Opinion Dynamics

Boston | Headquarters

617 492 1400 tel
617 497 7944 fax
800 966 1254 toll free

1000 Winter St
Waltham, MA 02451

Memorandum

To: Fernando Morales, Ameren Illinois Company; Jennifer Morris, Illinois Commerce Commission

From: Opinion Dynamics Evaluation Team

Date: September 5, 2019

Re: Updated AIC Standard Core and Small Business Direct Install Net-to-Gross Ratios

Introduction

In 2018, the evaluation team conducted research with Standard Core and Small Business Direct Install (SBDI) participants to update the net-to gross ratios (NTGRs) for equipment types available through these offerings for application in 2020. We developed the NTGRs using self-reported information from computer-assisted web interviewing (CAWI) surveys with program participants. The evaluation team also conducted follow-up telephone interviews with survey respondents to inform spillover analysis. We used both participant survey and follow-up telephone interview responses to develop estimates of free-ridership (FR) and participant spillover (PSO). This memo presents NTGRs for the following offerings: Standard Lighting for Business (SLB); Heating, Ventilation, and Air Conditioning (HVAC); Leak Survey and Repair; and Small Business Direct Install (SBDI).

Summary of NTG Results

Table 1 summarizes the results of our Standard Core and SBDI NTGR analyses. Notably, the evaluation team conducted research for equipment offered through the Standard Core and SBDI offerings, however, due to low survey response rates and low participation in several offerings, we limit our NTGR recommendations to the SLB, HVAC, LSR, and SBDI offerings. The evaluation team plans to conduct additional research during the next year to supplement our data and allow for reliable estimates of NTGRs for other Standard Core offerings such as Specialty Equipment (SE), Variable Frequency Drives (VFD), and Steam Trap Repair/Replacement (STRR).

Table 1. Updated Standard Electric and Gas NTGRs from 2018 Research

Offering	Number of Responses (n)[a]	Free-Ridership (FR)	Participant Spillover (PSO)[b]	NTGR (1-FR+PSO)
Standard Core Offerings				
Standard Lighting for Business Electric	81	17.4%	1.3%	83.9%
HVAC Electric	5	31.7%	0.0%	68.3%
HVAC Gas	12	57.4%	0.0%	42.6%
Leak Survey and Repair Electric	2	15.1%	0.0%	84.9%
SBDI Offering Electric	127	9.4%	0.2%	90.8%

[a] The number of respondents included in the Standard Lighting for Business NTGR analysis (n = 81) differs from the actual number of respondents who completed the survey reported in Table 2 (n = 88) as some respondents were excluded from the analysis because they could not verify the installation of lighting equipment.
[b] None of the HVAC or Leak Survey and Repair respondents reported any PSO; hence, PSO is 0 for HVAC and Leak Survey and Repair.

Data Collection and Sampling Methodology

Standard Core

The evaluation team fielded CAWI surveys with customers who participated in the Core offerings in 2018. The survey focused on installation verification, satisfaction with program processes, and attribution (free-ridership and spillover). The sample of Core participant projects came from the September 2018 extract of the AMPLIFY database we received.

As in previous evaluations, we sampled by project contact, rather than by project, because many customers completed more than one project in 2018. These customers generally submitted the same contact name for each of the different projects. To reduce respondent burden and to facilitate question wording, we asked each contact about only one project. Note that we also dropped contacts for whom no valid email was available (since this was a web survey) and contacts with staffing grant and retro-commissioning projects.[1] The evaluation team formed a sample frame of 633 unique customer contacts for the Standard Core survey.

If a contact had more than one project with the same end use (e.g., HVAC), we typically chose one of their projects randomly. The only exceptions were contacts who installed multiple lighting projects; in such cases, we asked the contact about the lighting project with the largest savings. If a contact had projects with different end uses (including lighting), we asked about the rarest type of non-lighting project. For example, if the program database contained only five steam trap projects compared to 20 HVAC projects, steam trap projects were prioritized. This approach was intended to ensure that our sample would include a sufficient number of low-incidence non-lighting projects to support development of NTGRs for different equipment types.

We attempted a census of contacts with both lighting and non-lighting projects. Table 2 presents the population values, sample frame information, and completed survey information for the Standard Core and SBDI offerings that support this NTGR research. As the table shows, there were a small number of completes compared to the population of Specialty Equipment, VFD, and Steam Trap Repair/Replacement projects. This limited our ability to develop NTGRs for these equipment types.

[1] Given the limited sample sizes for efforts to evaluate these Custom offerings, the evaluation team excluded these participants from the Core Standard survey sample and instead included them in the samples of these other offerings.

Table 2. Standard Core Offerings - Data Supporting 2018 NTGR Research

Offering	Number of Survey Completes (*n*)	In Sample	Number of Projects in Population	% of Projects Covered in Survey	% of Electric Savings Covered in Survey	% of Gas Savings Covered in Survey
Standard Lighting for Business	88	534	768	11.5%	12.4%	-
HVAC	14	55	76	18.4%	29.5%	30.0%
Specialty Equipment	5	18	50	10.0%	10.4%	0.0%
VFD	3	11	14	21.4%	6.0%	-
Steam Trap Repair/Replacement	4	13	19	21.1%	-	19.3%
Leak Survey and Repair	2	2	3	100%	100%	-

SBDI

Similar to Standard Core, the evaluation team also conducted a web survey with customers who participated in the SBDI offering in 2018, attempting a census of unique contacts. The SBDI survey also focused on installation verification, satisfaction with program processes, and attribution (free-ridership and spillover). We developed the sample frame based on an extract of the participant database as of September 2018. The data extract included 1,398 unique SBDI projects. We dropped projects without a valid email address and removed duplicate contact names, resulting in a total of 570 projects in our sample frame (see Table 4).

Table 3. SBDI Offering - Data Supporting 2018 NTGR Research

Offering	Number of Survey Completes (*n*)	In Sample	Number of Projects in Population	% of Projects Covered in Survey	% of Electric Savings Covered in Survey
SBDI	127	570	1,398	9.1%	6%

NTGR Overview

Net impact evaluation is generally described in terms of determining program attribution. Program attribution accounts for the portion of gross energy savings associated with a program-supported measure or behavior change that would not have been realized in the absence of the program. The share of program-induced savings, indicated as a NTGR, is made up of FR and PSO. FR is the portion of the program-achieved verified gross savings that would have been realized absent the program and its interventions. PSO occurs when participants take additional energy-saving actions that are influenced by the program interventions but did not receive program support.

The formula to calculate the NTGR is:

$$NTGR = 1 - FR + PSO$$

The Illinois evaluation teams have worked with the Illinois Commerce Commission (ICC) and the Illinois Stakeholder Advisory Group (SAG) to create a standard Illinois Statewide NTG approach for use in Illinois energy efficiency evaluation, measurement, and verification work. Per the NTG Methods attachment to the

Illinois TRM,[2] all NTG data collection and analysis activities for program types covered by the attachment that began after January 1, 2019 must conform to the statewide NTGR methods. While data collection occurred in 2018, our survey covered all inputs required by TRM version 7.0. Therefore, this evaluation conforms with the requirement of Version 7 of the TRM.

Free-Ridership (FR)

Methodology

Free-riders are program participants who would have installed the same energy-efficiency measure(s) or taken the same energy-saving actions without program support. FR estimates are based on a series of questions that explore the influence of the program on participants' purchasing decisions as well as actions the participant likely would have taken had the program not been available.

As prescribed by the Core Non-Residential Protocol in the NTG Methods attachment, we implemented two FR algorithms for Core projects and one FR algorithm for SBDI projects.[3] The algorithms consist of three scores: (1) influence of program components (PC) score, (2) overall program influence (PI) score,[4] and (3) no-program (NP) score (counterfactual), as well as a timing adjustment. Each sub-score serves as a separate estimator of FR and can take on a value of 0 to 1, where a higher score means a higher level of FR. The overall free-ridership score for a project is the average of the three scores, combined with a timing adjustment. Depending on the algorithm, the timing adjustment is applied to either the no-program score component or the preliminary overall FR score (average of the three sub-scores). The FR score for each project thus ranges from 0 (no FR) to 1 (100% FR).

The three scores included in the algorithms, their variations, and the timing adjustment are described below.

1. **Influence of Program Components.** This score is based on a series of questions that ask respondents to rate the importance of program and non-program components in their decision to install the energy-efficient equipment, using a scale of 0 to 10 (where 0 is "Not at all important" and 10 is "Very important").

   Program Components considered include such items as the availability of the incentive, information from program marketing materials, a recommendation from program staff, and previous program experience. Non-Program Components considered include business standard practice and corporate policy. Other components, such as payback period and previous experience with incented equipment, could qualify as either program or non-program components based on responses to follow-up questions included in the survey. We estimate the Program Components score as follows:

Equation 1. Program Components Score

$$PC\ Score = 1 - \left(\frac{PF_{max}}{10}\right)$$

[2] Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 7.0. Volume 4: Cross-Cutting Measures and Attachments. Dated: September 28, 2018. Effective: January 1, 2019.

[3] In this memo, we present results from two specifications of FR for the Core offering (both versions of Algorithm 1 and Algorithm 2) and one specification of FR for the SBDI offering (Algorithm 1). For each offering, we select one algorithm as our choice to calculate program free-ridership and justify our choice of algorithm.

[4] Notably, for SBDI, the PI Score may be dropped from the FR algorithm to reduce respondent burden. Source: Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 7.0. Volume 4: Cross-Cutting Measures and Attachments. Dated: September 28, 2018. Effective: January 1, 2019.

where:

- PF_{max} is the highest score given to a program factor.

Greater importance of the program components means a lower level of FR. In this approach, if a respondent rated the program rebate 10 out of 10, the recommendation of program staff 8 out of 10, and the information from program materials 8 out of 10, PF_{max} would be 10 and the PC score would be 0.

2. **Program Influence.** This score is based on a survey question asking the respondent to rate the importance of the program compared to the importance of other factors in their decision to implement the energy-efficient equipment. To do so, respondents were asked to divide 100 points between the program and other, non-program factors. This score is estimated as:

Equation 2. Program Influence Score

$$PI\ Score = 1 - \left(\frac{Points\ Given\ to\ Program}{100}\right)$$

More points allocated to the program means a lower level of FR. For example, if a respondent gave the program 70 points out of 100, the PI score would be 0.30.

3. **No-Program Score.** This score is based on the likelihood that the exact same energy-efficient equipment would have been installed without the program, using scale of 0 to 10 (where 0 is "Not at all likely" and 10 is "Very likely") and is calculated as follows:

Equation 3. No-Program Score

$$NP\ Score = 1 - \left(\frac{Likelihood\ to\ Install\ Same\ Equipment}{10}\right)$$

A greater likelihood of participating without the program means a higher level of FR. For example, if the participant provides a likelihood rating of 7 to install the same equipment in the absence of the program, their NP FR score would be a 0.70.

In the first FR algorithm for Core, and the FR algorithm used for the SBDI offering, the NP score incorporates a timing adjustment (discussed next) as follows:

$$NP\ Score\ Adjusted = \left(\frac{Likelihood\ to\ Install\ Same\ Equipment}{10}\right) * Timing\ Adjustment$$

4. **Program Timing Adjustment.** There are two ways to calculate the program timing adjustment in accordance with the NTG Methods attachment, and they incorporate information from one or two survey questions.

- The first question asks (1) whether the installation would have occurred at the same time without the program; and (2) if the installation would have occurred later, how much later.
- The second question asks the respondent to provide a likelihood, on a 0 to 10-point numeric scale, of installing the same energy efficient equipment within 12 months of when it was actually installed.

The two timing adjustments are referred to as Timing Adjustment 1 and Timing Adjustment 2 and are described below.

Timing Adjustment 1

Timing Adjustment 1 uses only the first question. In this adjustment, later purchases without the program means a lower level of FR. This adjustment is calculated on a 0 to 1 scale. A timing adjustment of 1 means that there is no evidence that the program changed the time frame in which the project would have occurred, while a lower value of the timing adjustment means that the program caused the project to occur sooner. The timing adjustment provides the program with some credit for accelerating the project. Timing Adjustment 1 is calculated as follows:

$$\text{Timing Adjustment 1} = 1 - (\text{Number of Months Expedited} - 6) / 42$$

Timing Adjustment 1 is used in the first specification of the Core algorithm and in the SBDI algorithm. It is multiplied by the No-Program FR score.

Timing Adjustment 2

Timing Adjustment 2 uses both timing adjustment questions. In this adjustment, later purchases without the program means a lower level of FR, but the likelihood of implementing within a certain timeframe without the program is also taken into account. Like Timing Adjustment 1, this adjustment is calculated on a 0 to 1 scale, and a timing adjustment of 1 means that there is no evidence that the program changed the time frame in which the project would have occurred. A lower value of the timing adjustment means that the program caused the project to occur sooner. Timing Adjustment 2 is calculated as follows:

$$\text{Timing Adjustment 2} = 1 - ((\text{Number of Months Expedited} - 6) / 42) * (10 - \text{Likelihood of Implementing within 1 Year}) / 10))$$

Timing Adjustment 2 is used in the second specification of the Core algorithm and is multiplied by the average of the Program Components (PC), Program Influence (PI), and No-Program (NP) scores. It is not used in the SBDI algorithm.

This evaluation implemented and analyzed the following two FR algorithms.

- **Algorithm 1:** (PC Score + PI Score + [NP Score * Timing Adjustment 1]) / 3
- **Algorithm 2:** (PC Score + PI Score + NP Score) / 3) * Timing Adjustment 2

In the first algorithm, the NP score is adjusted by Timing Adjustment 1 and then an average of the PC score, the PI score, and the adjusted NP scores is calculated. In the second algorithm, the average of the PC, PI, and NP scores are taken, and this average is adjusted by Timing Adjustment 2. Table 4 summarizes the differences between the two FR algorithm and which algorithms were implemented for the analyses of the Core and SBDI offerings.

Table 4. Free-Ridership Algorithm Specifications

Free-Ridership	Variant Used					Algorithm Implemented	
Algorithm Specification	Program Component Score	Program Influence Score	No-Program Score	Adjusted No-Program Score	Overall Timing Adjustment	Core Offering	SBDI Offering
Algorithm 1	✓	✓		✓		✓	✓
Algorithm 2	✓	✓	✓		✓	✓	

We used Cronbach's alpha as a tool to help us evaluate the different algorithm specifications for the SLB and HVAC offerings, as it is a tool that examines the consistency of tests that measure the same construct.[5] As each of the three scores incorporated into the final FR estimate serves as a separate estimate of FR, we used Cronbach's alpha to examine the internal consistency of the three scores for each specification, working from the basis that a higher degree of internal consistency is desirable for the algorithm. We also examined and compared FR results across algorithms.

Core Results

Figure 1 presents FR estimates for the Core Standard SLB and HVAC offerings for the two FR algorithms discussed above. The figure also shows the associated Cronbach's alphas. The evaluation team selected Algorithm 2 as our specification for both Standard Lighting and Business HVAC. These are circled in the figure below. We based this decision on a couple of factors:

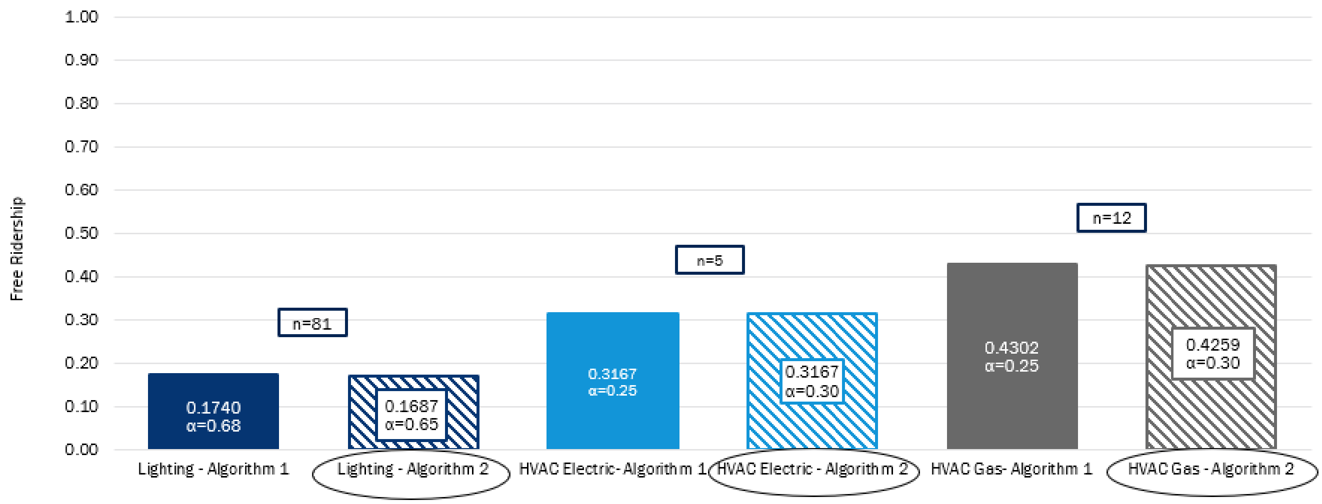
- First, a general rule of thumb is that a Cronbach's alpha of 0.7 or higher indicates an acceptable level of internal consistency.[6] As can be seen, the alpha values for both algorithms approach this threshold for the lighting equipment type.
- Second, our professional judgement is that Algorithm 2's mathematical application of the timing adjustment is the most conceptually valid.

As we attempted a census of all participants for this evaluation, there are no error bounds around our estimates of the NTGRs for Core SLB and HVAC.

[5] Because there were so few Leak Survey and Repair projects (and hence survey completes) in 2018, the evaluation team did not calculate Cronbach's alpha to assess the algorithm specifications for FR for this equipment type. The team instead relied upon the algorithm most consistent with the one selected for the SLB and HVAC end uses.

[6] In measuring any underlying construct (intelligence, program influence, etc.), if you increase the number of items or questions, you increase Cronbach's alpha. Researchers in other fields, such as sociology or psychology, often rely on a battery of 10 or more questions. However, due to a number of factors such as respondent fatigue, we typically are able to ask about three to four key NTGR questions. Thus, simply due to the relatively small number of NTGR questions, our alphas are more likely to be smaller than those reported in other fields. As a result, the normal thresholds for alpha (e.g., 0.70) that are typically based on larger batteries of questions might not apply.

Figure 1. 2018 Core Standard Lighting for Business and HVAC FR and Cronbach's Alphas by Algorithm



To maintain consistency, we also used Algorithm 2 for the Leak Survey and Repair FR estimate (15.1%, n=2).

SBDI Results

Using Algorithm 1 as outlined above, the FR estimate for the SBDI Program is 9.4% (n=127).

Participant Spillover

Methodology

Participant Spillover (PSO) refers to the installation of energy-efficient measures by program participants who were influenced by the program but did not receive an incentive. An example of PSO is a customer who installed incented equipment in one facility and, as a result of the positive experience, installs additional equipment at another facility but does not request an incentive (outside PSO). In addition, the participant may install additional equipment, without an incentive, at the same facility because of the program (inside PSO).

We examined both inside and outside PSO in projects from the Standard Lighting for Business and SBDI offerings using participant responses to the CAWI surveys and follow-up telephone interviews. We conducted an engineering analysis of participant responses to determine the savings associated with measures identified as SO.

After calculating the PSO savings reported by participants in our sample, we used Equation 4 to develop the program PSO rate.

Equation 4. Participant Spillover Rate

$$PSO\ Rate = \frac{Total\ Net\ PSO\ Savings_{Participant\ Sample}}{Total\ Ex\ Post\ Gross\ Program\ Savings_{Participant\ Sample}}$$

Core and SBDI Results

Table 5 presents the results of the PSO analysis for Standard Lighting for Business and SBDI, as these were the only cases where spillover was detected. Notably, none of the Core participants who responded to the survey reported any PSO for HVAC or Leak Survey and Repair. As such, there is no PSO for HVAC or for Leak Survey and Repair.

Table 5. 2018 Core SLB and SBDI SO Results

Initiative	Ex Post Gross Savings		Participant Spillover	
	MWh	MW	MWh	MW
Standard Lighting for Business	62.63	0.01	1.3%	0.8%
SBDI	5.78	0.00	0.2%	0.1%