MA C&I Incentivized Share of High-Efficiency Equipment Final Memorandum

Memo to:	From:
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Team and Energy Efficiency Advisory Council EM&V	**Team**
Consultants	**Date:** July 23, 2017

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Assessment of the Incentivized Share of High-Efficiency Equipment

To develop estimates of the incentivized share of high efficiency equipment purchases, the study team (Itron and DNV GL) merged data collected during the Massachusetts Commercial and Industrial (C&I) On-site Assessments (P41) and the Market Share and Sales Trends Study (P50) (collectively P41/P50)[1] with the 2011 to 2014 upstream and non-upstream PA-sponsored energy efficiency program tracking data. These data were used to develop estimates of the quantity of certain types of equipment purchased by Massachusetts businesses from 2011 to 2014, the number of rebate-eligible high-efficiency purchases of that same equipment, and the number of rebate-eligible equipment purchases receiving rebates. Identifying the recent installations that are rebate-eligible and the share of rebate-eligible purchases that received a rebate, can help to describe the size of rebate-eligible market and the share of the high efficiency market that is captured by the 2011 through 2014 PA-sponsored programs. This information could help the PAs know which customer segments are purchasing high efficiency equipment, the types of high efficiency equipment being purchased, where barriers to high efficiency purchases remain, and provide insights into where the PA-sponsored programs are associated with a large or small share of the high efficiency purchases.

Given the data available from the P41/P50 study, the analysis of the incentivized share of high-efficiency equipment focused on high efficiency lighting including CFLs, LEDS, and tubular LEDs,[2] stand-alone cooling,[3] chillers, stand-alone heating,[4] boilers, water heating, and energy management systems (EMS). This analysis, however, encountered numerous data challenges that led to a high degree of uncertainty for many of the study findings.

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1 DNV GL, MA C&I Market Characterization On-Site Assessments and Market Share and Sales Trends Study, 2016.

2 The analysis initially included linear fluorescents. The high degree of uncertainty surrounding the efficiency status of T8 lamps led to the early removal of linear fluorescents from the analysis.

3 Stand-alone cooling included multiple types of cooling rebated by PAs including air-cooled heat pumps, air-cooled unitary AC and split systems, evaporatively-cooled air conditioning systems, water source heat pumps, variable refrigerant flow multi-split air conditioning and ductless heat pumps.

4 Stand-alone heating included furnaces with ECM motors, condensing unit heaters, and infrared heaters.

The high degree of data uncertainty associated with this research has led the analysis team, the MA PAs, and the EEAC evaluation consultants to conclude that the data used for the incentivized share analysis are insufficient to accurately estimate the incentivized share of high efficiency equipment within the MA C&I sector. The analysis led to the following data findings:

- From 2011 to 2014, MA C&I customers purchased a high share of stand-alone cooling that met or exceeded the MA PA-sponsored energy efficiency requirements,
- More than 1,000,000 Tubular LEDs are estimated to have been installed from 2011 to 2014,
- MA C&I customers reduced their purchases of CFLs and increased their purchases of LED bulbs from 2011 to 2014.

Future attempts to combine data across multiple projects should take care to review the data adequacy prior to conducting any substantial analysis. Given the high level of uncertainty, this memorandum describes the data challenges, reliable findings, and takeaways from the analysis.

Data Challenges

The nature of the tracking data and the P41 on-site data contributed to the data challenges.

Challenges for the incentivized share analysis associated with the tracking data include the following:

- Limited measure description,
- Unreliable quantity information, and
- Lack of customer account numbers in the upstream tracking data.

The tracking data often provided limited information or description of both custom and non-custom rebated equipment. Tracking data measure descriptions were necessary, within this study, to help match the equipment that received a rebate to the new, high efficiency equipment observed during the on-site data collection. The non-custom measure data often included a limited description of the equipment. For some measures, the equipment description was sufficient, while for others, it was lacking key information like system types and capacities necessary to help with matching. Custom measures provided the least information on measure description. While it is often possible to gather the necessary measure level information for custom projects from custom application back-up materials kept in tracking databases, the additional budget necessary for custom application review was not included in the study plan.

For stand-alone air conditioning measures, the tracking data does not designate a quantity unit. The tracking data appear to record quantity for stand-alone cooling in tons of cooling capacity or equipment units but there is no way to identify when the different units of quantity are applied.   Tracking data for Custom measures also lacks quantity information, though these data are available at the application detail level. The limited measure descriptions and questionable quantity information made it difficult to

determine if the tracking data equipment information that was merged to the P41 on-site data were consistent with the equipment found on-site.

The upstream program tracking data includes information on the participant's name and address but does not include the customer account numbers. For the purposes of this study, it is likely that the merge of the upstream data with the P41 on-site data led to an under count of the number of customers and measures receiving rebates. The challenges of merging the upstream data with the P41 data limited confidence in the study's representation of the number of rebate-eligible equipment receiving rebates.

It is likely that all three tracking data challenges contribute to concerns that the incentivized share estimates developed during this study are systematically biased low.[5]

Challenges with developing estimates of the incentivized share from the P41 on-site data include the following:

- Self-report data and on-site sampling,
- Difficulty determining equipment efficiency, and
- Sample size limitations and weighting concerns.

During the P41 data collection, the field staff asked the site contact for the age of the observed equipment. Self-report data, however, are subject to error leading to the potential under or over identification of measures purchased from 2011 to 2014. During the data collection, the field staffs' time on-site was limited and access to some areas of the building may have been restricted. Both issues contributed to uncertainty associated with on-site sampling of equipment. For sites, which required sampling due to their size, the field staff provided information on the share of each type of equipment observed and site weights were adjusted to accommodate sampling. This approach, however, may have limited the accuracy of the recording of newly purchased equipment. For example, if the recently purchased equipment were in the unobserved portion of the facility, the recently purchased equipment may have not been recorded during the on-site data collection.

During the P41 on-site data collection, the field staff was instructed to collect nameplate or efficiency information from equipment. Efficiency and nameplate information, however, is sometimes incomplete. The location or position of the equipment may have limited the ability to record nameplate data. In addition, the make and model lookups were not always able to determine equipment efficiency. For these reasons, the efficiency of some newly purchased equipment is unknown. The on-site sampling

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[5] It is likely that tracking data issues are largest for equipment included in the upstream programs. The upstream lighting program incentivized LED lamps in 2012 to 2014. No upstream CFL lamps were observed in the upstream program from 2011 to 2014. Tubular LEDs were not in the upstream program during the 2011 to 2014 time-period. Stand-alone cooling equipment was included in the upstream program in 2013 and 2014, but very few items received upstream incentives in 2013.

and the missing efficiency information contributed to a systematic undercount of the number of recently purchased rebate-eligible pieces of equipment.

The P41 on-site data included equipment stock and recent purchase information from 800 non-residential customers in Massachusetts. The P61 study analysed recent purchases (2011 to 2014) of high-efficiency equipment. Focusing on recent purchases of high-efficiency equipment within the 800 facilities substantially reduces the number of sites and the quantity of equipment included in the P61 study relative to the P41 study. For example, the P41 study found 1,434 stand-alone heating units of which 175 were new stand-alone units, but only 3 units met the input capacity requirement to be considered rebate-eligible. The substantial reduction in the number of units from 1,434 units in P41 to 3 in P61 leads to concerns associated with representativeness of the data and the likelihood that it is not appropriate to draw conclusions concerning the incentivized share when only 3 high efficiency units were observed. Sample sizes of less than 30 matched incentivized pieces of equipment were observed in the analysis of chillers, stand-alone heating, boilers, and water heating.

The final concern surrounding the P61 data is the study's reliance on the P41 site weights. The P41 weights were developed to weight the 800 non-residential customers to the Massachusetts non-residential electric customers. The P41 sample design was based on the non-residential electric frame and the weights were designed to enable these 800 customers to represent the electric frame. It is possible that these weights do not lead to good population estimates of the incentivized share of high efficiency natural gas boilers, water heaters, or stand-alone heating which are all natural gas measures. The different distribution of natural gas customers by business type and customer electricity usage size may lead the electric weights to misrepresent the natural gas frame. Concerns about sample size and weighting lead to an increase in the uncertainty associated with the study findings, demonstrated by large volatility when comparing weighted vs. unweighted estimates for certain kinds of equipment.

Data Findings

Given the data uncertainties discussed above, many of the study findings were deemed unreliable. Select data, however, were found to be credible and should be considered when planning programs.

- Efficiency analysis of the P41/P50 data found that 50% of stand-alone cooling purchased from 2011 to 2014 were rebate eligible. Massachusetts businesses are often buying stand-alone cooling equipment that exceed federal energy efficiency standards and meet or exceed the efficiency requirements of the PA-sponsored programs.

- o During the 2011 to 2014 program period many of the stand-alone cooling equipment were eligible for either a Tier 1 or a Tier 2 rebate,[6] depending on the equipment's efficiency. Continuing to encourage Massachusetts businesses to purchase higher efficiency through the availability of larger rebates for Tier 2 equipment may help Massachusetts businesses continue to lead the market for cooling equipment.
  - o The estimated incentivized share of stand-alone cooling, while displaying a high level of uncertainty, implied that most rebate eligible equipment is installed without an incentive.
  - o The first year with substantial upstream rebate activity for stand-alone cooling was 2014. The limited period of the upstream program for stand-alone cooling reduces the uncertainty of the program tracking to P41/P50 match and the estimated incentivized share.
  - o The program tracking data does imply, however, a substantial increase in rebated stand-alone cooling associated with the upstream program. The increased activity may lead to a higher rebated share of stand-alone cooling in the future.
- The P41/P50 data lead to the estimate that nearly 1,000,000 tubular LEDs were installed during 2011 to 2014. Tubular LEDs were not generally included in the upstream or non-upstream prescriptive programs from 2011 to 2014. While a small share of these lamps may have received incentives under the custom program, it is likely that most of these lamps were installed without a rebate.
- The P41/P50 data imply that substantially more A lamp screw-in LEDs than CFLs were installed from 2011 to 2014 in Massachusetts businesses. These data clearly show that Massachusetts businesses are rapidly adopting the newer LED technology.

Study Takeaways

This study clearly illustrates the difficulty of trying to match equipment across two datasets developed for different purposes. Both sets of data are valuable and informative, but each set of data contains data challenges that contributed to the high degree of uncertainty associated with this study. In the future, care should be taken when attempting to combine data developed to satisfy other objectives. A better understanding of the initial data challenges may have been warranted at the initiation of this study.

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[6] The Mass Save C&I Upstream HVAC/HP 2014 Tier 1 incentives required that a split AC with less than 65 kBtuh be at least 14 SEER & 12 EER and a packaged AC be at least 14 SEER & 11.6 EER. The Tier 2 requirements for these two measures were at least 15 SEER & 12.5 EER and 15 SEER and 12 EER, respectively. For units 65 to 240 kBtuh the Tier 1 requirements were 11.5 EER while Tier 2 were 12 EER.