# The Surveys Are In!
# A Comparison of Three Commercial Market Share Data Collection Methods

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## ABSTRACT

Collecting market share information for the commercial sector is valuable for program design. Detailed data, including equipment type and efficiency level, is required to determine market shares and track technology adoption over time. This paper compares three data collection methods used in the 2014 California Commercial Market Share Tracking (CMST) study: end user telephone surveys, end user on-site surveys, and contractor telephone surveys. The analyses focus on nonresidential linear fluorescent lighting and small HVAC units, which were identified as high priority equipment types in the California Strategic Plan. The CMST study found significant differences between on-site and telephone survey data, highlighting the value of on-site surveys, which yield the most granular and accurate data of the three methods. Still, on-site surveys are relatively costly and are only practical for market share tracking when they focus on equipment types with relatively high incidence so that sufficient recent purchases are observed. Self-reported contractor telephone surveys can provide fairly accurate high-level information at a considerably lower cost than on-site surveys, although they do not yield the detailed technology adoption information that can be gathered through on-site surveys. By analyzing the findings of the CMST study and the joint CSS/CMST telephone survey[1], this paper will present a comparison of data quality, relative costs, and potential implementation strategies for the three survey types.

## Introduction

The 2014 California Commercial Market Share Tracking (CMST) study analyzed recent purchases for certain high priority equipment types in the nonresidential sector, including linear fluorescents and small HVAC units, that were purchased and installed in California from 2009-2012. The market share information was used to produce efficiency distributions of recent purchases for the linear fluorescent and cooling markets, with recent purchases defined as equipment purchased since 2009. CMST on-site survey participants were nested within CSS/CMST telephone survey respondents, allowing for direct comparisons between the two surveys. In addition to these extensive efforts, lighting and HVAC contractor telephone surveys produced self-report information on sales and installations of these equipment types in the nonresidential sector in California during 2011-2012 from the supply-side perspective. Combining the CMST study findings from the telephone survey, on-site survey, and contractor surveys, this paper will propose strategies for cost-effective data collection in order to maintain an up-to-date understanding of commercial market trends, design more effective programs, and determine program influence.

[1] The joint telephone survey was an overlapping data collection effort used for both the 2014 California Commercial Saturation Survey (CSS) and Commercial Market Share Tracking (CMST) study.

## Data Collection Methods

The following sections provide a brief overview of each of the three data collection methods employed in the CMST study.

### End User Telephone Survey

The two primary objectives of the joint CSS/CMST telephone survey were to collect a wide variety of information on businesses in the California IOU service territories and to recruit for the CSS and CMST on-site surveys. The telephone survey sample was based on the population of California nonresidential sites in the IOU electric frame. The telephone survey collected information on the customer's firm demographics, environmental consciousness, awareness of energy efficiency programs and current participation in these programs, and the types of lighting, refrigeration, and HVAC equipment currently used at the site. The telephone survey also asked respondents if they have purchased linear fluorescent fixtures and/or air conditioning equipment since 2009 and asked eligible sites to participate in an on-site verification of recent purchases. The CSS/CMST telephone survey was administered from November 2011 to April 2013 and resulted in 7,890 completed surveys.

### End User On-Site Survey

The on-site data collection effort verified recent purchases identified during the telephone survey and collected information on additional recent purchases of these technologies that were not identified during the telephone survey. The CMST on-site sample came from a combination of sites that self-reported during the telephone survey to have purchased eligible equipment since 2009 (CMST sites) and sites that self-reported that they had not purchased any new equipment but were found to have CMST-eligible equipment during the CSS on-site visit (CSS sites). The data collected in the CMST on-site survey includes the quantity of equipment purchased, the self-reported year of purchase, and equipment make and model numbers.

The on-site surveys were an extensive effort and were subject to rigorous controls. Surveyors were trained to identify specific technologies. They had access to a knowledgeable site contact, often a facility manager or site engineer, and asked questions while surveying the site to supplement what was observed. While some on-site information (such as year of installation) relied on self-reporting, the site contact was more likely to be knowledgeable about the equipment than the telephone survey contact because they were identified as such by the phone survey respondent for that site. Telephone survey contacts were identified from a variety of sources and represented diverse roles; therefore, they might be a knowledgeable contact (such as a facility manager or the person who applied for the rebate) or they might be an administrator (such as the business owner, manager, or accountant). Additionally, on-site surveyors recorded and took photographs of equipment make and model numbers, which were subject to a secondary lookup and served to verify manufacturer names, model numbers, system types, and efficiency ratings. The efficiency information enabled the development of efficiency distributions for the high priority equipment types. For these reasons, the on-site data provides the most detail of the three survey methods and, having undergone the most stringent quality controls, is the most reliable data. Therefore, the following analysis compares the end user telephone survey and contractor telephone survey results with the on-site data to test the accuracy of these less costly methods.

The CMST end-user on-site survey was administered from November 2011 to May 2013 and resulted in 568 completed linear fluorescent on-sites and 197 completed HVAC on-sites.

### Contractor Telephone Surveys

The lighting contractor telephone survey and the HVAC contractor telephone survey questioned contractors about the efficiency distribution of their recent sales and installations of linear lighting fixtures and small packaged and split-system single-zone HVAC systems, respectively.

Information from a Dunn and Bradstreet extraction of electrical contractors was used to develop a lighting contractor frame representing the population of lighting contractors in California. Distinguishing lighting contractors from electrical contractors was the first set of screening questions in the survey. The CMST battery of the lighting contractor survey questioned lighting contractors about the share of their sales and installations of linear fixtures associated with T12, standard 700-series T8, standard 800-series T8, high performance T8, reduced wattage T8, T5, and linear LED fixtures. Since the survey gathered market share information from 2011-2012 and the survey was administered in 2013, contractors were also asked if sales and installations of lighting equipment had changed throughout that period. These questions aimed to uncover potential changes in the market share of linear technologies since the implementation of the Department of Energy's General Service Lighting legislation banning the production of T12s.[2]

The HVAC contractor frame was developed from contractors with current C20 licenses. A C20 license from the California Contractor State License Board (CSLB) is a required state license for HVAC contractors that install, maintain, service, and repair HVAC systems in California. The objective of the HVAC contractor survey was to determine the efficiency and distribution of small packaged and split-system air conditioning units (less than 65,000 Btuh) sold and installed from 2011-2012. The CMST battery questioned HVAC contractors about the share of their sales and installations associated with base efficiency and high efficiency units. For this analysis, high efficiency units were broken down into four categories based on SEER rating: 14-14.99 SEER, 15-15.99 SEER, 16-16.99 SEER, and 17 and higher SEER.

The CMST contractor surveys were administered in 2013 and resulted in 95 completed lighting contractor surveys and 123 completed HVAC contractor surveys.

## Results

### End User Telephone Surveys vs. End User On-Site Surveys

The following analyses assess the accuracy of self-reported telephone survey data relative to on-site survey data in regard to recently purchased lighting and HVAC equipment types and efficiencies. The findings from these analyses will help researchers determine if self-reported telephone survey information is sufficiently accurate to be used for some equipment types or end uses and if the degree of inaccuracy in self-reported information is large enough to warrant the added expense associated with on-site data collection.

Two analyses were conducted for each end use: 1) an aggregate incidence analysis of equipment across the entire sample, and 2) a site-level comparison analysis that identifies false positive and false negative reporting for each site. The aggregate incidence analysis weights sample results to the population, while the site-level comparison analysis looks at specific sites and is not weighted.

**Lighting Aggregate Incidence Analysis.** Businesses responding to the telephone survey were asked if they had purchased any lighting equipment since January 2009. Businesses that reported having recently purchased lighting equipment were asked to describe the type of lighting equipment purchased. Businesses that responded that they had recently purchased linear fluorescent fixtures (T5s, T8s, T10s, and T12s), "skinny tubes," or "fat tubes" were later recruited to participate in the CMST on-site verification study. During the on-site verification effort, make and model numbers of the recently purchased linear fluorescent fixtures were collected to better understand the efficiency level of the equipment.

Table 1 presents the aggregate incidence of equipment from the telephone survey and the on-site survey. The on-site survey, conducted by trained surveyors communicating with knowledgeable site contacts, allowed for a greater disaggregation of equipment than the telephone survey. For each efficiency level, the telephone survey share represents the population-weighted number of businesses who self-reported

[2] The Energy Policy Act (EPAct) of 2005 banned the production of T12s for commercial purposes starting in July of 2012.

having recently purchased that equipment relative to all businesses who self-reported having recently purchased linear fixtures; the on-site survey share represents the population-weighted number of businesses where recently purchased equipment of that efficiency level was found on site relative to all businesses where recently purchased linear fixtures were found on site. The aggregate incidence analysis does not analyze the accuracy of any given site's response, but looks at the ability of businesses to correctly respond on average. The analysis uses separate weights for the telephone and on-site surveys.[3] Given that many market share analyses are interested in the incidence of end uses and equipment types, this analysis allows false positives and false negatives to cancel in order to shed light on the aggregate accuracy of telephone survey data relative to on-site survey data.

As seen in Table 1, businesses had some difficulty self-reporting recent lighting purchases at the efficiency level. On average, T12 fixtures were over-reported in the telephone survey compared to the on-site survey. With the production and import of T12s discontinued as of 2012, nonresidential lighting purchasers may still be adjusting to the technology and terminology change. In contrast, businesses under-reported recent purchases of high performance T8 fixtures in the telephone survey. Telephone survey respondents were prompted to identify their recently installed lighting from a list that included "high performance T8" and "T8 fluorescent fixtures." The on-site survey allowed for greater disaggregation of T8 efficiency levels, but high performance T8 shares can be directly compared between the two surveys. T8s are a rapidly evolving technology, with four generations of T8 lamps currently being installed, and businesses may be unfamiliar with the differences between them. When looking at the share of T8 fixtures as a whole (not shown in table), 66% of telephone survey businesses reported recently purchasing T8 fixtures, while 87% of on-site survey businesses had new T8 fixtures, suggesting that telephone survey respondents struggled to identify their recently purchased lighting as T8 irrespective of the bulb generation.

**Table 1.** Aggregate Incidence of Recently Purchased Linear Fixtures by Efficiency Level, Telephone and On-Site Survey Results

| **Telephone Survey Efficiency Level** | **Telephone Survey Percent of Businesses** | **On-Site Survey Percent of Businesses** | **On-Site Survey Efficiency Level** |
|---|---|---|---|
| T12 | 12% | 4% | T12 |
| T8 (Not high performance) | 56% | 58% | T8 (Not high performance) |
| | | *30%* | *Standard 700-series T8* |
| | | *19%* | *Standard 800-series T8* |
| | | *11%* | *Reduced wattage T8* |
| High performance T8 | 11% | 31% | High performance T8 |
| T5 | 11% | 10% | T5 |
| LED | 0.40% | 0.26% | LED |
| ***n*** | **1,264** | **568** | ***n*** |

* The telephone and on-site survey results are weighted by survey-specific site weights. The percent of businesses does not sum to 100% because a site can install linear technologies of multiple efficiency levels over the four year time period. The "Other" categories for each survey have been excluded from the table since they represent different types of lighting and should not be compared between the phone survey and the on-site survey.

[3] The telephone survey site weights were designed to weight up sample points to the number of sites in the nonresidential frame, which represents all California nonresidential customers that had IOU electric accounts in 2010 and 2011. The on-site survey site weights were developed separately for linear fluorescents and cooling equipment and were designed to weight up sample points to the number of sites purchasing equipment in the nonresidential frame.

**Lighting Site-Level Comparison Analysis.** The following site-level comparison analysis looks at the ability of businesses to correctly self-report the types of recently purchased equipment at their facility. This site-level comparison is restricted to those sites that participated in both the telephone and on-site surveys. The analysis compares a site's telephone survey responses with the results of the on-site verification. It identifies sites that reported having recently purchased linear fixtures which were then verified on site. The analysis also identifies sites that reported not having recently purchased linear fixtures, yet recently purchased equipment was observed at the facility during the on-site verification. The results from this analysis provide information on the accuracy of matched telephone and on-site information.

Table 2 presents the site-level comparison of the telephone and on-site survey findings for the presence of recently purchased linear fluorescent fixtures in the facility. The results show that, overall, 75% of sites correctly reported their recent linear fluorescent purchases as verified on site, and that sites were about equally as likely to be correct whether they self-reported having recently purchased linear fluorescent (78%) or they self-reported not having them (74%). The share of sites whose report of having recently purchased linear fluorescent fixtures was contradicted on site (false positive, 22%) is very similar to the share of sites whose report of not having recently purchased linear fluorescent fixtures was contradicted on site (false negative, 26%). However, since more sites reported not having recently purchased linear fluorescent fixtures in the telephone survey, the share of total sites who reported false positives is only 4%, compared to the 21% share of total false negatives. Note that only 239 out of 568 sites (42%) with recently purchased linear fixtures found on site were self-identified on the telephone survey (not shown in table). This implies that it may be misleading to look at the market share of recently purchased linear technologies based only on sites that were self-identified during a telephone survey because the on-site sample would exclude sites that self-reported not having new linear fixtures but that actually have them installed on site. Additionally, an on-site sample based solely on telephone survey sites that self-identified purchasing new equipment would need a considerably larger telephone survey sample in order to get a sufficiently large on-site sample, effectively adding more cost to the telephone survey effort. The error for the 26% of customers who stated that they did not have recently purchased linear fluorescent fixtures and then were found to have them on site may be explained, in part, by purchases made between the time of the telephone survey and the on-site survey. The period between the telephone and on-site surveys for a given site ranged from a few days to more than a year.

**Table 2.** Site-Level Comparison for Recently Purchased Linear Fixtures, Telephone and On-Site Survey Results

| Recently Purchased Linear Fixtures? | Verified On Site | Not Verified On Site | | n |
|---|---|---|---|---|
| | | False Negative | False Positive | |
| Telephone – Yes | 78% | | 22% | 305 |
| Telephone – No | 74% | 26% | | 1,251 |
| **Total** | **75%** | **21%** | **4%** | **1,556** |

Table 3, Table 4, and Table 5 present the site-level comparison of the telephone and on-site survey findings for the presence of new T12, T8, and T5 fixtures, respectively. The overwhelming majority (99%) of telephone survey respondents who reported having no new installations of T12 fixtures were correct based on on-site data. Recently purchased T12 fixtures were found on site at only 16 out of 1,556 total sites and only 1 site correctly reported having recently purchased T12 fixtures during the telephone survey (1 out of 16, or 6%). The distribution of sites with T8 fixtures in Table 4 more closely reflects the distribution of sites with linear fluorescent fixtures in Table 2, with 75% of telephone survey respondents who also participated

in the on-site survey correctly identifying if they did or did not have new T8 fixtures. Only 165 out of 484 sites (34%) where new T8 fixtures were found on site were self-identified in the telephone survey (not shown in table). Table 5 shows that 55% of telephone survey respondents who reported having recently installed T5 fixtures were found to have no new T5 fixtures on site, thus indicating a false positive. Since T5s are a newer technology relative to T12s and T8s, respondents may be less familiar with them, causing the high instance of misreporting. The aggregate incidence analysis shows a similar share of new T5 fixture installations between the telephone survey (11%) and the on-site survey (10%), suggesting that new installations of T5 fixtures can be self-reported fairly accurately. However, the site-level comparison analysis reveals that only 22 out of 92 sites (24%) where new T5 fixtures were found on-site reported having them in the telephone survey (not shown in table).

**Table 3.** Site-Level Comparison for Recently Purchased T12 Fixtures, Telephone and On-Site Survey Results

| Recently Purchased T12 Fixtures? | Verified On Site | Not Verified On Site | | n |
|---|---|---|---|---|
| | | False Negative | False Positive | |
| Telephone – Yes | 8% | | 92% | 13 |
| Telephone – No | 99% | 1% | | 1,543 |
| **Total** | **98%** | **1%** | **1%** | **1,556** |

**Table 4.** Site-Level Comparison for Recently Purchased T8 Fixtures, Telephone and On-Site Survey Results

| Recently Purchased T8 Fixtures? | Verified On Site | Not Verified On Site | | n |
|---|---|---|---|---|
| | | False Negative | False Positive | |
| Telephone – Yes | 72% | | 28% | 228 |
| Telephone – No | 76% | 24% | | 1,328 |
| **Total** | **75%** | **21%** | **4%** | **1,556** |

**Table 5.** Site-Level Comparison for Recently Purchased T5 Fixtures, Telephone and On-Site Survey Results

| Recently Purchased T5 Fixtures? | Verified On Site | Not Verified On Site | | n |
|---|---|---|---|---|
| | | False Negative | False Positive | |
| Telephone – Yes | 45% | | 55% | 49 |
| Telephone – No | 95% | 5% | | 1,507 |
| **Total** | **94%** | **4%** | **2%** | **1,556** |

**HVAC Aggregate Incidence Analysis.** An aggregate incidence analysis was also performed for recent purchases of cooling equipment, as displayed in Table 6. The on-site survey, conducted by trained surveyors communicating with a knowledgeable site contact, allowed for a greater disaggregation of equipment than the telephone survey. The telephone survey shares represent the percentage of businesses who self-reported having recently purchased equipment relative to all businesses who self-reported having

recently purchased cooling equipment, and the on-site survey shares represent the percentage of businesses where recently purchased equipment was found on site relative to all businesses where recently purchased cooling equipment was found on site. Recall that the aggregate incidence analysis uses separate weights for the telephone and on-site surveys.[4] Further, the telephone survey asked about recent purchases of cooling equipment regardless of size, while the on-site survey focused on recent purchases of HVAC systems with a specific cooling capacity threshold. The types of HVAC systems eligible for the CMST on-site survey include packaged and split-system single-zone HVAC systems with DX (direct expansion) cooling less than or equal to 65,000 Btuh cooling capacity and packaged single zone systems with evaporative cooling less than or equal to 65,000 Btuh cooling capacity. On average, businesses that reported purchasing new cooling equipment under-reported the incidence of base efficiency equipment and over-reported the incidence of high efficiency equipment in the telephone survey compared to the on-site survey.

**Table 6.** Aggregate Incidence of Recently Purchased Cooling Equipment by Efficiency Level, Telephone and On-Site Survey Results

| **Telephone Survey Efficiency Level** | **Telephone Survey Percent of Businesses** | **On-Site Survey Percent of Businesses** | **On-Site Survey Efficiency Level** |
|---|---|---|---|
| **Base Efficiency Tiers** | | | |
| Base Efficiency | 21% | 87% | Base Efficiency |
| | | 13% | *< 11 SEER* |
| | | 1.13% | *11-11.99 SEER* |
| | | 1.78% | *12-12.99 SEER* |
| | | 78% | *13-13.99 SEER* |
| **High Efficiency Tiers** | | | |
| High Efficiency | 57% | 18% | High Efficiency |
| | | 7% | *14-14.99 SEER* |
| | | 5% | *15-15.99 SEER* |
| | | 8% | *16-16.99 SEER* |
| | | 3% | *≥ 17 SEER* |
| ***n*** | **1,394** | **198** | ***n*** |

* The telephone and on-site survey results are weighted by survey-specific site weights. The percent of businesses does not sum to 100% because a site can install cooling equipment of multiple efficiency levels over the four year time period. The "Other" categories for each survey have been excluded from the table since they represent different types of equipment and should not be compared between the phone survey and the on-site survey.

**HVAC Site-Level Comparison Analysis.** Table 7 presents the site-level comparison of the telephone and on-site survey results for the presence of recently purchased cooling equipment in the facility using unweighted matched survey data. These data indicate that only 39% of sites that reported having recently purchased cooling equipment during the telephone survey were found to have the equipment on site. Customers were more likely to be correct if they stated that they did not purchase new cooling equipment, with 94% of sites verified to have no new cooling equipment during the on-site survey. The error for the 6% of customers who stated that they did not have recently purchased cooling equipment and then were found to have new equipment on site may be explained, in part, by purchases made between the time of the telephone survey and the on-site survey. The period between the telephone and on-site surveys for a given site ranged

[4] See footnote 5.

from a few days to more than a year. The sites who failed to report their recently purchased cooling equipment during the telephone survey represent a substantial 69 out of 198 (35%) sites with recently purchased equipment found on site (not shown in table). Thus, a representative sample of on-sites should not be based solely on telephone survey self-reporting. Newly purchased cooling equipment was found at only 198 out of 1,556 sites, or 13%.

**Table 7.** Site-Level Comparison for Recently Purchased Cooling Equipment, Telephone and On-Site Survey Results

| Recently Purchased Cooling Equipment? | Verified On Site | Not Verified On Site | | n |
|---|---|---|---|---|
| | | False Negative | False Positive | |
| Telephone – Yes | 39% | | 61% | 329 |
| Telephone – No | 94% | 6% | | 1,227 |
| **Total** | **83%** | **4%** | **13%** | **1,556** |

The data collected as part of the CSS/CMST telephone survey represents the telephone survey contact's best understanding of the equipment their business purchased between 2009 and 2012. Attempting to understanding the efficiency distribution of purchases using self-reported data, however, is hampered by the telephone survey contact's understanding of and ability to remember the technologies installed at their business. Likewise, the CMST on-site data relied on the site contact's ability to recall the installation year of their equipment. However, the site contact was presumably more knowledgeable about the equipment than the telephone survey contact, as they were specifically identified during the telephone survey. Further, the amount of on-site data that relied on self-reporting was minimized since the on-site surveyors directly observed and recorded information such as quantity and model number. For HVAC, only specific technologies under a specific size range qualified for the CMST study, making it even more difficult to identify CMST-eligible equipment from the telephone survey alone. The efficiency distribution of CMST equipment developed from the on-site data was dependent on the make and model lookups, leading to a more accurate picture of the efficiency distribution during this time period than the self-reported telephone survey data. Taken alone, self-reported telephone survey data could misrepresent the recent purchase market for target end uses and equipment types.

### End User On-Site Surveys vs. Contractor Telephone Surveys

The lighting and HVAC contractor telephone surveys and the CMST on-site end user survey each provide information on the distribution of equipment installed in nonresidential facilities in California from 2011 to 2012. Since the CMST on-site survey collected data about equipment purchased after January 2009, these results are presented for equipment installed from 2009-2012 and from 2011-2012 to enable better comparison with the contractor surveys. Note that the results presented in this section represent shares of fixtures, whereas the results presented in the telephone/on-site survey analysis above represent shares of sites (site-level comparison analysis) or weighted businesses (aggregate incidence analysis).

**Lighting Results.** As shown in Table 8, the estimated distributions of base and high efficiency linear lighting fixtures installed from both the contractor and end user surveys are very similar. The contractor survey estimated that 38% of nonresidential linear fixtures sold and installed in California (2011-2012) were base efficiency, while the end user survey estimated that 30% of linear fixtures installed from 2011-2012 were base efficiency. The end user share is 46% if the time period is extended to 2009-2012.

This similarity lends support to the likelihood that the base efficiency share of linear fluorescent fixtures is between 30% and 38% for the time period 2011-2012.

**Table 8.** Efficiency Distributions of Recently Installed Linear Fluorescent Fixtures, Contractor and End User Survey Results

| Efficiency Level | Lighting Contractor Survey, 2011-2012 | End User Survey, 2011-2012 | End User Survey, 2009-2012 |
|---|---|---|---|
| Base Efficiency | 38% | 30% | 46% |
| High Efficiency | 62% | 70% | 54% |
| n | 82 | 246 | 546 |

* The end user results are weighted by site weight. The contractor survey results are weighted by revenue weight.

The base and high efficiency groups can be disaggregated into specific linear technologies. The base efficiency group includes T12, standard 700-series T8, and standard 800-series T8 fixtures. The high efficiency group is disaggregated into high performance T8, reduced wattage T8, T5, and linear LED fixtures. Table 9 shows that there are considerable differences between the estimated efficiency shares for the contractor survey and the end user on-site survey when the base and high efficiency shares are disaggregated into finer efficiency levels.

Standard 700-series T8 fixtures accounted for 10% of self-reported contractor installations and 20% of end-user installations from the on-site data for 2011-2012. Standard 800-series T8 fixtures represented 25% of contractor installations and 9% of end user installations for 2011-2012. The contractor and end user distributions are quite different for these two standard series T8 groups, but they become more similar when the shares are combined: lighting contractors estimate a 35% share, while end user data supports a 29% share for standard series T8 fixtures.

The lighting contractor and end user shares are similar for high performance T8 fixtures, but are dissimilar for the remaining high efficiency technologies. The end user survey estimates a reduced wattage T8 fixture share of 43% for the 2011-2012 period, while the contractor survey estimates 15%. The T5 estimates are also very different, with lighting contractor data indicating a 20% fixture share and end user data indicating a 6% fixture share for the same period. For T5 fixtures, the lighting contractor share and the end user share are statistically significantly different using accepted t-test values.

**Table 9.** Efficiency Distributions of Recently Installed Linear Fluorescent Fixtures by Efficiency Level, Contractor and End User Survey Results

| Efficiency Level | Lighting Contractor Survey, 2011-2012 | End User Survey, 2011-2012 | End User Survey, 2009-2012 |
|---|---|---|---|
| **Base Efficiency Tiers** | | | |
| T12 | 3% | 0.44% | 0.71% |
| Standard 700-series T8 | 10% | 20% | 30% |
| Standard 800-series T8 | 25% | 9% | 15% |
| **High Efficiency Tiers** | | | |
| High performance T8 | 20% | 21% | 25% |
| Reduced wattage T8 | 15% | 43% | 20% |
| T5 | 20% | 6% | 9% |
| LED panel | 5% | | |
| LED | 3% | 0.25% | 0.10% |
| n | 82 | 246 | 546 |

* The end user results are weighted by site weight. The contractor survey results are weighted by revenue weight.

**HVAC Results.** As shown in Table 10, the estimated distributions of base and high efficiency cooling equipment installed from both the contractor and end user surveys are similar. The contractor survey estimated that 78% of nonresidential small air conditioning units sold and installed in California (2011-2012) were base efficiency, while the end user survey estimated that 65% of units installed from 2011-2012 were base efficiency. The end user share increases to 72% if the time period is extended to 2009-2012. These two estimates of the share of base efficiency installations are similar, lending support to the likelihood that the base efficiency share is between 65% and 78% for the 2011-2012 period.

**Table 10.** Efficiency Distributions of Recently Installed Cooling Equipment, Contractor and End User Survey Results

| Efficiency Level | HVAC Contractor Survey, 2011-12 | End User Survey, 2011-2012 | End User Survey, 2009-2012 |
|---|---|---|---|
| Base Efficiency | 78% | 65% | 72% |
| High Efficiency | 22% | 35% | 28% |
| n | 123 | 99 | 192 |

* The end user results are weighted by site weight. The contractor survey results are weighted by revenue weight.

The high efficiency category can be disaggregated into 14-14.99 SEER, 15-15.99 SEER, 16-16.99 SEER, and 17 and higher SEER. Table 11 shows considerable differences between the on-site and contractor surveys when the data is disaggregated into specific efficiency ranges. For 14-14.99 SEER units, contractors reported a share of 14%, while the on-site data indicated only a 6% share for 2009-2012 and 0% for 2011-2012. This stark difference can be seen for all of the high efficiency shares.

**Table 11.** Distributions of Recently Installed High Efficiency Cooling Equipment by Efficiency Level, Contractor and End User Survey Results

| High Efficiency Level | HVAC Contractor Survey, 2011-12 | End User Survey, 2011-2012 | End User Survey, 2009-2012 |
|---|---|---|---|
| 14-14.99 SEER | 14% | 0% | 6% |
| 15-15.99 SEER | 4% | 13% | 10% |
| 16-16.99 SEER | 4% | 17% | 10% |
| ≥ 17 SEER | - | 5% | 2% |
| n | 123 | 99 | 192 |

* The end user results are weighted by site weight. The contractor survey results are weighted by revenue weight.

The CMST study found that, on average, businesses under-reported recent purchases of high efficiency linear fluorescent fixtures during the telephone survey and over-reported recent purchases of high efficiency cooling equipment as compared to on-site data. This may be because HVAC efficiency codes and standards change more rapidly than lighting codes.[5] Additionally, cooling equipment has a longer effective useful life than linear fluorescent lighting. Consequently, when cooling equipment is replaced, the new equipment may be much more efficient than the old equipment, yet may only be up to minimum code requirements (base efficiency). This may explain why site contacts who have recently purchased cooling equipment mistake their base efficiency equipment for high efficiency equipment. One possible solution is to train HVAC contractors to educate customers on the efficiency of their recently installed equipment.

The findings presented above suggest that lighting and HVAC contractor efficiency estimates are more accurate at aggregated levels than they are at the efficiency level. However, it should be noted that differences between the end user and contractor survey results could be attributed, in part, to sampling differences between the two analyses. For example, lighting contractors who participated in this study could have a larger interest in specific business types or a focus on specific technologies, both of which would affect the overall distribution of linear fixture installations that the contractors report. Given the development of the lighting contractor sample frame, the lighting contractor survey does not account for installations made directly by business owners or facility managers.

When reviewing the reliability of these data, both data sources also likely include self-report error. During on-site surveys, site contacts were asked to self-report the year in which new equipment was purchased. During contractor telephone surveys, lighting contractors were asked to self-report their distribution of sales and installations for eight different linear lighting efficiency levels over the previous two years; HVAC contractors were asked to self-report their efficiency distribution of sales and installations for five different efficiency levels (base plus four high efficiency levels) over the previous two years. While it is reasonable to assume that contractors estimate these shares to their best ability, it is unlikely that they examined their actual sales data during the telephone survey. Asking contractors to disaggregate their sales into several different efficiency levels may lead to increased error, leading to reliable base and high efficiency estimates but less reliable efficiency-specific shares. In contrast, the make and model lookups implemented for the on-site data support the conclusion that the distribution of new lighting and cooling equipment found on-site is accurately classified into specific efficiency levels.

In summary, self-reported data from contractors can provide an accurate depiction of high level information (base versus high efficiency), but detailed sales or on-site information is needed to better estimate efficiency-specific distributions.

[5] Recall that T12s have been in production since the 1930s and were only effectively banned in 2012. See footnote 4.

## Conclusions

There are advantages and disadvantages for each of the three commercial market share data collection methods discussed. While telephone surveys do not provide the most complete and accurate picture of the market, they are relatively inexpensive to implement and are a useful tool for determining on-site survey eligibility and recruitment. On-site surveys performed by trained surveyors and regulated by rigorous quality controls yield a unique set of highly detailed and reliable data that is necessary for informing the current distribution of recent installations within the nonresidential market by specific domains of interest, such as customer size, business type, and program participation. The ability to disaggregate the efficiency distribution by these characteristics provides interested parties with an understanding of market shares, baselines, standard practices, potential spillover, and enhanced program design. However, on-site surveys are relatively costly and are only practical for market share tracking when they focus on equipment types with relatively high incidence so that sufficient recent purchases are observed. Contractor telephone surveys are a cost-effective alternative to frequent on-site survey efforts for collecting high-level information on commercial markets such as lighting and HVAC. Although contractor surveys do not yield the detailed technology adoption information that can be gathered through on-site surveys, they may be used to obtain quicker feedback on market trends, target lower incidence equipment types, and garner supply-side knowledge of equipment and programs. The speed of change within the nonresidential linear lighting market necessitates frequent data collection to help maintain an up-to-date understanding of the current market trends. While small HVAC units within the nonresidential sector are also a high priority equipment type, the high share of base efficiency sales found in the CMST study indicates that this market is not currently as dynamic as the nonresidential linear lighting market. Therefore, contractor surveys may provide valuable updates to on-site survey data when implemented every one to three years for lighting contractors and every two to four years for HVAC contractors. These findings may inform cost-effective data collection strategies in order to maintain an up-to-date understanding of commercial market trends, design more effective programs, and determine program influence.

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