

MEMORANDUM

To: Massachusetts Program Administrators and Energy Efficiency Advisory Council
From: Michael Strom, Chris Russell, Lisa Wilson-Wright, and Lynn Hoefgen, NMR Group, Inc.
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Subject: Massachusetts Residential Lighting Cross-Sector Sales Research
Date: March 24, 2015

The goal of the cross-sector lighting sales research was to review evaluations conducted in other jurisdictions on commercial purchases from lighting programs targeting the residential sector, and in turn to produce a recommended “placeholder” value on the proportion of these program lighting purchases that Massachusetts (MA) customers install in commercial settings. That number is intended to be useful for the PAs for near-term planning.

In this memo we discuss our methodology, the reports that were included in the background research, and how we came to our recommended placeholder value of residentially-targeted program bulb purchases installed in commercial settings.

METHODOLOGY

Secondary research into applicable studies formed the basis of the current methodology. The Team reviewed 23 evaluation reports, each of which touched on the topic of cross-sector sales—namely, the installation rates of residentially-targeted program light bulbs into commercial applications. The Team was interested not only in studies that evaluated this cross-sector topic area, but also the extent to which those results could be applied to MA. The team assessed applicability to MA according to a variety of factors, including the program size and design, incentive type, bulb types supported, regional differences, and the time period and approach of the evaluation. To that end, the Team endeavored to prioritize those studies that would potentially prove most relevant to the MA-focused commercial allocation placeholder.

The Team also considered the various biases brought about by the different means of assessing cross-sector sales, and the implications of such biases for the eventual commercial allocation estimates. We touch on this area in more detail in the Biases and Threats to Validity section.

BACKGROUND RESEARCH

The basis for the current research was a review of 23 evaluation reports. These reports spanned four different study types:

- Store intercept studies
- Residential phone surveys

- Residential and nonresidential onsite surveys, and
- A small business phone survey.

Table 1 lists these studies and also includes information on the client undertaking the evaluation, the state in which the evaluation was conducted, a description of the study and program type, and the dates in which the results were published and applied.

Table 1: Background Research Studies

Client	State	Program	Study Type	Publish Date	Applied Time Period
CPUC	CA	Residential Lighting Program	Residential Phone Survey, Store Intercept Study, and Residential and Nonresidential Onsite	2/8/2010	2006-2008
Ameren IL	IL	Residential Lighting Program	Store Intercept Study	1/1/2014	2013
ComEd	IL	Residential ENERGY STAR Lighting Program	Store Intercept Study	3/6/2014	2013
EmPOWER	MD	Residential Lighting and Appliance Program	Store Intercept Study	3/8/2012	2011
Efficiency Maine	ME	Residential Lighting Program	Residential Phone Survey	11/1/2012	2011
Efficiency Maine	ME	Residential Lighting Program	Residential Phone Survey	Forthcoming	2013
Consumer's Energy	MI	ENERGY STAR Residential Lighting Program	Residential Phone Survey	5/7/2014	2013
Midwest Utility	MO	Upstream Lighting Program	Store Intercept Study	3/24/2011	2010
Midwest Utility	MO	Upstream Lighting Program	Store Intercept Study	6/10/2014	2013
Duke Energy	NC	Energy Efficient Lighting Program	Store Intercept Study	7/12/2013	2011 & 2012
Dayton Power & Light	OH	Residential Lighting Program	Residential Phone Survey	5/11/2012	2011
MetEd	PA	Residential Lighting Program	Residential Phone Survey	11/17/2014	2013
PECO	PA	Smart Lighting Discounts Program	Store Intercept Study	7/15/2013	2011
PPL	PA	Residential Lighting Program	Small Business Phone Survey	11/15/2013	2013
Focus on Energy	WI	Residential Lighting and Appliance Program	Store Intercept Study	5/1/2014	2012

As shown in Table 1, the studies for which we obtained results applicable to the present research spanned a number of different regions and ten states. They also represent a fairly wide time span (2006 through 2014).

Of particular importance to the present research was not only discerning the study design, time period, and region, but also the allocation of residentially-targeted program bulbs into commercial settings estimated from each study. The final column in Table 2 below cites this estimate of commercially allocated program bulbs from each of the background studies. The table arranges these estimates from a low of 0% (in which residential phone survey respondents in Maine and bulb purchasers surveyed at retail stores in California indicated not installing any bulbs in business/commercial settings) to a high of almost 19%, estimated from a residential phone survey in the Southern California Edison program territory of California.

Table 2: Commercial Allocation across All Studies

Client	State	Program	Study Type	% Commercial Allocation (Precision)*	Publish Date
SDG&E	CA	Residential Lighting Program	Store Intercept Study	0.0%	2/8/2010
Efficiency Maine	ME	Residential Lighting Program	Residential Phone Survey	0.0% (+/-4.4%)	Under Revision
Midwest Utility	MO	Upstream Lighting Program	Store Intercept Study	3.0%	3/24/2011
ComEd	IL	Residential ENERGY STAR Lighting Program	Store Intercept Study	3.0%	3/6/2014
Ameren IL	IL	Residential Lighting Program	Store Intercept Study	3.0%	1/1/2014
Efficiency Maine	ME	Residential Lighting Program	Residential Phone Survey	4.0%	1/1/2012
Consumer's Energy	MI	ENERGY STAR Residential Lighting Program	Residential Phone Survey	4.7%	5/7/2014
SDG&E	CA	Residential Lighting Program	Residential & Nonres Onsite Survey	4.8%	2/8/2010
MetEd	PA	Residential Lighting Program	Residential Phone Survey	4.9%	11/17/2014
EmPOWER	MD	Residential Lighting and Appliance Program	Store Intercept Study	5.2%	3/8/2012
SCE	CA	Residential Lighting Program	Store Intercept Study	6.0%	2/8/2010
SCE	CA	Residential Lighting Program	Residential & Nonres Onsite Survey	6.0%	2/8/2010
PG&E	CA	Residential Lighting Program	Residential & Nonres Onsite Survey	6.1%	2/8/2010
PG&E	CA	Residential Lighting Program	Store Intercept Study	6.5%	2/8/2010
Focus on Energy	WI	Residential Lighting and Appliance Program	Store Intercept Study	7.1%	5/1/2014
SDG&E	CA	Residential Lighting Program	Residential Phone Survey	8.3%	2/8/2010
PG&E	CA	Residential Lighting Program	Residential Phone Survey	8.4%	2/8/2010
Duke Energy	NC	Energy Efficient Lighting Program	Store Intercept Study	10.0%	7/12/2013
Midwest Utility	MO	Upstream Lighting Program	Store Intercept Study	11.0% (+/-1.4%)	6/10/2014
Dayton Power & Light	OH	Residential Lighting Program	Residential Phone Survey	5.0%	5/11/2012
PECO	PA	Smart Lighting Discounts Program	Store Intercept Study	12.2% (+/-4.5%)	7/15/2013
PPL	PA	Residential Lighting Program	Small Business Phone Survey	17.1% (+/-4.7%)	11/15/2013
SCE	CA	Residential Lighting Program	Residential Phone Survey	18.7%	2/8/2010

* Precision around the estimate shown in parentheses, when available.

After considering the commercial allocations across all studies, the Team was interested in determining whether these estimates showed differences depending on the study design. Table 3 presents the average commercial allocation by study type (store intercept, residential phone survey, residential and nonresidential onsite survey, and small business phone survey). The most common study type (11 of the 23 studies) across the reviewed literature was the store intercept survey, in which recent light bulb purchasers are queried immediately after their purchase in the retail store. In this way the evaluators could be certain they were speaking with a relevant respondent (i.e., a bulb purchaser). Next most frequent (eight of 23 studies) was the residential phone survey, in which respondents from the applicable program administrator service territory respond to questions about potential recent purchases (and often general lighting knowledge and usage questions). The Team also reviewed three onsite survey studies. Across these three study designs, the average commercial allocation only varied from 5.6% from the onsite studies to 6.8% for the residential phone surveys. The only study conducted utilizing a small business phone survey had a higher estimate of commercial allocations, at roughly 17%.

Table 3: Commercial Allocation across Studies by Study Type

Study Type	# of Studies	Average Commercial Allocation
Store Intercept Survey	11	6.1%
Residential Phone Survey	8	6.8%
Residential and Nonresidential Onsite Survey	3	5.6%
Small Business Phone Survey	1	17.1%
Overall	23	6.7%

The Team also examined the studies based on the similarity of the evaluated program to the MA lighting program. In doing so the Team considered program aspects including the size of the program (service territory and number of incandescent bulbs), incentive type (upstream, downstream, coupon, direct install, etc.), bulb types supported (MA has focused on incandescent standard CFLs, specialty CFLs and LEDs), and potential regional differences. The programs considered most similar to MA were those that were large in terms of the lighting budget, service territory and number of incandescent bulbs, and that focused on supporting a variety of efficient bulb types (not only standard CFLs). The Team did not place the same degree of emphasis on the region of the country in which the evaluation was conducted, as all regions considered would demonstrate demographic differences from MA. Table 4 displays the commercial allocation of program bulbs between those programs more and less similar to MA, and the two types do not display substantially different estimates of cross-sector sales.

Table 4: Commercial Allocation by Similarity to MA Program

Study Type	# of Studies	Average Commercial Allocation
More Similar to MA	14	6.6%
Less Similar to MA	9	7.0%

BIASES AND THREATS TO VALIDITY

While the studies considered for the present research certainly shed light on the percentage of bulbs sold through light bulb programs that are installed in commercial applications, one must also weigh the inherent biases present in all the various study methods. The Team presents applicable pros and cons of each design in Table 5 below.

Cadmus has provided evidence that commercial allocation estimates from both store intercept and residential phone surveys are likely to underestimate the true percentage of program bulbs being used commercially. They point out that residential phone surveys rely on the probability that at least some of the respondents who are contacted own or manage businesses, and are also the parties responsible for purchasing lighting for those businesses.¹ Yet, sample sizes are usually too small to reach a reasonable number of respondents who are responsible for business lighting purchases—observe the 0% commercial sales figure from the Efficiency Maine survey (Table 2).

Also highlighted in the Cadmus evaluation are the often unintentionally biased results brought on by the design and implementation of telephone surveys with residential customers. Of particular note is that customer recall of purchases and purchase timing are not reliable with small-ticket items. An additional drawback of telephone surveys is identifying the reported purchases as program bulbs or not; this is achieved by making a number of assumptions and assigning a bulb as program or non-program based on whether they were purchased at a certain store, time, or price point—or a combination of all three—and such reports can also be susceptible to recall error.

Store intercept surveys have an advantage over telephone surveys in this regard, by reaching customers when bulb purchases are fresh in their minds. The survey administrator can check the actual bulbs the customer is purchasing to establish whether they were program bulbs.² The most notable drawback to store intercept surveys is the difficulty of getting the store manager (or their corporate offices) to agree to let the survey administrator into the store. This lack of store access often leads to abbreviated sales channel representation and limited information on overall program success. Also, due to the nature of data gathering, the store intercepts are likely to occur only at very specific dates and times (which may or may not be the times that commercial businesses shop). The design of such studies, then, can also lead to small and under-representative samples.

To avoid the pitfall of not catching business owners in residential surveys or underrepresenting store variation, in the small business survey report for PPL Cadmus utilized the small business telephone survey to estimate the number of small business lighting purchases that were program bulbs. Cadmus estimated that 17% of PPL's program-discounted CFLs were being purchased for use in commercial

¹ The Cadmus Group Inc. Nov. 2013. *Final Annual Report to the Pennsylvania Public Utility Commission for the Period June 2012 through May 2013 Program Year 4 For Pennsylvania Act 129 or 2008 Energy Efficiency and Conservation Plan* prepared for Pennsylvania Public Utility Commission

² Many store intercept surveys do not limit calculations to program bulbs, however. They often consider all CFLs purchased and determine which types of applications they are going into. This allows for a larger sample, and assumes that cross-sector sales between program and non-program bulbs are comparable.

applications. This method involves less potential lighting purchaser and store inclusion bias but it is an anomalous number when compared to the 22 other studies under review. It also relies on respondent self-reporting and is likely to suffer from the same biases encountered in residential customer self-reported estimates. This method also has the problem of assuming that the bulbs identified during the survey meet a set of assumptions about whether the reported bulbs are program bulbs, introducing the opportunity for miscounts and errors into the study.

NMR and others have also argued that when assessing concepts such as recent lighting purchases and types of bulbs currently in use, onsite saturation studies conducted by lighting experts are substantially more reliable than telephone surveys with customers, who are often confused by the variety of lighting options available and have difficulty accurately recalling the number of bulbs they had purchased in a given time period.³ However, the drawbacks of onsite lighting studies include limited sample sizes with associated high sampling error, unknown non-response bias, relatively high costs, and the intrusive nature of the effort. Determining whether the observed bulb is a program bulb is dependent on post-observation matching of model number, which can be time consuming and introduces another opportunity for error. Even so, onsite evaluation may be the best option available because a technician can document what lighting is in the business or home, and—while identifying the time and place of purchase still depends on respondent self-reporting—it is based on particular bulbs in particular sockets, unlike telephone surveys. Given the inherent issues of limited sample size and non-response bias associated with onsite evaluations (which may be amplified for a measure as narrow as cross-sector sales), combining an onsite study with some type of commercial telephone survey could be ideal.

³ NMR. 2010. *The Market for CFLs in Massachusetts*: Delivered to the PAs January 28, 2010.

Table 5: Pros and Cons of Reviewed Commercial Allocation Study Types

Study Type	Pros	Cons	Cost	Accuracy and Representativeness
Phone Survey	Can be done quickly and on a large scale	Dependent on consumer recall of purchases and their timing, place, and price, which has been shown to be faulty	Low	Low
Residential Phone Survey	Access to a large sample of lighting consumers	Sample would have to be extremely large to ensure that we are capturing business purchasers.	Low	Low
Small Business Phone Survey	Access to a large sample of small businesses	Gathering data on business who utilize program bulbs does not give a representation of how all bulb purchases are utilized	Moderate	Low
Store Intercept Survey	Speak to bulb purchasers when their recall is precise	Permission from retailers is hard to get and leads to a limited representation of sales outlets. With few purchasers for commercial applications and likely a smaller % purchasers vs. number of bulbs purchased for commercial applications, the sample size required to find and estimate the % of bulbs in commercial applications would need to be very high – which is costly	Moderate	Program Dependent ⁴
Nonresidential On-site Survey	Data collection by trained on-site technicians increases likelihood that bulb data will be gathered accurately	The sample size will often be small due to budget constraints and reports of time, place, and price of purchase are still dependent on consumer recall. Bulb data also has to be matched to find out which models are program models and this could be difficult or introduce error. Further, businesses often have a greater variety of sources for obtaining bulbs and could use a mix of sources over time, including lighting contractors and/or other small contractors. The business owner or contact might be unaware of where the contractors made the lighting purchases	High	Medium

⁴ The representativeness of store intercept surveys depends in large part on the type of stores and channels a particular program sells its bulbs through. For programs dominated by a few big box stores the representativeness can be high, since those are the stores where intercepts can be conducted (pending retailer approval). For states that have shifted sales away from big box stores, like MA, representativeness would be low to moderate. In such instances, the cost would be very high to achieve accuracy and representativeness for commercial applications.

RECOMMENDED ESTIMATE OF RESIDENTIAL LIGHTING PROGRAM BULBS FOUND IN COMMERCIAL SETTING

The Team recommends using a placeholder of 7% to be applied to the Massachusetts upstream lighting program sales as an indicator of those used in commercial settings. The 7% figure is the overall rounded average of all the studies considered in the review. All the studies under review included some form of bias, but by allowing all of the studies to have equal weight in the recommended average we minimize the per-study bias.

The Team recognizes that MA's actual cross-sector sales figure may differ from the recommended 7% figure and that to estimate a more accurate number MA would have to conduct primary research. We recommend that if MA does continue this investigation, they should do so in a manner that reduces bias as much as possible. Major sources of bias include inaccurate consumer recall, lack of population (small business) targeting or sample size, identifying bulbs as program bulbs based on assumptions or methods that only relate to residential applications, and underrepresenting certain types of sales outlets.