable to verify	n/a	Visual inspection	n/a
	Confirm that auto-closer must firmly close door when door is within 1 inch of door latch	Door firmly closes Door does not firmly close Can't determine Unable to verify	n/a	Open door within one inch of latch and release to verify that auto-closers are operational.	n/a
Auto-closers for walk-in cooler or freezer glass doors	Confirm the number of low temp doors with auto-closers installed	<input number>	# of doors	Visual inspection and work with on-site staff to determine which walk-ins were retrofit	n/a
	Confirm the number of medium temp doors with auto-closers installed	<input number>	# of doors	Visual inspection and work with on-site staff to determine which walk-ins were retrofit	n/a
	Confirm that the perimeter of each door with an autocloser is >= 16 ft	Door perimeter greater than 16 feet Door perimeter less than 16 feet	ft	Measured from inside of door frame	n/a
	Confirm door type	Glass door Solid door Can't determine Unable to verify	n/a	Visual inspection	n/a
	Confirm that auto-closer must firmly close door when door is within 1 inch of door latch	Door firmly closes Door does not firmly close Can't determine Unable to verify	n/a	Open door within one inch of latch and release to verify that auto-closers are operational.	n/a
Strip curtains	Confirm the square feet of doorway where curtains are installed in low temp applications	Low temperature Medium temperature Can't determine Unable to verify	n/a	"Low temperature" covers evaporator temperatures below 0°F. Product will be frozen. "Medium temperature" covers evaporator temperatures between 1°F and 35°F. Product is not frozen and may be dairy, vegetable, etc related.	n/a
	Confirm the square feet of doorway where curtains are installed medium temp applications	<input number>			
	Condition of curtains	<open ended>	n/a	Note the condition of curtains. For example, have they been tied to the side or cut in any way?	n/a
Night covers	Confirm the linear feet of vertical case night cover installed	<input number>	Linear feet of case	Visual inspection and work with on-site staff to determine which cases were retrofitted with night covers. Note that night covers may be external, internal and integrated to the case.	Review invoices or program documentation to determine where nightcovers were replaced.
	Confirm the linear feet of horizontal case night cover installed	<input number>	Linear feet of case	Visual inspection and work with on-site staff to determine which cases were retrofitted with night covers	n/a
	Confirm the operational characteristics of the night covers	<input number>	hr/s/day	Discuss with staff to determine how many hours the night covers are pulled down per day	n/a
	Note condition of night covers	<open ended>	n/a	Note the physical condition of night covers. Are they still functional?	n/a

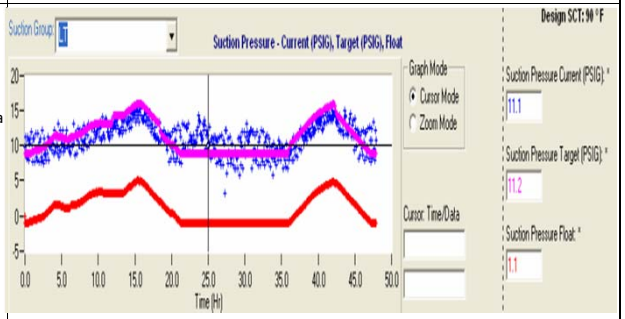
Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Electronically Commutated Motors (ECM) in cases	Confirm type of motors installed	ECM Shaded Pole Permanently Split Capacitor Can't determine Unable to verify	n/a	The verification of ECM's should cause minimal disruption to store operation. The procedure below should ALWAYS be followed before physical verification of a case ECM: - Ask store manager if it's okay to remove product and identify the cases you want to verify - Spot check ECM's in a sample of cases - Identify cases that will cause minimal disruption to verify (e.g. large beverage case will take less time to verify than frozen OJ case) - Before unstocking a case, ask store manager if there is any specific order for restocking and pay attention to what the case looked like BEFORE product was removed. - Don't forget to turn the fan back ON if that method of verification is used!! Possible methods for physical verification include: 1) Look for "EC Motor" or "Arktik 59" sticker on the inside of the case or motor 2) Look at the color of the motor. Green is a common color of ECM's, depending on the manufacturer.	<u>Option 1:</u> Review invoices or program documentation to determine the number of motors and type. <u>Option 2:</u> Locate any replacement case motors in the stock room and confirm the type of fan motor. Conversations with staff. If the number of ECM's installed in cases cannot be determined based on a documentation review or visual inspection, assume 1 motor per 3 linear feet (or per door) of case for Reach-ins and 1 motor per 4 linear feet for Open Multi-deck Cases.
	Number of ECM's installed	<Input number>	# ECMs installed	See above	See above
Electronically Commutated Motors (ECM) in walk-in coolers or freezers	Number of ECM's installed in walk-ins	<drop down>	# ECMs installed	Visual inspection and work with on-site staff to determine which cases or walk-ins were retrofit	Review invoices or program documentation to determine where motors were replaced.
	Number of ECM's installed in walk-in reach-ins	<drop down>	# ECMs installed	Review documentation and spot check for a sample of cases	See above
	Confirm type of motors installed	ECM Shaded Pole Permanently Split Capacitor Can't determine Unable to verify	n/a	The verification of ECM's should cause minimal disruption to store operation. The procedure below should ALWAYS be followed before physical verification of an ECM: - Ask store manager if it's okay to remove product and identify the evaporator you want to verify - Spot check ECM's in a sample of walkins - Don't forget to turn the fan back ON if the fan is turned off during verification! <u>Possible methods for physical verification include:</u> 1) Turn off the fans and watching them wind down. If they are ECM's, they won't stop smoothly; they are jittery and move 10-30 deg at at time when they slow down to stop. 2) Look for "EC Motor" sticker on the inside of the evaporator box 3) Look at the color of the motor. Green is a common color of ECM's, depending on the manufacturer.	<u>Option 1:</u> Review invoices or program documentation to determine the number of motors and type.
Permanent Split Capacitor (PSC) motors in walk-in reach-ins	Number of PSC's installed in walk-ins	<Input number>	# PSCs installed	Visual inspection and work with on-site staff to determine which cases or walk-ins were retrofit	
	Number of PSC's installed in walk-in reachins	<Input number>	# PSCs installed	Visual inspection and work with on-site staff to determine which cases or walk-ins were retrofit	
	Confirm type and the number of PSC's installed	ECM Shaded Pole Permanently Split Capacitor Can't determine Unable to verify	n/a	The verification of PSC's should cause minimal disruption to store operation. If fan motors are accessible without removing large amounts of product, visually confirm the number and type of motors installed, similar to the walk-in motors. The procedure below should ALWAYS be followed before physical verification of a PSC motor: - Ask store manager if it's okay to remove product and identify the cases you want to verify - Spot check PSC's in a sample of walk-ins - Don't forget to turn the fan back ON if that method of verification is used!! Visually confirm make/model during the site visit, and verify online or by calling the manufacturer that the motors are PSC. Some motors may denote they are PSC's on the nameplate or can be identified by the presence of an cigarette shaped capacitor on the side of the motor.	Option 1: Review invoices or program documentation to determine the number of motors and type.

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Permanent Split Capacitor (PSC) motors in cases	Number of PSC's installed in cases	<Input number>	# PSCs installed	Visual inspection and work with on-site staff to determine which cases where retrofit	
	Confirm type and the number of PSC's installed	ECM Shaded Pole Permanently Split Capacitor Can't determine Unable to verify	n/a	The verification of PSC's should cause minimal disruption to store operation. If fan motors are accessible without removing large amounts of product, visually confirm the number and type of motors installed, similar to the walk-in motors. The procedure below should ALWAYS be followed before physical verification of a PSC motor: - Ask store manager if it's okay to remove product and identify the cases you want to verify - Spot check PSC's in a sample of walk-ins - Don't forget to turn the fan back ON if that method of verification is used!! Visually confirm make/model during the site visit, and verify online or by calling the manufacturer that the motors are PSC. Some motors may denote they are PSC's on the nameplate or can be identified by the presence of an cigarette shaped capacitor on the side of the motor.	Option 1: Review invoices or program documentation to determine the number of motors and type.
Variable Frequency Drive (VFD) on condenser fan motors	Confirm that ALL condenser fan motors are controlled via VFD	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection and work with on-site staff to gain access to the condenser fan VFD and motors. VFD may be located mechanical/refrigeration equipment room, or near or on condensers.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls
	Total condenser fan motor horsepower on site controlled by VFD's	<input number>	horsepower	Visual inspection of nameplate information on site.	Review invoices or program documentation, in particular refrigeration schedules and condenser cut sheets, to determine the number and capacity of the condenser fan motors and type of controls
	Operating conditions	<open ended>	n/a	Visual inspect VFD and denote current operating conditions. For example, what % speed or Hz is the VFD operating at? What are the current weather conditions like? Has the VFD been put "in hand" or in "manual" operating mode? Note any observations	Conversation with store manager or facility manager

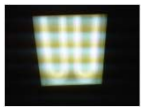
Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Floating head pressure control (FHPC's) for multiplex compressors	Confirm compressor nameplate horsepower that have FHPC's	<input number>	horsepower	Visual inspection of compressor nameplate for compressors that have floating head pressure controls installed. If possible, reference on-site refrigeration and controls drawings or plans to determine which compressors have floating head pressure controls installed, as the measure may not apply to all compressors on site.	Review invoices or program documentation to determine the number and capacity of the compressors with FHPC's. Conversation with staff
	Condenser type	Air cooled Evaporatively cooled Can't determine Unable to verify	n/a	Visual inspection of unit and nameplate information on site.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls
	Floating head pressure controls exist and function as follows: Air-cooled condensers: o Must maintain an ambient following condensing setpoint of 12°F temperature differential (TD) or less between the outside air drybulb temperature and the setpoint. o Either use a variable speed drive or assume no change in fan operation. Evaporative-cooled condensers: o Must maintain a wetbulb following setpoint of 17°F TD or less between the outside air wetbulb temperature and the setpoint. o Must be controlled with a variable speed drive or 2 speed fan control Minimum saturated condensing temperature must be equal to or less than 70°F.	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	If a site contains this measure, when the verifier contact the site they should ask questions to understand what kind of controls are installed and the verifer should schedule the site verification so that a facility staff person, corporate energy specialist or refrigeration contractor is present to assist in accessing the EMS so that relevent data points listed below can be verified. Also, the verifier will request trend data if it is available to confirm the measure. View the EMS setpoint for the saturated condensing temperature to confirm it's at 70 deg. Use the EMS to view the floating head pressure control set up indicating the minimum head pressure setpoint and control type (floating or fixed). Some EMS's are password protected, so if this measure is present at a site, EMS access should be discussed with the store facility staff prior to the site visit. If available, review a few days of trend data to confirm that floating head pressure controls are enabled. Ideally head pressure or saturated condensing temperature can be viewed, over time, with ambient outside air temperature. The trend graphs should show that head pressure or temperature is floating and follows the outside air temperature during the trended time period. Obtain EMS screen shots.	Option 1: If trend data or controls setpoints are not available, record setpoints observed during the site visit. These should still be accessible through the EMS, as head pressure (psi) or saturated condensing temperature (deg F) or sometimes visible on the main EMS screen without having to press any buttons. Record ambient temperature while on site. If the saturated condensing temperature is less than 85 deg F and outside air is less than 75 deg F, floating head pressure controls are likely working. Option 2: If the EMS is not accessible at all, the drawings could be checked for pressure transducers on racks, outdoor air temp sensors, drop leg temperature sensors (line coming out of condensers). Should be part of the EMS drawings and would indicate that the correct sensors and components are installed for this measure.
	Saturated condensing temperature minimum setpoint is 70 deg F or less	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	If a site contains this measure, when the verifier contact the site they should ask questions to understand what kind of controls are installed and the verifer should schedule the site verification so that a facility staff person, corporate energy specialist or refrigeration contractor is present to assist in accessing the EMS so that relevent data points listed below can be verified. Also, the verifier will request trend data if it is available to confirm the measure. View the EMS setpoint for the saturated condensing temperature to confirm it's at 70 deg.	

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Floating head pressure control (FHPC's) for multiplex compressors with VFD's	Confirm compressor nameplate horsepower that have FHPC's	Can't determine Unable to verify	horsepower	Visual inspection of compressor nameplate for compressors that have floating head pressure controls installed. If possible, reference on-site refrigeration and controls drawings or plans to determine which compressors have floating head pressure controls installed, as the measure may not apply to all compressors on site.	Review invoices or program documentation to determine the number and capacity of the compressors with FHPC's. Conversation with staff
	Condenser type	Air cooled Evaporatively cooled Can't determine Unable to verify	n/a	Visual inspection of nameplate information on site.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls
	Floating head pressure controls exist and function as follows: Air-cooled condensers: o Must maintain an ambient following condensing setpoint of 12°F temperature differential (TD) or less between the outside air drybulb temperature and the setpoint. Evaporative-cooled condensers: o Must maintain a wetbulb following setpoint of 17°F TD or less between the outside air wetbulb temperature and the setpoint. Minimum saturated condensing temperature must be equal to or less than 70°F.	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Use the EMS to view the floating head pressure control set up indicating the minimum head pressure setpoint and control type (floating or fixed). Some EMS's are password protected, so if this measure is present at a site, EMS access should be discussed with the store facility staff prior to the site visit. If available, review a few days of trend data to confirm that floating head pressure controls are enabled. Ideally head pressure or saturated condensing temperature can be viewed, over time, with ambient outside air temperature. The trend graphs should show that head pressure or temperature is floating and follows the outside air temperature during the trended time period. Obtain EMS screen shots.	Option 1: If trend data or controls setpoints are not available, record setpoints observed during the site visit. These should still be accessible through the EMS, as head pressure (psi) or saturated condensing temperature (deg F). Record ambient temperature while on site. If the saturated condensing temperature is less than 85 deg F and outside air is less than 75 deg F, floating head pressure controls are likely working. Option 2: If the EMS is not accessible at all, the drawings could be checked for pressure transducers on racks, outdoor air temp sensors, drop leg temperature sensors (line coming out of condensers). Should be part of the EMS drawings and would indicate that the correct sensors and components are installed for this measure.
	Condenser fans must be controlled by VFD's	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of nameplate information on site.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls
	Confirm condenser fan capacity controlled by VFD's	<input number>	horsepower	Visual inspection of nameplate information on site.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls
	Saturated condensing temperature minimum setpoint is 70 deg F or less	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	View the EMS setpoint for the saturated condensing temperature.	

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Floating head pressure control (FHPC's) for single compressor systems	Confirm compressor nameplate horsepower that have FHPC's	Can't determine Unable to verify	horsepower	Visual inspection of compressor nameplate for compressors that have floating head pressure controlller installed. If needed, reference on-site refrigeration and controls drawings or plans to determine which compressors have floating head pressure controls installed, as the measure may not apply to all compressors on site.	Review invoices or program documentation to determine the number and capacity of the compressors with FHPC's. Conversation with staff
	Confirm that non adjustable flood-back control valves have been replaced with adjustable flood-back control valve (head pressure control valve) to lower minimum condensing head pressure from 180 psig (93 F for R22) to saturated pressure equivalent of 70 F or less. Alternatively, a fan control safety switch can be used to maintain adequate head pressure.	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Some possible methods for physical verification: 1) Work with a refrigeration contractor on site to measure saturated refrigerant pressure, which can then be used, with the assistance of a refrigerant chart, to look up the corresponding saturated refrigerant temperature to determine if it meets the minimum program requirements. This method requires coordination with a refrigeration contractor who has a pressure gauge wtih the correct fitting type to take measurements. Head pressure can either be floated by disabling the fixed hold-back valve and cylcing the fan ON/OFF or replacing the fixed hold-back valve with a variable setting hold-back valve and setting it at the lowest discharge charge pressure that the compressor. Below are possible verification methods for each installation type. 2) If the fan is fixed speed then it should be running all the time if the OA temperature is over 40 F, it will likely cycle on/off below 40 F. When OA temperature is below 70 F (best if you check below 60 F). Check pressure on discharge of compressor, it should be close to the saturation pressure of OA temp + 12F- 25F, depending on condenser sizing. If it is older condenser/compressor attached to a cooler it will be closer to 25F delta T, if it is newer condenser/compressor attached to freezer it will be closer to 12F delta T. For example, if outside air is 50F and you are measuring on an older cooler you might check that pressure is close to the saturation pressure of refrigerant at 50F + 18F = 68F. Verify that the hold back valve has been disabled. The main thing is to verify at OA temperatures below 70F that the pressure on the discharge side of the compressor is lower than a standard setting of 90-95F. 3) If the fan is variable speed then the discharge pressure should be measured to find out what pressure the fan is trying to hold the refrigerant to or if possible, read controller setting. The fan setting should be holding it at pressure equivalent to 70F saturated temperature.	1) Identify the expansion valve type and ensure that it is electronic or balanced port or a device is installed to supplement refrigerant to ethe evaporator to prevent starving the evaporator coil 2) Identify the installation of a controller for head pressure control. 3)Review invoices or program documentation. Conversation with staff
	To prevent evaporator from starving, at low condensing pressures, one of the following must be implemented: - Replace each expansion valve with balanced-port valve or electronic expansion valve (EEV) sized to meet the load requirement at 70º F condensing temperature - Install a device to supplement refrigerant feed to each evaporator attached to the condenser. Exemption: Existing expansion valve is a balanced port or electronic expansion valve.	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	If accessible, visually confirm the presence of an electronic expansion valve OR a device (e.g. balance port valve) is installed before each evaporator coil fed from the compressor.	Review invoices or program documentation.Conversation with staff

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Floating suction pressure control (FSPC's) for multiplex compressor systems	Confirm/record compressor nameplate horsepower for cases controlled by FSPC	<input number>	horsepower	Visual inspection of nameplate information on site.	Review invoices or program documentation to determine the number and capacity of the compressors with FSPC's. Conversation with staff
	Confirm that suction pressure controls are installed and operational. To meet program requirements, suction pressure must be adjusted to the highest point that can still maintain setpoint temperatures at monitored cases on the suction circuit	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	If a site contains this measure, when the verifier contact the site they should ask questions to understand what kind of controls are installed and the verifer should schedule the site verification so that a facility staff person, corporate energy specialist or refrigeration contractor is present to assist in accessing the EMS so that relevent data points listed below can be verified. Also, the verifier will request trend data if it is available to confirm the measure. Use the EMS to view the floating suction pressure control set up indicating the suction pressure setpoint, associated case pressure or temperature sensors and control type (floating or fixed). Some EMS's are password protected, so if this measure is present at a site, EMS access should be discussed with the store facility staff prior to the site visit. If available, review a few days of trend data to confirm that suction pressure is floating. A "Suction Pressure Float" input in the EMS also indicates FSPC's are installed. Ideally suction pressure can be viewed and should indicate the suction pressure is floating over time, particularly during periods of low occupancy (e.g. when the store is closed)	 Review invoices or program documentation to determine the number and capacity of the compressors with FSPC's. Check for temperature sensors in the critical cases- for each suction group- would be the feedback loop for the FSPC's and should be part of the EMS drawings. Conversations with staff.
High efficiency multiplex compressor system	Confirm compressor nameplate capacity for new compressor multiplex rack installed.	Can't determine Unable to verify	tons	Visual inspection of compressor nameplate for compressors that have floating head pressure controls installed. If possible, reference on-site refrigeration and controls drawings or plans to determine which compressors have floating head pressure controls installed, as the measure may not apply to all compressors on site.	Review invoices or program documentation to determine the number and capacity of the compressors with FHPC's. Conversation with staff
	Condenser type	Air cooled Evaporatively cooled Can't determine Unable to verify	n/a	Visual inspection of nameplate information on site.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls
	Floating head pressure controls exist and function as follows: <u>Air-cooled condensers</u>: o Must maintain an ambient following condensing setpoint of 10°F temperature differential (TD) or less between the outside air drybulb temperature and the setpoint for low temperature systems, and a 15°F TD or less for medium temperature systems. When a single circuit condenser is used, it must operate at a 10°F TD or less. Minimum saturated condensing temperature must be equal to or less than 70°F. <u>Evaporative-cooled condensers:</u> o Must maintain a wetbulb following setpoint of 25°F TD or less between the outside air wetbulb temperature and the setpoint. Minimum saturated condensing temperature must be equal to or less than 70°F.	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Use the EMS to view the floating head pressure control set up indicating the minimum head pressure setpoint and control type (floating or fixed). Some EMS's are password protected, so if this measure is present at a site, EMS access should be discussed with the store facility staff prior to the site visit. If available, review a few days of trend data to confirm that floating head pressure controls are enabled. Ideally head pressure or saturated condensing temperature can be viewed, over time, with ambient outside air temperature. The trend graphs should show that head pressure or temperature is floating and follows the outside air temperature during the trended time period. Obtain EMS screen shots.	Option 1: If trend data or controls setpoints are not available, record setpoints observed during the site visit. These should still be accessible through the EMS, as head pressure (psi) or saturated condensing temperature (deg F). Record ambient temperature while on site. If the saturated condensing temperature is less than 85 deg F and outside air is less than 75 deg F, floating head pressure controls are likely working. Option 2: If the EMS is not accessible at all, the drawings could be checked for pressure transducers on racks, outdoor air temp sensors, drop leg temperature sensors (line coming out of condensers). Should be part of the EMS drawings and would indicate that the correct sensors and components are installed for this measure.
	<u>Air Cooled</u>: Condenser fans must be staged or controlled by VFD's <u>Evaporative cooled</u>: Condenser fans must be controlled by VFD's	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of nameplate information on site.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Oversized condenser	Confirm condenser nameplate capacity for oversized condenser installed.	Can't determine Unable to verify	tons	Visual inspection of condenser nameplate for oversized condenser. If possible, reference on-site refrigeration schedule and specifications to obtain more complete details.	Review invoices or program documentation to determine the capacity of installed condenser. Capacity should be the installed condenser capacity (not the refrigeration load)
	Confirm condenser energy efficiency ratio (EER) at a TD of 30. EER must be greater than 105 to meet program requirements	<input number>	EER	Visual inspection of condenser nameplate and model number. If possible, reference on-site or program documentation, specifically refrigeration drawings and equipment specifications (which can also be obtained online) to determine condenser EER.	Review invoices or program documentation to determine condenser EER
	Floating head pressure controls exist and function as follows: Air-cooled condensers: o Must maintain an ambient following condensing setpoint of 8°F temperature differential (TD) or less between the outside air drybulb temperature and the setpoint for low temperature systems, and a 13°F TD or less for medium temperature systems. When a single circuit condenser is used, it must operate at an 8°F TD or less. Minimum saturated condensing temperature must be equal to or less than 70°F. Evaporative-cooled condensers: o Must maintain a wetbulb following setpoint of 18°F TD or less between the outside air wetbulb temperature and the setpoint. Minimum saturated condensing temperature must be equal to or less than 70°F.	Meets program requirements Does not meet program requirements Can't determine Unable to verify		If a site contains this measure, when the verifier contact the site they should ask questions to understand what kind of controls are installed and the verifer should schedule the site verification so that a facility staff person, corporate energy specialist or refrigeration contractor is present to assist in accessing the EMS so that relevent data points listed below can be verified. Also, the verifier will request trend data if it is available to confirm the measure.Use the EMS to view the floating head pressure control set up indicating the minimum head pressure setpoint and control type (floating or fixed). Some EMS's are password protected, so if this measure is present at a site, EMS access should be discussed with the store facility staff prior to the site visit. If available, review a few days of trend data to confirm that floating head pressure controls are enabled. Ideally head pressure or saturated condensing temperature can be viewed, over time, with ambient outside air temperature. The trend graphs should show that head pressure or temperature is floating and follows the outside air temperature during the trended time period. Obtain EMS screen shots.	Option 1: If trend data or controls setpoints are not available, record setpoints observed during the site visit. These should still be accessible through the EMS, as head pressure (psi) or saturated condensing temperature (deg F). Record ambient temperature while on site. If the saturated condensing temperature is less than 85 deg F and outside air is less than 75 deg F, floating head pressure controls are likely working. Option 2: If the EMS is not accessible at all, the drawings could be checked for pressure transducers on racks, outdoor air temp sensors, drop leg temperature sensors (line coming out of condensers). Should be part of the EMS drawings and would indicate that the correct sensors and components are installed for this measure.
	Air Cooled: Condenser fans must be staged or controlled by VFD's Evaporative cooled: Condenser fans must be controlled by VFD's	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of nameplate information on site. See VFD on Condenser fan measure, for further detail on verification methods.	Review invoices or program documentation to determine the number and capacity of the condenser fan motors and type of controls
Hot food holding cabinet	Confirm equipment capacity	<input number>	cubic feet	Visual inspection of equipment make, model number and nameplate information.	Review invoices or program documentation to determine the capacity of installed equipment.
	Confirm the number of hot food holding cabinets installed	<input number>	hot food holding cabinets	Visual inspection on site.	Conversations with store staff
	Confirm that the installed Hot Food Holding Cabinet is listed on Consortium for Energy Efficiency's (CEE) **Tier 2** qualifying list, found under "Hot Food Holding Cabinets" link at http://www.cee1.org/com/com-kit/com-kit-equip.php3, or has an Idle Energy Rate of ≤ 20 Watts/ft3.	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of equipment make, model number and nameplate information. Cross check model number against CEE specification and/or determine Idle Energy Rate of equipment specification to determine if it meets program requirements	Review invoices or program documentation to determine the Idle Energy Rate or to determine if it is on the CEE Tier 2 list.
Combination oven	Confirm the number of combination ovens installed		combination ovens	Visual inspection on site.	Conversations with store staff
	Confirm that the qualifying list of products is on the approved EnergySmart Grocer approved product list	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of equipment make, model number and nameplate information. Cross check with EnergySmart Grocer approved product list.	Review invoices or program documentation to the installed equipment details.

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
Pre-rinse spray valves	Confirm the number of pre-rinse spray valves installed	<input number>	Pre-rinse spray valves	Visual inspection on site.	Review invoices or program documentation to determine the number of pre-rinse spray valves installed. Conversations with staff
	Confirm the flow rate of nozzle is <= 1.6 gpm	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection on site to identify pre-rinse spray valve make/model number. Often the rated flow rate is visible on the spray valve nozzle.	Review invoices or program documentation to determine the model number and specifications of spray valves installed.
	Confirm the dishwashing water is electrically heated	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of water heater make and model number. Conversations with on-site staff	Review invoices or program documentation.
	Confirm the facility serves more than 10 meal shifts per week (e.g. lunches and dinners five nights/week)	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Conversations with facility staff regarding facility kitchen operations. There are some exceptions to this requirement which may include: Exceptions may include commercial bakeries, central school district cafeterias, or catering facilities that are used less frequently, but intensely with each use. Note exceptions where found.	n/a
Case lighting: T12 - T8	Confirm the number of 4 ft T12 lamps replaced	<input number>	T8 lamps	Visually inspect case lighting retrofits and count T8 lamps present. Work with store staff to identify which case lights have been replaced, if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm the number of 5 ft T12 lamps replaced		T8 lamps		
	Confirm the number of 6 ft T12 lamps replaced		T8 lamps		
	Confirm the number of 8 ft T12 lamps replaced		T8 lamps		
	Confirm that ballasts are electronic	Electronic ballast Magnetic ballast Can't determine Unable to verify		Visual inspection of ballast model number if accessible.  Magnetic Ballast Photo  Electronic Ballast Photo	Option 1: If ballast model numbers are not accessible, a photo can be taken of the lamp with a cell phone to determine ballast type or a ballast checker or flicker checker can be used. Example photos are provided to the right of the two ballast types. Option 2: Look for spare/replacement ballasts in the stock room and determine if they are electronic.
LED Reachin: new	Confirm the linear feet of high power LED lamps (4 to 7.5 Watts/Linear foot) installed in NEW reach-in cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which new cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm the linear feet of low power LED lamps (< 4 watts/linear foot) installed in NEW reach-in cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which new cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
LED Reachin: existing	Confirm the linear feet of high power LED lamps (4 to 7.5 Watts/Linear foot) installed in EXISTING reach-in cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which existing cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm the linear feet of low power LED lamps (< 4 watts/linear foot) installed in EXISTING reach-in cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which existing cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm that existing linear fluorescent lamp ballasts were not used	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of installed LED lamps and ballasts	Review invoices or program documentation.

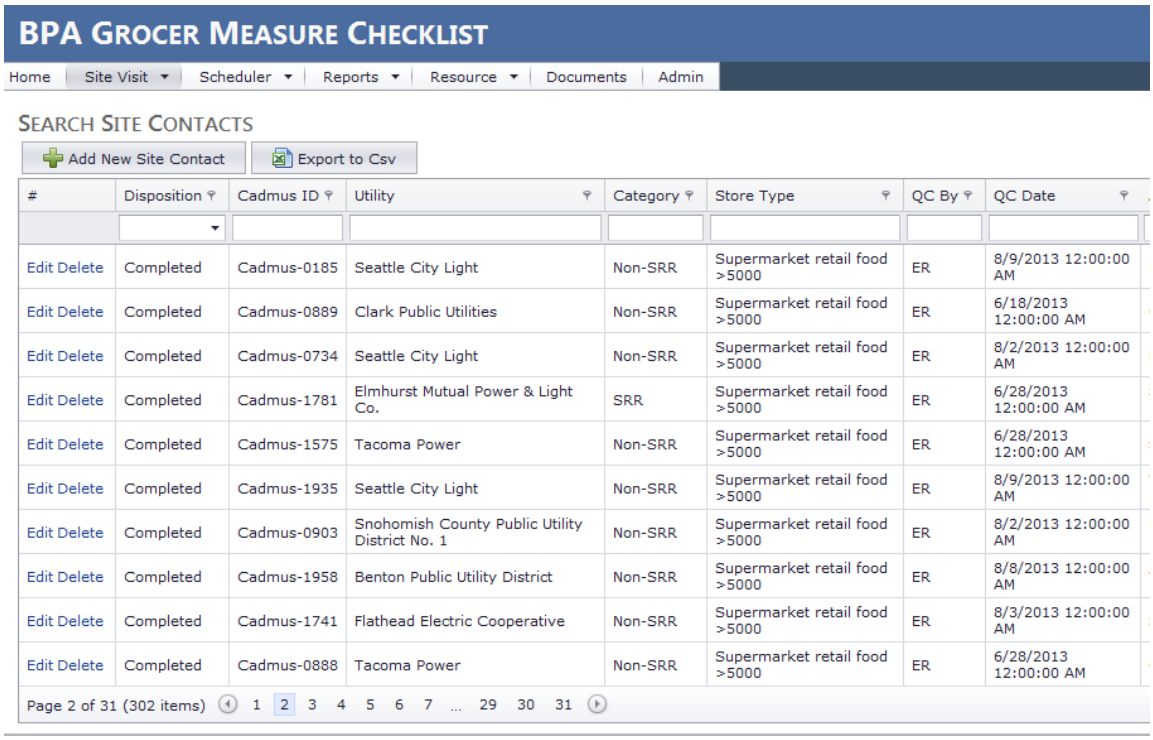
Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
LED Reachin Motion Sensors	Confirm the linear feet of LED lamp controlled by occupancy sensors	<input number>	Linear feet of LED lamp	Visually inspect cases with motion sensors and count linear feet of LED lamp controlled. Work with store staff to identify which cases have LEDs with motion sensors if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm that the motion sensor must reduce lighting load to 20% or less of full load when unoccupied	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	If possible, visually inspect cases when they are in 'unoccupied' mode. Estimate what portion of the lights are turned 'off' during unoccupied load. If 80% or more of the lamps are 'off' during unoccupied mode' the motion sensors comply.	Review motion sensor controls specifications to determine controls programming and if Occ sensor are just ON/OFF or dimming and determine if they meet program requirements. Conversations with store staff may also help to determine actual motion sensor operational characteristics.
LED Open: Existing cases	Confirm the linear feet of high power LED lamps (4 to 7.5 Watts/Linear foot) installed in EXISTING open cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which existing cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm the linear feet of low power LED lamps (< 4 watts/linear foot) installed in EXISTING open cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which existing cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm that existing linear fluorescent lamp ballasts were not used	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of installed LED lamps and ballasts and confirm the fixture is permanently installed.	Review invoices or program documentation.
LED Open: New cases	Confirm the linear feet of high power LED lamps (4 to 7.5 Watts/Linear foot) installed in NEW open cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which new cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm the linear feet of low power LED lamps (< 4 watts/linear foot) installed in NEW open cases	<input number>	Linear feet of LED lamp	Visually inspect case lighting retrofits and count linear feet of LED lamp present. Work with store staff to identify which new cases have LEDs if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm that existing linear fluorescent lamp ballasts were not used	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	Visual inspection of installed LED lamps	Review invoices or program documentation.
Walk-In lighting / CFL's in walk-in coolers or freezers	Confirm the number of CFL retrofit's in walk-in coolers	<input number>	CFL's	Visually inspect walk-in cooler and freezer lighting retrofits and count CFL lamps present. Work with store staff to identify which walk-inlights have been replaced, if it isn't clear from the documentation.	Review invoices or program documentation.

Measure Name	Program Requirement Requiring Verification	Verified condition options	Units	Recommended Verification Method	Alternative Verification Methods
General Store Overhead lighting	Confirm that the number and count of lighting fixtures entered in the lighting calculator match on site conditions	Matches lighting calculator inputs Does not lighting calculator inputs Can't determine Unable to verify	n/a	Count light fixtures by type in the store and determine if type and number of fixtures installed matches the lighting calculator inputs. Where program requirements are not met, provide details on discrepancies in notes.	Review invoices or program documentation.
	Confirm that actual store lighting operating hours matches the lighting calculator inputs	Matches lighting calculator inputs Does not lighting calculator inputs Can't determine Unable to verify	n/a	Review lighting controls system or EMS and obtain schedules. Determine if schedules match the schedules used in the lighting calculator. Where program requirements are not met, provide details on discrepancies in notes.	Conversations with store staff on store lighting operating hours
	Confirm that ballast type and factor installed in the store match the lighting calculator inputs and assumptions	Matches lighting calculator inputs Does not lighting calculator inputs Can't determine Unable to verify	n/a	Visually inspect ballasts if they are accessible to determine the ballast model number fi ballasts are visible without taking apart the fixture. Review project documentation to and invoices to confirm ballast model number, and determine if the ballast factor matches calculator inputs	Look for spare/replacement ballasts in the stock room and obtain model number and ballast factor from the replacement ballasts.
	Confirm that "HVAC system inputs" in the lighting calculator match as-found conditions in the store	Matches lighting calculator inputs Does not lighting calculator inputs Can't determine Unable to verify	n/a	Visually inspect HVAC system documentation tor actual equipment o determine heating fuel type and other lighting calculator HVAC inputs.	Conversations with store staff on heating and cooling equipment and associated fuel-types
CFL: Non-refrigeration applications	Confirm the number of CFL retrofits in non-refrigeration applications	<input number>	CFL's	Visually inspect lighting retrofits and count CFL lamps present. Work with store staff to identify which lamps have been replaced, if it isn't clear from the documentation.	Review invoices or program documentation.
	CFL wattage is 14-28 watts/lamp	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	If lamp wattage can be viewed without disassembling fixture or removing lamp, visually inspect lamps to determine wattage	Review invoices or program documentation
Vending machine controls	Confirm the number of controller installations on Glass Front Beverage Machines	<input number>	controller	Visually inspect vending machines to determine where controls are present. Work with store staff to identify which machines had control retrofits, if it isn't clear from the documentation.	Review invoices or program documentation.
	Confirm the number of controller installations on Large machines w/illuminated front	<input number>	controller	Visually inspect vending machines to determine where controls are present. Work with store staff to identify which machines had control retrofits, if it isn't clear from the documentation.	Review invoices or program documentation
	Confirm that the controller installed includes a passive infrared occupancy sensor to turn off fluorescent lights (illuminated front machines ONLY) and compressor when the surrounding are is unoccupied for 15 minutes or longer. During unoccupied periods, the controls must periodically power up the machine to maintain product temperature.	Meets program requirements Does not meet program requirements Can't determine Unable to verify	n/a	If possible, visually inspect machine when they are in 'unoccupied' mode. Visually confirm that lights turn off, as does compressor.	Review motion sensor controls specifications and controller spec sheet to determine controls programming. Conversations with store staff may also help to determine actual motion sensor operational characteristics.

Appendix C: Final Database Screen Shots

Cadmus developed an online tracking database to compile data collected in the field for each site. Cadmus field staff then used this database during site visits, and entered data during each site visit using iPads. The screen shots below demonstrate the database structure and type of information collected for each site.

Figure B-1. Main User Interface Listing all Stores Requiring Verification



#	Disposition	Cadmus ID	Utility	Category	Store Type	QC By	QC Date
Edit Delete	Completed	Cadmus-0185	Seattle City Light	Non-SRR	Supermarket retail food >5000	ER	8/9/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-0889	Clark Public Utilities	Non-SRR	Supermarket retail food >5000	ER	6/18/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-0734	Seattle City Light	Non-SRR	Supermarket retail food >5000	ER	8/2/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-1781	Elmhurst Mutual Power & Light Co.	SRR	Supermarket retail food >5000	ER	6/28/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-1575	Tacoma Power	Non-SRR	Supermarket retail food >5000	ER	6/28/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-1935	Seattle City Light	Non-SRR	Supermarket retail food >5000	ER	8/9/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-0903	Snohomish County Public Utility District No. 1	Non-SRR	Supermarket retail food >5000	ER	8/2/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-1958	Benton Public Utility District	Non-SRR	Supermarket retail food >5000	ER	8/8/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-1741	Flathead Electric Cooperative	Non-SRR	Supermarket retail food >5000	ER	8/3/2013 12:00:00 AM
Edit Delete	Completed	Cadmus-0888	Tacoma Power	Non-SRR	Supermarket retail food >5000	ER	6/28/2013 12:00:00 AM

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Figure B-2. Store Details for Cadmus-0185 (with three measures requiring verification)

#	Row	Verified ECM Type	Verified Number of ECMs Installed	Reported Number of ECMs Installed
Edit Delete	1	ECM	175.0000	175.0000

Save Previous Next

Figure B-3. Required Verification Parameters for ECM in Cases (measure completed by verifier)