

## Memorandum

**To:** Jonathon Jackson (Ameren Illinois Company) and Jennifer Morris (Illinois Commerce Commission)  
**From:** Jane Colby, Sara Wist, Alex Chamberlain, and David Tripamer (Cadmus)  
**Date:** August 14, 2018  
**Re:** Residential Nonparticipant Customer Survey Results

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Ameren Illinois Company (AIC) is in its tenth year of efficiency program operation and conducts general marketing and education in addition to providing incentives for specific equipment upgrades. Over time, this marketing and education can create spillover in the general population. For the Program Year 9 (PY9) evaluation, the evaluation team surveyed a sample of AIC nonparticipating customers to identify and quantify nonparticipant spillover (NPSO) that may be resulting from its programs and marketing. We also utilized the survey to collect other customer feedback on program awareness, and attitudes toward energy efficiency. The evaluation team's technical staff contacted customers that indicated possible NPSO savings to confirm the necessary details that would allow us to quantify NPSO attributable to the program. This memo summarizes our methods and findings. The survey instrument is included as Appendix A.

### Key Findings

The evaluation team used the Illinois TRM Version 5.0 (IL-TRM V5.0) protocol to calculate NPSO savings which resulted in savings of 3,867 MWh (3.1% of PY9 residential portfolio net electricity savings) and 94,525 therms (4.4% of PY9 residential portfolio net gas savings). In comparison, PY8's NPSO savings were zero using the same IL-TRM V5.0 calculation protocol. In both years we conducted sensitivity analysis to determine spillover savings if the respondents program importance threshold was 5.0 as specified in the updated IL-TRM V6.0, rather than 7.0, specified by IL-TRM V5.0. For PY8, the sensitivity analysis resulted in 2,208 MWh of NPSO savings and for PY9, 11,878 MWh and 94,525 therms (note the therms savings did not change in the sensitivity analysis). NPSO is reported as a percentage of net savings because the savings is MWh and therms are compared to the sum of the residential portfolio savings; the Behavior Modification program is only evaluated in terms of net savings and therefore the portfolio sum can only be computed for net savings. As such, when applying NPSO to future programs, it should be applied to the net savings and not simply added to the NTGR.

In addition to another year of marketing and education, the increase in spillover savings could be due to a change in the survey question. In past years, we asked an open-ended question about whether customers installed additional energy efficiency measures that were not incented by the program. In PY9 we listed possible measures and asked customers whether they had installed any of the measures or taken any of the actions in the list. In PY9, the evaluation team found 72 customers who were aware of AIC's energy efficiency programs and reportedly installed a measure. In PY7 and PY8, the corresponding number of customers were 15 and 17. In all years, we further qualified the potential NPSO according to the IL-TRM V5.0 which resulted in fewer actual NPSO measures. This memo provides further detail of our analysis.

The rest of our survey analysis showed previous trends mostly continuing. Overall satisfaction in PY9 has continued to rise since PY7 and PY8, and the proportion of respondents that take an energy savings action

such as turning off the lighting or appliances when not in use, using efficiency light bulbs, or using a programmable thermostat greatly increased since PY7 and PY8 (differences were statistically significant).

## Survey Methodology

In November 2017, the evaluation team conducted telephone surveys with 350 nonparticipating residential AIC customers. Nonparticipants are customers who did not participate in an AIC program or receive a home energy report through the Behavioral Modification Program in the past three years. The survey objectives were to:

- Gauge customer awareness of AIC energy efficiency programs
- Assess customer satisfaction with AIC
- Explore customers’ energy efficiency awareness, attitudes, and actions
- Identify potential spillover measures

The evaluation team called nonparticipants from a sample frame of 4,999 customers randomly chosen from the entire nonparticipant population.<sup>1</sup> We called customers from the sample frame until we reached 350 completes. On average, we called each customer approximately five times. Table 1 provides the survey dispositions.

**Table 1. Residential Nonparticipant Survey Dispositions**

Disposition	Input <sup>a</sup>	Total
Complete interview	I	350
Eligible incomplete interview	N	81
Survey-ineligible household	X1	273
Not an eligible household	X2	1,090
Household with undetermined survey eligibility	U1	2,991
Undetermined if eligible household	U2	214
<b>Total Participants Dialed in Sample</b>	<b>N/A</b>	<b>4,999</b>

<sup>a</sup> Inputs are for American Association for Public Opinion Research (AAPOR) response and cooperation rates detailed below.

The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample. We calculated the response rate using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).<sup>2</sup> We chose to use AAPOR Response

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<sup>1</sup> AIC provided the evaluation team with its residential customer database. The evaluation team removed customers who had participated in an AIC energy efficiency program during the previous three years to determine the nonparticipant population to draw the survey sample.

<sup>2</sup> American Association for Public Opinion Research. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*. Pp. 62 and 63. Revised 2016. Available online: [https://www.aapor.org/AAPOR\\_Main/media/publications/Standard-Definitions20169theditionfinal.pdf](https://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf).

Rate 3 (RR3) for all AIC program evaluations because we are often unable to determine the eligibility of all sample units through the survey process. We use a 2-level version of RR3 including an estimate of eligibility for these unknown sample units. We present the formula used to calculate RR3 below:

$$RR3 = \frac{I}{(I + N) + e1(I1 + e2 * U2)} \tag{1}$$

$$e1 = \frac{I + N}{(I + N + X1)} \tag{2}$$

$$e2 = \frac{I + N + X1 + U1}{(I + N + X1 + U1 + X2)} \tag{3}$$

We also calculated a cooperation rate, which is the number of completed interviews divided by the total number of eligible sample units actually contacted. In essence, the cooperation rate gives the percentage of respondents who completed an interview out of all of the respondents with whom we actually spoke. We used AAPOR Cooperation Rate 3 (COOP3), which is calculated as:

$$COOP3 = \frac{I}{((I + P) + R)} \tag{4}$$

Where:

P = Partial interview

R = Refusal

Table 2 provides the PY9 response and cooperation rates, in comparison with the PY8 rates.

**Table 2. Residential Nonparticipant Survey Response and Cooperation Rates**

AAPOR Rate	PY8 Percentage	PY9 Percentage
Response Rate (RR3)	7.4%	14.8%
Cooperation Rate (COOP1)	26%	34.0%

Due to the relatively low response rates, we analyzed the difference in average annual energy use between respondents and non-respondents to assess for possible bias. As shown in Table 3, average annual energy use is very similar between respondents and non-respondents (1.3% difference).

**Table 3. Average Yearly Usage Comparison of Non-Respondents and Respondents**

Period	Average kWh of Non-respondents (n=4,860) <sup>a</sup>	Average kWh of Respondents (n=295) <sup>a</sup>
One year (09/16 – 08/17)	821.17	831.88

<sup>a</sup> Includes accounts with missing data in one or more months

Both the respondents and non-respondent accounts include some missing data – 449 monthly data points out of the 4,860 non-respondent accounts and 23 from the 295 respondent accounts; on average respondents were missing 1.6% fewer monthly data points as a share of total than non-respondents.

Therefore, we conclude there is no systematic bias relative to average energy consumption between survey respondents and non-respondents.

## NPSO Methodology

The survey contained several questions to identify potential spillover measures. Specifically, the survey asked respondents if they were aware that AIC offers energy efficiency programs or rebates, whether they installed improvements that did not receive a rebate, and if so, what was installed and how do they know it is energy efficient. The survey then asked respondents specific questions about the influence that this awareness had on their decision to install such measures. The evaluation team attempted to contact all customers identified with possible spillover to verify specific measure information that the survey missed or if the data collected were contradictory or confusing. In all, the evaluation team called 10 customers for a follow-up and received five responses (after calling each of the 10 customers three times). If we were not able to get any follow-up information, we relied on the survey data and made conservative measure assumptions about unit size and efficiency levels.

The evaluation team applied an approach consistent with the IL-TRM V5.0 to estimate NPSO savings. In general, to receive credit for NPSO savings, a nonparticipant who installed efficient equipment must meet the following requirements:

- Be familiar with AIC's energy efficiency program
- Indicate that some aspect of the program motivated their purchasing decision (Attribution Score 1)
- Indicate that they would not have installed the measure if they had not known about energy efficiency from AIC or its programs (Attribution Score 2)

The formula to determine the Spillover Score (per the IL-TRM V5.0) is:

$$\text{Spillover Score} = (\text{Attribution Score 1} + (10 - \text{Attribution Score 2}))/2.$$

The IL-TRM V5.0 defines Attribution Score 1 as, "The influence level (on a scale of 0 to 10, where 10 is extremely influential and 0 is not at all influential) the Program Administrator had on the decision to purchase the measure."<sup>3</sup> Attribution Score 2 is, "the likelihood (on a scale of 0 to 10, where 10 is highly likely and 0 is not at all likely) that the customer would have installed the measure had they not been influenced by the program."<sup>4</sup> In order to have savings attributed to AIC, a respondent's Spillover Score must be greater than 7.0.

Table 4 shows an example of how electric or gas savings from NPSO is calculated. Column F shows the average savings per surveyed customer, determined by dividing the total allocated savings (sum of column E) by the number of completed surveys.

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<sup>3</sup> Illinois Energy Efficiency Stakeholder Advisory Group. *Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 5.0, Volume 4: Cross-Cutting Measures and Attachments*. Section 4.1.4. December 2016. Available online: [http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Version\\_5/Final/IL-TRM\\_Effective\\_060116\\_v5.0\\_Vol\\_4\\_X-Cutting\\_Measures\\_and\\_Attach.021116\\_Final.pdf](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final/IL-TRM_Effective_060116_v5.0_Vol_4_X-Cutting_Measures_and_Attach.021116_Final.pdf)

<sup>4</sup> *Ibid.*

**Table 4. Estimation of Respondents' Nonparticipant Spillover Savings**

A	B	C	D	E	F
Spillover Measure	Spillover Score	Measure Savings (kWh or Therms)	Allocated Savings	Total Savings	Average Savings Per Surveyed Customer
Measure 1	Scale of 0 to 10	Savings 1	100% if [B] > 7.0 0% if [B] ≤ 7.0	[C] * [D]	N/A
Measure 2	Scale of 0 to 10	Savings 2		[C] * [D]	
Measure N	Scale of 0 to 10	Savings N		[C] * [D]	
				Sum of column E = Total kWh Savings	Total kWh Savings / Number of Completed Surveys

Table 5 provides the calculation methodology for estimating the total NPSO. The approach calls for extrapolating savings from the survey population to the entire nonparticipating residential customer population to estimate overall NPSO in kWh or therms. NPSO is converted into a percentage of net savings by dividing by the sum of the program savings for the total portfolio. Because the Behavior Modification Program savings are calculated only on a net basis, the final NPSO percentage should be applied to the net portfolio savings rather than gross savings.

**Table 5. Calculation Methodology of Total Nonparticipant Spillover Generated**

Variable	Description	Source/Calculation
F	Average kWh Energy Savings per Surveyed Customer	Survey data and impact evaluation
J	Total Nonparticipant Residential Population	Customer database
K	NPSO MWh Energy Savings Extrapolated to Nonparticipant Population	[F * J] / 1,000 kWh/MWh
S	Total Evaluated Net MWh Savings <sup>5</sup>	PY9 Individual Residential Reports
G	NPSO as Percentage of Total Evaluated Savings	K / S

## Detailed Results

This section of the memo provides the detailed results of our NPSO analysis followed by an analysis of each of the other topics covered in the nonparticipant survey—Awareness of Efficiency Programs, Satisfaction with AIC, and Respondent Characteristics.

<sup>5</sup> For PY9, residential portfolio savings can only be computed at the net savings level because the Behavior Modification program is evaluated in net savings only. As such, NPSO must be computed from portfolio net savings rather than added to the NTGR.

## NPSO Analysis

The first step in the spillover analysis was to screen out survey respondents who were not aware that AIC implements energy efficiency programs. Of the 350 respondents, 113 answered said that they were aware that AIC implements energy efficiency programs.<sup>6</sup> While not used in the NPSO analysis, if respondents answered no, they were then read a list of AIC's energy efficiency programs and asked if they recognized any of them.<sup>7</sup> All responses to the second question were "yes."

Of the 113 respondents that were aware AIC implemented energy efficiency programs, 72 reported installing an energy efficient measure and 52 (of the 113 respondents) reported taking one of four energy savings steps: adjusting a thermostat, scheduling a home audit, or recycling a refrigerator or a freezer.<sup>8</sup> This is greater than PY7 or PY8 when respondents that were aware of an AIC program and reported installing a measure numbered 15 and 17 respectively.<sup>9</sup> In PY9, we changed the survey guide to remind respondents of possible measures and it is possible that this question rewording improved customer recall of their actions.

The evaluation team eliminated the measure "adjusting a thermostat to save energy" due to the uncertainty around savings persistence, after trying unsuccessfully to reach those making it past the other spillover criteria, which eliminated 41 of the 52 reportedly taking energy savings actions. Of the 72 respondents possible measure installations, we asked those with measures of varying efficiency levels<sup>10</sup> the same question from previous years "How do you know that this equipment is energy efficient?" Based on responses to this question, 37 possible spillover measures remained.

After these questions, the survey asked those respondents with remaining possible spillover measures the spillover scoring questions (A12-A14 or A17-A19):

- On a 0-10 scale, with 0 being not at all important and 10 being extremely important, how important was [program attribute] in your decision to install the measure (or take the energy efficient action)
- If you did not have the [program attribute] how likely is it that you would have installed the equipment? Please use a 0 to 10 scale where 0 means you definitely WOULD NOT have made the installation (taken the energy efficient action) and 10 means you definitely WOULD have made the installation (taken the energy efficient action) without the information from the program.

Measures that passed the above criteria were asked additional questions to gather measure-specific data to calculate savings. Seven respondents had a spillover score greater than 7.0 in PY9. However, two of these were dropped:

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<sup>6</sup> Survey Question A4: "Before today, were you aware that Ameren Illinois offers rebates and discounts for energy-saving equipment and home improvements?"

<sup>7</sup> Survey Question A6: "Do any of the following rebates or incentives sound familiar to you?"

<sup>8</sup> See survey questions A8 for the installed measures and survey question A15 for the energy savings steps.

<sup>9</sup> Note that in PY7, PY8, and PY9 lighting measures were excluded from spillover savings

<sup>10</sup> Question A9—note however that this question was not asked for all reported measure installations. The survey assumes that insulation measures, smart thermostats, solar panels, etc. are inherently efficient. The question is meant for measures that have multiple efficiency levels (only some of which are efficient).

- One customer installed water heating measures but was eliminated because they had a propane water heater
- One customer said they had a home audit and installed new lighting measures and window insulation. We do not count lighting savings because of the upstream program and savings around window insulation are difficult to verify with engineering equations. Moreover, we were unable to reach this customer in follow-up calls.

In PY7, one respondent met the spillover threshold<sup>11</sup> and zero respondents met the spillover threshold in PY8. Table 6 shows the measures, spillover scores, and savings for each customer.

**Table 6. Spillover Score Calculations for Eligible Customers**

Customer	Measure	Spillover Score	kWh	Therms
1	Water Heater Tank Wrap	10	-	5.70
1	Refrigerator Replacement	10	54.46	-
2	Programmable Thermostat	9	720.01	-
2	Efficient Windows	10	12.06	-
3	Variable Speed Pool pump	7.5	827.70	-
4	Efficient Windows	10	24.81	8.45
5	Programmable Thermostat	7.5	56.76	61.69
<b>Total Savings</b>			<b>1,695.78</b>	<b>75.84</b>

Some customers installed more than one measure; the evaluation team calculated each spillover score at the measure level, so savings were estimated for each measure meeting the spillover criteria. Savings calculations and assumptions are found in Appendix B.

Table 7 shows the total spillover MWh and therms savings.

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<sup>11</sup> Note that in PY7, the spillover methodology did not include attribution score 2 (which is the counterfactual).

**Table 7. Calculating NPSO From IL-TRM V5.0 Threshold**

Variable	Description	MWh	Therms
F	Average Energy Savings per Surveyed Customer	1.6958 MWh/350 customers = 0.0048 MWh/customer	75.84 therms/350 customers = 0.22 therms/customer
J	Total Nonparticipant Residential Population*	798,146	436,223
K	NPSO Savings Extrapolated to Population	3,867	94,525
S	Total Evaluated Net Energy Savings **	130,824	2,577,693
G	NPSO as Percentage of PY9 Total Evaluated Net Savings	3%	4%

\* Calculated by removing participants from AIC-provided customer list. Does not include IPA Multifamily program because it is focused on common area measures which we interpreted to be non-residential.

## Sensitivity Analysis

As a sensitivity analysis, we assessed spillover savings using a threshold spillover score of 5.0 instead of 7.0 (as it is set to be in the IL-TRM V6.0). Using the 5.0 threshold, NPSO total MWh savings would increase to (approximately<sup>12</sup>) 11,878 and total therms savings would stay the same. Three more customers would have met all the criteria, and the additional measures that would have been added are:

- Efficient furnace fan
- Garage, attic, and ceiling insulation
- Refrigerator recycling

## Awareness of Efficiency Programs

To qualify for NPSO savings, (among other criteria) respondents had to be aware of AIC’s energy efficiency programs. However, we also asked a follow-up question to see if those that were aware of AIC’s energy efficiency programs could name a specific AIC program. We found that, of the 113 respondents aware of AIC’s energy efficiency programs, 91 (or 26% of all 350 respondents) were able to name a specific AIC program(s). This is not a statistically significant decrease from the PY8 results at a 95% confidence level, when 27% of all 350 respondents could name a specific program(s).

Among those respondents who could name at least one specific AIC program, most mentioned rebates from the Residential Heating and Cooling (25%) and Appliance Recycling (15%) programs. Only 9% of respondents could name the upstream Residential Lighting Program,<sup>13</sup> and few knew about the Home Efficiency (5%) and

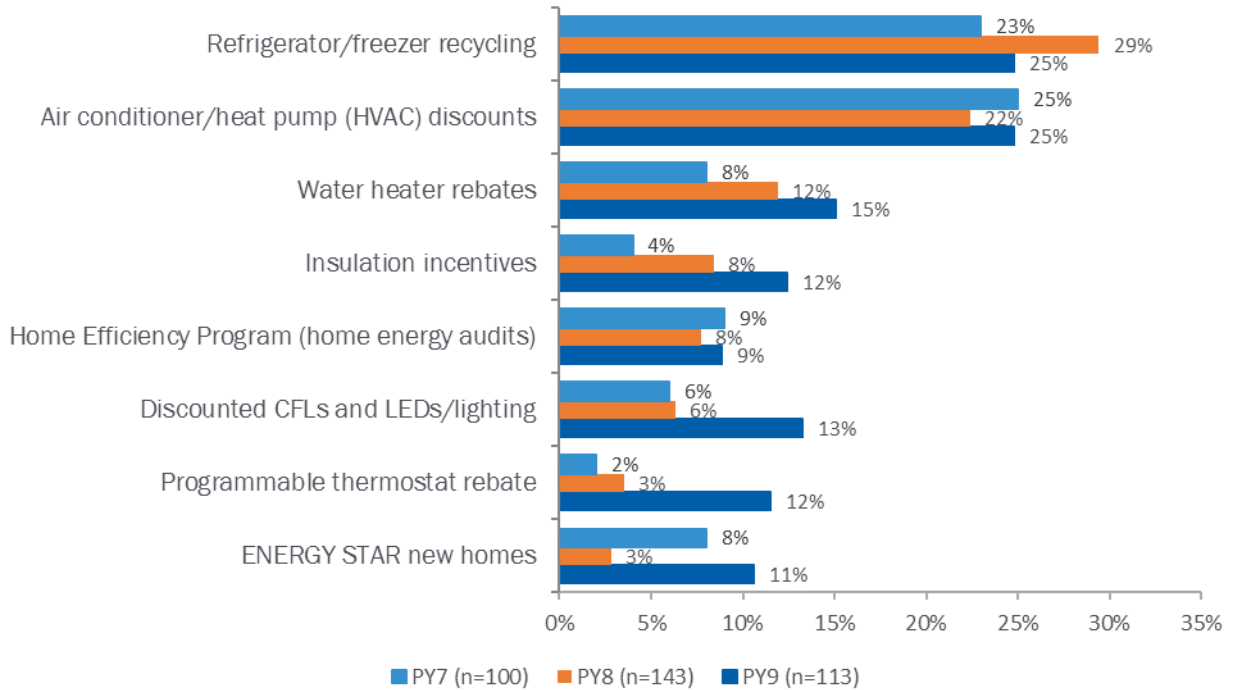
<sup>12</sup> Approximately because additional follow-up calls would need to be made to confirm some of the measures.

<sup>13</sup> This is not uncommon due to the upstream and transparent nature of the program.



ENERGY STAR New Homes (3%) programs. Figure 1 shows the proportion of customers that can name program in each program year, which has stayed fairly consistent from PY7 through PY9.

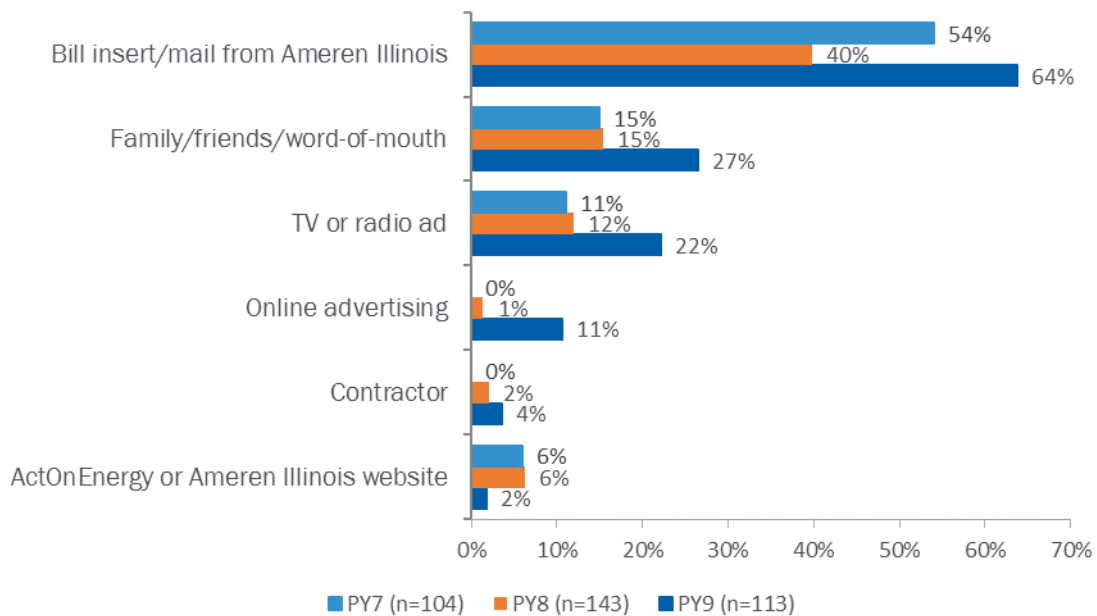
**Figure 1. Program Name Recall Trends from PY7 through PY9\***



\*Survey question A5: “What rebates or discounts have you heard about?” Multiple responses allowed.

As shown in Figure 2, the majority of respondents (64%) learned about AIC’s programs through their utility bill. Respondents also frequently mentioned word of mouth (27%) and radio or television ads (22%). Nineteen percent of respondents did not know or remember how they learned about AIC’s programs. Some of the other categories not shown in Figure 2 included hearing about programs at Ameren Illinois events (n=2), in the newspaper (n=2), and from door-to-door representatives (n=2). The top response categories are similar between PY7 and PY8.

**Figure 2. How Respondents’ Heard of AIC Programs from PY7 through PY9\***



\* Survey question A7: “Where did you hear or read about Ameren Illinois’ energy efficiency rebate opportunities?” (Comparison of top responses; multiple responses allowed.)

When asked about the best way for AIC to provide them with information about energy efficiency programs and rebates, most respondents (73%) indicated that providing information through their monthly bill is the best mode of communication; approximately 16% prefer email.<sup>14</sup> Compared to PY7 and PY8 survey results, respondents’ preferred modes of communication have remained the same. In addition, 88% of respondents who learned about AIC’s energy efficiency rebate opportunities from their monthly bill prefer this mode of communication, similar to results from PY8 (91%).

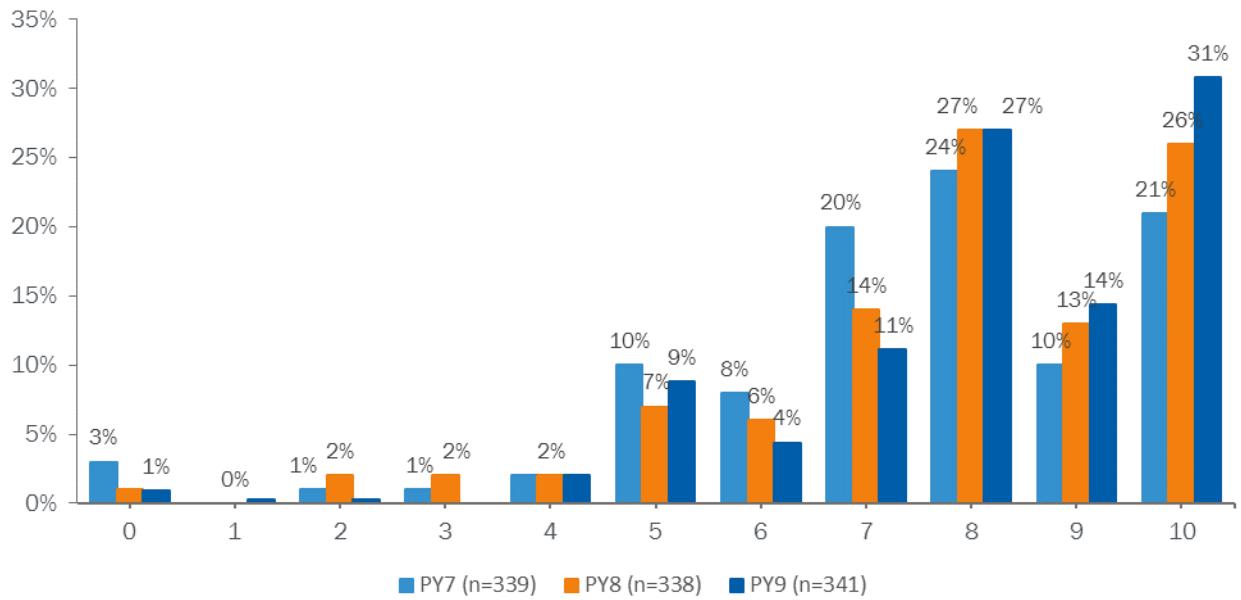
## Satisfaction with AIC

In the survey, the evaluation team asked about customers’ satisfaction with AIC as a utility provider. Based on a 10-point scale, with 0 being very dissatisfied and 10 being very satisfied, 73% of respondents rated their satisfaction as an 8 or higher, compared to 66% in PY8 and 55% in PY7. Respondents in PY9 gave an overall mean satisfaction score of 8.11, which is higher than PY8’s and PY7’s overall mean scores of 7.80 and 7.45, respectively.<sup>15</sup> Figure 3 shows the distribution of satisfaction scores in PY7, PY8, and PY9.

<sup>14</sup> Survey question A39: What is the best way for Ameren Illinois to provide you with information about energy efficiency programs and rebates? (PY7 n=350, PY8 n=350, PY9 n=350; multiple responses allowed).

<sup>15</sup> We tested to see if PY9’s mean satisfaction score was 0.1 points higher than PY8’s mean satisfaction score using a two-sample t-test. We found the results to not be statistically significant at the 95% confidence level.

**Figure 3. Respondents’ Satisfaction with AIC as a Utility Provider from PY7 through PY9\***



\* Survey question A42: “How would you rate your satisfaction with Ameren Illinois overall?” (Customers who responded “don’t know” or “refused” are excluded.)

The evaluation team asked follow-up questions of the 95 respondents who gave a satisfaction score of seven or below in PY9 to determine their reasoning for the score.<sup>16</sup> Below is a list of the top reasons for lower satisfaction:

- Utility bills are too expensive (33%)
- No other choice of services or providers (7%)
- Dissatisfied with general service or customer service (5%)
- Outage problems (5%)
- Lack of customer outreach and communication (4%)
- Didn’t know about rebates (4%)

The team compared the mean satisfaction scores between respondents who were aware that AIC offers rebates and discounts and respondents who were not aware that AIC offered rebates and discounts.<sup>17</sup> The

<sup>16</sup> Survey question A43: “Can you say more about why you gave this rating?” (n=75). Out of the 95 respondents who gave a satisfaction score of 7 or below, 20 either did not know the reason for or refused to explain their score.

<sup>17</sup> Awareness and unawareness here refer to answering yes or no to question A4, “Before today, were you aware that Ameren Illinois offers rebates and discounts for energy-saving equipment and home improvements?”

mean satisfaction score for those aware of AIC programs was 8.3, compared to 8.0 for those who were unaware. However, the difference between these scores was not statistically significant at the 90% confidence level.

The survey also revealed, however, that of the 246 customers who provided a rating of eight or higher, almost two-thirds (67%) were unaware that AIC offered rebates or incentives. This degree of unawareness and high satisfaction remained about the same as the levels from PY8 (64%).<sup>18</sup>

## Energy Efficiency Awareness, Attitudes, and Actions

Another set of questions asked about energy efficiency awareness, attitudes and actions. Specifically, we asked customers how important saving energy was to them and to rate how efficient their homes were. We also asked respondents to rate their own level of energy efficiency knowledge, the actions they have taken to make their home more energy efficient, and what challenges they have faced trying to save energy in their home. The following sections provide our findings on these topics.

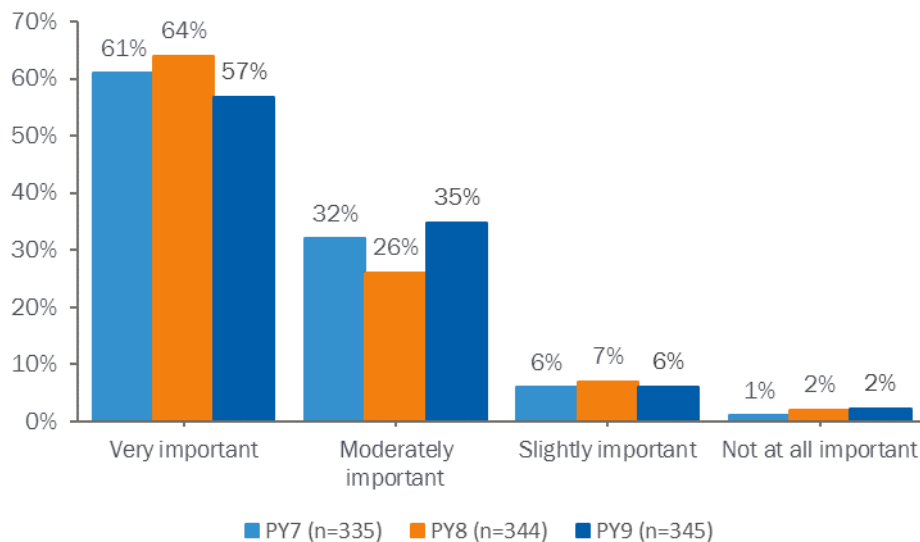
### Importance of Saving Energy

Nearly all respondents (92%) said that saving energy in the home is important to them, as displayed in Figure 4. These results are similar to responses from PY7 and PY8, when 93% and 90% of respondents, respectively, said that savings energy is very or moderately important. Meanwhile, only 2% of respondents said saving energy is not at all important, similar again to results from PY7 (1%) and PY8 (2%).

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<sup>18</sup> That is, they were not statistically different at the 90% confidence level.

**Figure 4. Importance of Saving Energy at Home from PY7 through PY9\***



\*Survey Question A33. “How important is saving energy in your home? Would you say...” (Customers who responded “don’t know” or “refused” were excluded).

## Efficiency of Respondents’ Homes

As Figure 5 shows, in PY9 the majority (80%) perceive their homes to be very or somewhat efficient, similar to results from PY7 (74%) and PY8 (76%). In PY9, the team asked respondents to provide a reason for their rating of home efficiency.<sup>19</sup> The respondents who believed their homes to be very or somewhat efficient (n=247) provided the following top reasons:

- Home has insulation (39%)
- Older home (21%)
- Efficient/newer appliances (18%)
- High or low energy bills (14%)
- Efficient lighting (13%)

In PY8, the top three reasons of respondents who believed their home to be very or somewhat efficient had insulation were having insulation (40%), efficient or newer appliances (27%), and efficient lighting (17%).

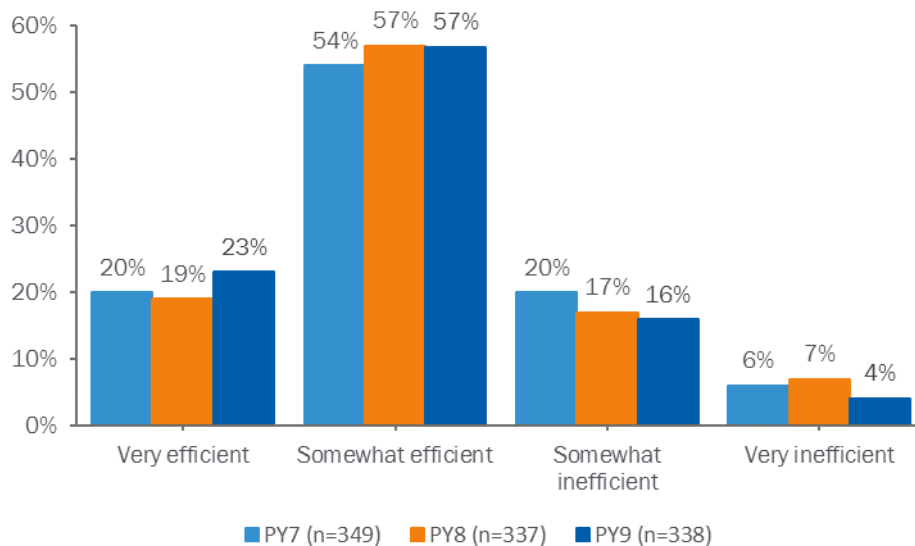
<sup>19</sup> Survey question A36: What makes your home [very/somewhat inefficient/efficient]? (PY7 n=312, PY8 n=313, PY9 n=312; multiple responses allowed; customers who responded “don’t know” or “refused” were excluded).

Seven percent of respondents said they try to conserve energy and/or are mindful of the amount of energy they use. Most respondents who said their home is energy-efficient because it has insulation cited installing new windows or re-caulking existing windows.

On the other hand, Figure 5 also reveals that approximately one-quarter of the respondents in both years think their home is either somewhat or very inefficient. For nearly all these respondents (94%), saving energy was either somewhat or very important to them – a larger percentage than respondents who think their home is already somewhat or very efficient (90%). The respondents who said that their homes are somewhat or very inefficient (n=65) listed the following as the top reasons:

- Home is older (46%)
- Home is drafty/leaky (34%)
- Home lacks insulation (31%)
- Inefficient or older appliances (15%)
- Needs new windows (15%)

**Figure 5. Efficiency of Respondents' Homes from PY7 through PY9\***



\* Survey Question A35. “How energy-efficient would you say your home is currently? Would you say...” (Customers who responded “don’t know” or “refused” were excluded.)

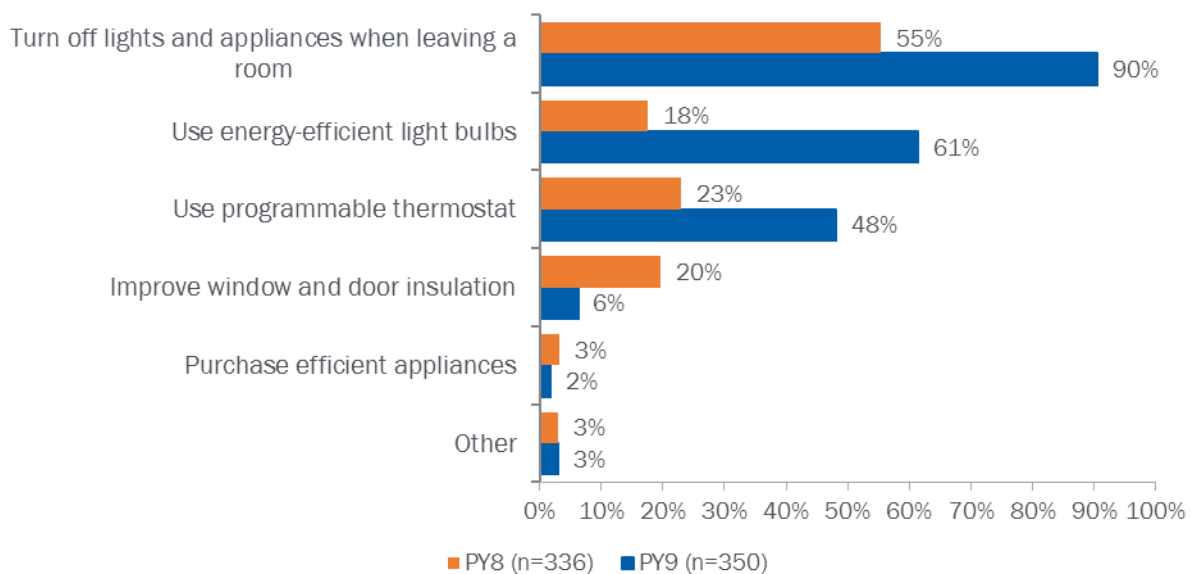
## Respondents’ Knowledge and Actions in Conserving Energy

The team asked respondents to rate their knowledge of how to improve their home’s efficiency. Using a 10-point scale, with 0 being not at all knowledgeable and 10 being very knowledgeable, respondents in PY9 gave

a mean response of 6.7 on their knowledge of how to improve home efficiency, down slightly, but not statistically different, from 6.8 in PY8.<sup>20</sup>

In addition, the team asked respondents about the ways they save energy at home. Four percent of respondents said they do not take, or didn't know if they took, any action to save energy at home. As shown in Figure 6, respondents most frequently said they turn off the lights and appliances when leaving the room (83%), use a programmable thermostat (59%), and use energy-efficient light bulbs (41%). In PY8, the most popular responses were turning off lights (55%), using a programmable thermostat (23%), and using efficient light bulbs (18%). In both years, turning off lights and appliances was the most popular energy efficiency action, although using a programmable thermostat and energy efficiency light bulbs have become increasingly more common.<sup>21</sup>

**Figure 6. How Do You Conserve Energy in Your Home?\***



\* Survey question A34. “What, if any, actions do you currently take to save energy in your home?” (n=335; figure represents the top responses, and customers who responded “don’t know” or “refused” were excluded).

Although behavioral changes are more common, respondents also mentioned equipment or shell improvements:

<sup>20</sup> Survey question A41: “On a scale from 0-10, where 0 is not at all knowledgeable and 10 is extremely knowledgeable, how would you rate your understanding of ways to make your home more energy efficient?” (PY7 n=344, PY8 n=333, PY9 n=331; customers who responded “don’t know” or “refused” were excluded.)

<sup>21</sup> Though PY7 is not shown in Figure 6, there was a statistically significant increase in the proportion of respondents who use a programmable thermostat in PY7 (14%) and PY8 (23%) and the increase to PY9 (48%) was also statistically significant. Moreover, the increase in turning off the lights and appliances and using a programmable thermostat from PY8 to PY9 was significant at the 95% confidence level.

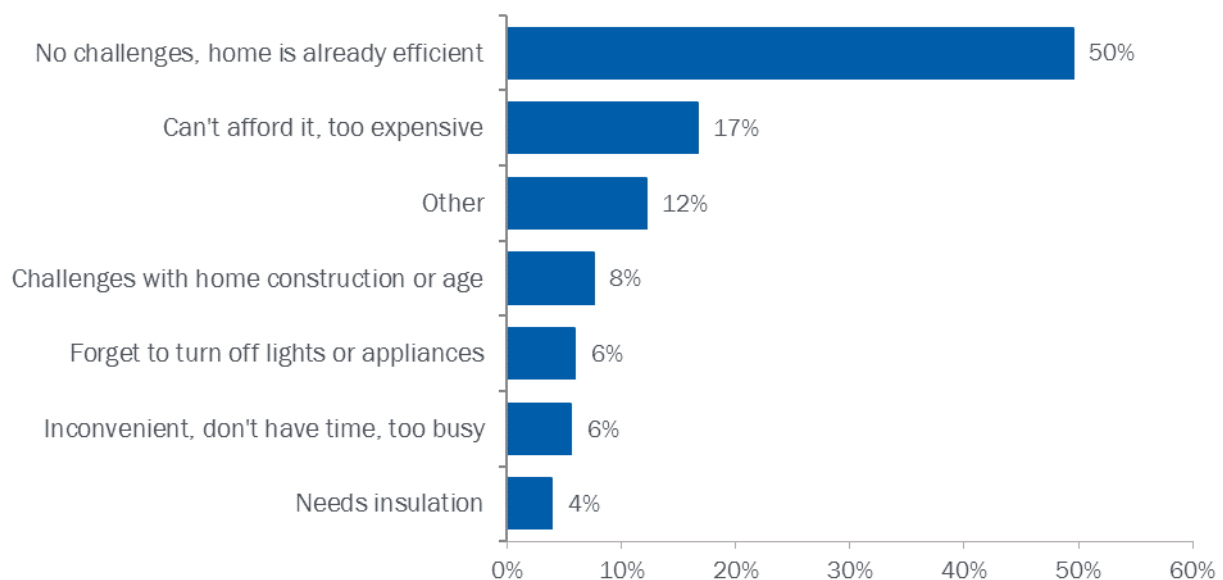
- 6% of respondents claimed to have made window and door insulation improvements such as caulking or replacing inefficient windows
- 2% of respondents indicated that they generally purchase energy-efficient appliances
- 3% of respondents perform other energy-efficient actions, including using a fireplace, installing and using solar heat, or using ceiling and room fans rather than an air conditioner

Although respondents said they made changes in their homes, such as improving insulation or adding efficient doors and windows, we did not include these respondents in our assessment of NPSO, because these respondents did not meet the other criteria for inclusion in NPSO: having awareness of AIC programs and acknowledging the impact of AIC programs on their decision-making process.

### Challenges with Saving Energy

Finally, the team asked respondents to list the challenges, if any, with saving energy in their homes.

**Figure 7. Challenges with Savings Energy in your Home\***



\* Survey question A40. "What challenges, if any, do you face in saving energy in your home?" (n=305; figure represents the top responses, and customers who responded "don't know" or "refused" were excluded; multiple responses were allowed).

Figure 7 shows that 50% of the respondents said there were no challenges with saving energy in their home. This could mean that respondents were unaware of any challenges or that the respondents do not view a specific barrier to saving energy as a challenge. Out of the 270 people who said that their home was very efficient or somewhat efficient, 138 of them (51%) listed a specific challenge to saving energy in their home.

In general, respondents also cited energy-efficient measures being too expensive (17%) and their homes being too old (8%). responses categorized as "other" included energy-efficient appliances being too hard to install or implement, as well respondents being unconfident improvements will save energy, or being afraid



of being uncomfortable. All remaining choices, typically with 3% or less of responses, were aggregated in “other” responses.

## Respondent Characteristics

We asked respondents to provide some demographic information to compare the representativeness of this survey to AIC’s total population. Since the Behavior Modification Program is conducted with approximately one-third of AIC customers, respondents to this survey (which did not include participants of the Behavioral Modification Program or any other AIC program) may differ from overall AIC customer demographics.

The majority of respondents (70%) live in a single-family dwelling, of whom 82% were owners. Regarding the age of the home:

- 32% of the homes were constructed before 1951
- 55% of the homes were constructed between 1951 and 2000
- 13% of the homes were constructed after 2000

The majority (81%) of respondents said their home has three or fewer occupants, including the respondent, which is similar to results from PY7 (80%) and PY8 (82%). Finally, 66% of respondents said their annual household pre-tax income is \$50,000 or less, up from 60% in PY8.

The team asked respondents about the primary fuel used to heat their home.<sup>22</sup> Most respondents (66%) use gas to heat their home, while 27% use electric and 5% use propane. These results are comparable to a 2011 saturation study by EnerNOC Utility Solutions, in which 69% of AIC customers used natural gas to heat their homes, 19% used electricity, and 12% used some other fuel type.<sup>23</sup> In terms of the water heater fuel type,<sup>24</sup> 58% of the nonparticipant survey respondents reported having gas water heaters and 37% reported having electric water heaters (4% of respondents reported they use propane). The EnerNOC study from 2011 found slight differences to the results of this survey, in which 74% of AIC customers had natural gas water heating fuel, 23% had electric water heating fuel, and 2% had some other water heating fuel type.

## Summary of Key Findings

The following is a summary of key findings from the survey analysis:

- **Key Finding #1:** Using the IL-TRM V5.0 protocol, the evaluation team estimated PY9 NPSO savings to be 3,867 MWh and 94,525 therms. Last year, the evaluation team found no NPSO savings. Differences may be due to changes in the survey that this year prompted customers on program names, and listed possible spillover measures rather than relying on customer recall. If the the IL-TRM

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<sup>22</sup> Nine respondents did not know the primary fuel used to heat their home, so we excluded them from this analysis.

<sup>23</sup> EnerNOC Utility Solutions. *Ameren Illinois Energy Efficiency Market Potential Assessment*. Figure 10-7 Distribution of Heating Technologies. July 8, 2013. Available online: <https://www.illinois.gov/sites/ipa/Documents/AppendixB-4vol1-5AmerenPotentialStudy.pdf>.

<sup>24</sup> Thirty-two respondents did not know the primary fuel type for their water heater, so the team excluded them from this analysis.

V6.0 protocol were used (which goes into effect next year), then NPSO savings would have been 11,878 MWh and 94,525 therms.

- **Key Finding #2:** The evaluation team made two adjustments to the survey which may have contributed to the increase in spillover savings. The first adjustment was presenting customers with a list of possible measures that they may have installed (as opposed to leaving it as an open-ended question). The number of customers in PY9 that were aware of AIC's energy efficiency programs and reportedly installed a measure was 72. In PY7 and PY8, these numbers were 15 and 17 respectively.

**Key Finding #3:** Likewise, the evaluation team added in a question asking respondents who said they were unaware of AIC's energy efficiency programs if they recognized any of AIC's efficiency programs from a list. However, every respondent that was initially unaware of AIC's energy efficiency programs (237) said that they recognized one of AIC's energy efficiency programs. We concluded that this was a leading question and excluded those customers from our NPSO savings. However, if we included those customers in the NPSO, then we would have added two customers and three measures.

- **Key Finding #4:** A higher proportion of customers in PY9 reported taking statistically significant more energy savings actions than in PY8. These include turning off lights and appliances when leaving a room, using energy efficiency light bulbs, and using a programmable thermostat. This aligns well with the increase in NPSO savings between this year and last year (see NPSO Analysis).

## Appendix A. PY9 General Population (Nonparticipant) Survey Instrument

### Notes for Survey

Interviewer instructions are in green.

CATI programming instructions are in red.

(Items that should not be read are in parenthesis.)

*Audience: This survey is for AIC customers who have not participated in a rebate program in PY9, PY8, and PY7.*

*Target: 350 completes (Note: Respondents that are terminated in questions A2 or A3 do not count towards the completion target because they are not part of the general population, they are considered participants)*

*Interim deliverables: At the end of each week of fielding, ODC will send Cadmus complete results for customers who provided a response to A50.*

*[Variables from sample]*

*Name*

*Address*

*Phone*

### Introduction and screening

- A1. Hello, I'm [INSERT FIRST NAME] calling from Opinion Dynamics on behalf of Ameren Illinois. We are conducting a survey about how households use and conserve energy. This is not a sales call. May I please speak with the person who pays the energy bill or head of the household? [IF NEEDED: I'm not selling anything; we are only interested in your opinions to understand how to assist customers in saving money on their utility bills. Your responses will remain confidential. We are a third party research firm hired by Ameren Illinois to complete this research.]
1. (Yes)
  2. (No) [ASK TO SPEAK WITH PERSON WHO MAKE DECISIONS ABOUT ENERGY USE]
  98. (Don't know) [ASK TO SPEAK WITH PERSON WHO MAKE DECISIONS ABOUT ENERGY USE]
  99. (Refused) [THANK AND TERMINATE]

Back-up information, not to be programmed:

[If "No – Not a convenient time," ask if Respondent would like to arrange a more convenient time for us to call them back or if you can leave a message for that person.]

[IF RESPONDENT ASKS HOW LONG, SAY: "APPROXIMATELY 10 MINUTES."]

[Only if asked for an AIC contact to verify the survey authenticity, offer Sharon Ruhland, who can be reached at 309.677.5192]

First, I have some questions about your familiarity with Ameren Illinois' energy efficiency programs.

- A2. In the past three years, did your household receive a rebate or discount from Ameren Illinois for installing energy-efficient equipment or improvements? [DO NOT READ RESPONSE OPTIONS]
1. (Yes) [Thank and terminate]
  2. (No)
98. (Don't know)
99. (Refused)
- A3. Ameren Illinois customers are also eligible to receive customized Home Energy Reports that contain tips for reducing energy consumption and comparisons of your household's energy usage to similar homes in your area. Do you recall receiving one of these reports in the mail, by e-mail, or by logging into an online portal within the last three years? [DO NOT READ RESPONSE OPTIONS]
1. (Yes) [Thank and terminate]
  2. (No)
98. (Don't know)
99. (Refused)

#### Awareness and NPSO

- A4. Before today, were you aware that Ameren Illinois offers rebates and discounts for energy-saving equipment and home improvements? [If NEEDED: This program is called "Act on Energy"] [DO NOT READ RESPONSE OPTIONS]
1. (Yes)
  2. (No) [SKIP TO A6]
98. (Don't know) [SKIP TO A6]
99. (Refused) [SKIP TO A33]
- A5. [IF "YES" TO A4] What rebates or discounts have you heard about? [DO NOT READ RESPONSES; ACCEPT MULTIPLE RESPONSES]
1. Air conditioner/heat pump (HVAC) discounts
  2. Refrigerator/freezer recycling
  3. Insulation incentives
  4. ENERGY STAR new homes
  5. Programmable thermostat rebate
  6. Discounted CFLs and LEDs/lighting
  7. Water heater rebates
  8. Home Efficiency Program (home energy audits)
  9. Other [SPECIFY: \_\_\_\_\_]
98. (Don't know) [DO NOT READ] [SKIP TO A33]
99. (Refused) [DO NOT READ] [SKIP TO A33]
- A6. [IF "NO" OR "DON'T KNOW" TO A4] Do any of the following rebates or incentives sound familiar to you? [RANDOMIZE LIST; READ RESPONSES; ACCEPT MULTIPLE RESPONSES]
1. Air conditioner/heat pump (HVAC) discounts
  2. Refrigerator/freezer recycling
  3. Insulation incentives
  4. ENERGY STAR new homes
  5. Programmable thermostat rebate
  6. Discounted CFLs and LEDs/lighting

- 7. Water heater rebates
- 8. Home Efficiency Program (home energy audits)
- 9. Other [SPECIFY: \_\_\_\_\_]
- 98. (Don't know) [DO NOT READ] [SKIP TOA33]
- 99. (Refused) [DO NOT READ] [SKIP TOA33]

- A7. [IF "YES" TO A4 OR "YES" TO ANY RESPONSES TO A6] Where did you hear or read about Ameren Illinois' energy efficiency rebate opportunities? [DO NOT READ RESPONSES; ACCEPT MULTIPLE RESPONSES]
- 1. Bill Insert/Mail from Ameren Illinois
  - 2. Family/friends/word-of-mouth
  - 3. Act on Energy or Ameren Illinois website
  - 4. TV or Radio Ad
  - 5. Contractor
  - 6. Online advertising
  - 7. Social media
  - 8. Other [SPECIFY: \_\_\_\_\_]
  - 98. (Don't know) [DO NOT READ]
  - 99. (Refused) [DO NOT READ]

**NPSO – Screener Questions** [ASK THESE IF A4="YES", OR A6 1-9="YES", ELSE SKIP TO Energy Efficiency Awareness and Attitudes]

- A8. I'm going to read you a list of energy efficient equipment and for each one, I'd like to know whether you have installed this type of equipment for use in your home in the past year that did not receive a rebate from Ameren Illinois?  
[DO NOT READ] I haven't installed any energy efficient equipment in the past year. [SKIP TO A15]

[CONTINUE]

1. [READ LIST OF MEASURES, RECORD YES/NO/DK/REFUSED FOR EACH ITEM A8\_1 - A8\_17]

- 1. (Yes)
- 2. No
- 98. ((Don't know) [DO NOT READ])
- 99. (Refused) [DO NOT READ]

2. [IF NEEDED, REMIND THAT IT'S ABOUT EQUIPMENT INSTALLED IN THE PAST YEAR]

- A8 1. Efficient light fixtures or ceiling fan [RECORD NUMBER: \_\_\_\_\_]
- A8 2. Efficient appliances
- A8 3. Efficient air conditioner
- A8 4. Efficient heat pump
- A8 5. Efficient showerheads or faucet aerators
- A8 6. Insulation [RECORD WHERE IT IS ADDED: \_\_\_\_\_]
- A8 7. Insulation for your hot water heater or piping [RECORD AMOUNT IN FEET (piping) OR SQUARE FEET (water heater): \_\_\_\_\_]
- A8 8. Efficient furnace fan with ECM (Electronically Commutated Motor)
- A8 9. Filter whistle
- A8 10. Programmable or "smart" thermostat [RECORD WHICH TYPE] \_\_\_\_\_

- A8 11. Constructed an ENERGY STAR New Home
- A8 12. Efficient water heater
- A8 13. Efficient windows
- A8 14. Solar panels
- A8 15. Other efficient product such as pool pump, air purifier, or dehumidifier
- A8.16. Efficient furnace
- A8 17. Any other equipment that I did not mention? [SPECIFY: \_\_\_\_\_]

A8a. [IF A8\_2=1] Which of the following efficient appliances did you install? [MULTIPLE RESPONSES ALLOWED]

- a. Refrigerator
- b. Freezer
- c. Clothes washer
- d. Electric clothes dryer
- e. Gas clothes dryer
- 98. (Don't know) [DO NOT READ]
- 99. (Refused) [DO NOT READ]

A8b. [IF A8\_3=1] Did you install a room air conditioner or central air conditioning?

- a. room air conditioner [RECORD NUMBER] \_\_\_\_
- b. central air conditioning
- 100. (Don't know) [DO NOT READ]
- 101. (Refused) [DO NOT READ]

A8c. [IF A8\_4=1] What type of heat pump did you install? [READ LIST IF NEEDED]

- a. air source heat pump
- b. geothermal heat pump
- c. ground source heat pump
- d. ductless heat pump
- e. dual fuel heat pump
- 102. (Don't know) [DO NOT READ]
- 103. (Refused) [DO NOT READ]

A8d. [IF A8\_5=1] How many of each of the following did you install?

- a. efficient showerheads [RECORD NUMBER] \_\_\_\_
- b. efficient kitchen faucet aerator [RECORD NUMBER] \_\_\_\_
- c. efficient bathroom faucet aerator [RECORD NUMBER] \_\_\_\_
- 104. (Don't know) [DO NOT READ]
- 105. (Refused) [DO NOT READ]

A8 e. [IF A15=1] Which of the following efficient products did you install? [READ LIST, MULTIPLE RESPONSES ALLOWED]

- a. pool pump
- b. dehumidifier
- c. air purifier
- 106. (Don't know) [DO NOT READ]
- 107. (Refused) [DO NOT READ]

- A9. [IF "YES" TO ANY FROM A8 1 - A8 5, OR A8 12 - A8 13, OR A8 15– A8 17] How do you know that this equipment is energy-efficient? [DO NOT READ RESPONSES. CHOOSE ALL THAT APPLY]
1. (ENERGY STAR label)
  2. (The retailer/dealer/builder/contractor told me it was)
  3. (Product label said it was efficient)
  4. (Other) [SPECIFY: \_\_\_\_\_]
  98. (Don't know)
  99. (Refused)
- A10. [IF YES TO A8 1 - A8 5, OR A8 12 - A8 13, OR A8 15 – A8 17 ] Why did you choose to install this particular energy efficiency level for your [INSERT PRODUCT FROM A8 SUB-QUESTION 2]
1. [RECORD RESPONSE]: \_\_\_\_\_
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]
- A11. [IF YES to A8 6 - A8 11, or A8 14] Why did you decide to install [INSERT PRODUCT FROM A8 SUB-QUESTION 2]
1. [RECORD RESPONSE]: \_\_\_\_\_
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]
- A12. When you were deciding to install your [RESPONSE TO A8 1 - A8 17] did you consider [RANDOMIZE AND READ LIST, RECORD YES/NO FOR EACH ITEM]?
1. Information from a contractor or retailer talking about Ameren Illinois' energy efficiency programs?
  2. Information that Ameren Illinois provided through a bill insert or mailing or online about saving energy?
  3. Information from a friend or family member who participated in Ameren Illinois' efficiency program?
  4. Personal experience participating in an Ameren Illinois energy efficiency program in the past?
  98. (Don't Know or Refused for all) [DO NOT READ] [SKIP TO A15]
- A13. [FOR EACH YES FROM A12] On a 0 -10 scale, with 0 being not at all important and 10 being extremely important, how important was [YES RESPONSE TO A12] in your decision to install [RESPONSE="YES" TO ANY EQUIPMENT IN A8 Subsection 2]?
1. Information from a contractor or retailer talking about Ameren Illinois' energy efficiency programs?
  2. Information that Ameren Illinois provided through a bill insert or online about saving energy?
  3. Information from a friend or family member who participated in Ameren Illinois' efficiency program?
  4. Personal experience participating in an Ameren Illinois energy efficiency program in the past?
  98. (Don't Know or Refused for all) [DO NOT READ] [SKIP TO A15]

- A14. [FOR EACH YES FROM A12] If you did not have the [YES RESPONSE(S) TO A12], how likely is it that you would have installed [RESPONSE="YES" TO ANY EQUIPMENT IN A8 Subsection 2]? Please use a 0 to 10 scale where 0 means you definitely WOULD NOT have made the installation and 10 means you definitely WOULD have made the installation without the information from [YES RESPONSE TO A13]?
1. Information from a contractor or retailer talking about Ameren Illinois' energy efficiency programs?
  2. Information that Ameren Illinois provided through a bill insert or online about saving energy?
  3. Information from a friend or family member who participated in Ameren Illinois' efficiency program?
  4. Personal experience participating in an Ameren Illinois energy efficiency program in the past?
98. (Don't Know or Refused for All) [DO NOT READ] [SKIP TO A15]
- 
- A15. Have you or anyone in your household taken any of the following energy efficient actions at your home in the past year? [READ LIST OF MEASURES A15 1 - A15 6, RECORD YES/NO FOR EACH ITEM]
1. (Yes)
  2. (No)
98. (Don't know)
99. (Refused)
- A15 1. Recycled a refrigerator  
A15 2. Recycled a freezer  
A15 3. Scheduled an air conditioner tune-up  
A15 4. Programmed thermostat to reduce usage (either at night or during the day when people are not home)  
A15 5. Had a home energy audit conducted  
A15 6. Any other action that I did not mention? [SPECIFY: \_\_\_\_\_]
- 
- A16. [IF YES to A15= 1-6] Why did you decide to [INSERT ACTION FROM A15]
1. [RECORD RESPONSE: \_\_\_\_\_]
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]
- 
- A17. When you were deciding to [INSERT ACTION FROM A15] did you consider [RANDOMIZE AND READ LIST OF MEASURES, RECORD YES/NO FOR EACH ITEM]
1. Information from a contractor or retailer talking about Ameren Illinois' energy efficiency programs?
  2. Information that Ameren Illinois provided through a bill insert or online about saving energy?
  3. Information from a friend or family member who participated in Ameren Illinois' efficiency program?
  4. Personal experience participating in an Ameren Illinois energy efficiency program in the past?
98. (Don't Know or Refused for all) [DO NOT READ] [SKIP TO A33]



- A18. [FOR EACH YES FROM A17] On a 0 -10 scale, with 0 being not at all important and 10 being extremely important, how important was [YES RESPONSE(S) TO A17], in your decision to [For each A15 1-6=1 RESPONSE TO A15]?
1. Information from a contractor or retailer talking about Ameren Illinois' energy efficiency programs?
  2. Information that Ameren Illinois provided through a bill insert or online about saving energy?
  3. Information from a friend or family member who participated in Ameren Illinois' efficiency program?
  4. Personal experience participating in an Ameren Illinois energy efficiency program in the past?
98. (Don't Know or Refused for all) [DO NOT READ] [SKIP TOA33]
- A19. [FOR EACH YES FROM A17] If you did not have the [YES RESPONSE(S) TO A17], how likely is it that you would have decided to [RESPONSE=1 TO A15]? Please use a 0 to 10 scale where 0 means you definitely WOULD NOT have taken the action and 10 means you definitely WOULD have taken the action.
1. Information from a contractor or retailer talking about Ameren Illinois' energy efficiency programs?
  2. Information that Ameren Illinois provided through a bill insert or online about saving energy?
  3. Information from a friend or family member who participated in Ameren Illinois' efficiency program?
  4. Personal experience participating in an Ameren Illinois energy efficiency program in the past?
98. (Don't Know or Refused for all) [DO NOT READ] [SKIP TOA33]

### NPSO – Measure Specific Questions

[PROCEED TO THIS SECTION IF A13<6 OR A14 >5 OR A18 <6 OR A19>5, ELSE SKIP TOA33]

- A20. [ASK IF, A8 6 OR A8 13 ="YES" AND A8 3, A8 4 = "NO"] What type of cooling equipment do you have in your home? OR [ASK IF ANY OF A8 3, A8 4 = "YES"] Apart from [INSERT A8 3, A8 4], what other type of cooling equipment is in your home, if any? [DO NOT READ RESPONSES; ACCEPT MULTIPLE RESPONSES]
1. Central air conditioner
  2. Ductless or mini-split heat pump
  3. Air-source heat pump
  4. Ground-source or geothermal heat pump
  5. Portable air conditioner
  6. Room air conditioner
  7. Evaporative (swamp) cooler
  8. Other [SPECIFY:\_\_\_\_\_]
  9. None
98. (Don't know)
99. (Refused)

- A21. [ASK IF, A8 6 OR A8 13 = "YES" AND A8 4 A8 16 = "NO"] What type of heating equipment do you have in your home? OR [ASK IF ANY OF A8 4 A8 16 = "YES"] Apart from [INSERT A8 4 AND/OR A8 16], do you have any other type of heating equipment in your home? [DO NOT READ RESPONSES; ACCEPT MULTIPLE RESPONSES]
1. Ductless or mini split heat pump
  2. Air-source heat pump
  3. Ground-source or geothermal heat pump
  4. Gas furnace/boiler
  5. Electric baseboard heat
  6. Electric furnace
  7. Other [SPECIFY: \_\_\_\_\_]
  8. None
  98. (Don't know)
  99. (Refused)
- A22. [IF YES TO A8 SUB-QUESTION 2 = A8 3, A8 4, A8 16] Before you installed your new [RESPONSE TO A8 SUB-QUESTION 2], was your old equipment still working? [READ LIST, SELECT ALL THAT APPLY]
1. Yes, my old equipment was still working
  2. No, my old equipment was not working
  3. I was not replacing any equipment
  4. (Other) [SPECIFY: \_\_\_\_\_]
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]
- A23. [IF YES TO A8 SUB-QUESTION 2 = A8 3, A8 4] Before you installed your new [RESPONSE TO A8 SUB-QUESTION 2], what type of cooling equipment did you have? [READ LIST, SELECT ALL THAT APPLY]
1. Central AC or air source heat pump
  2. Geo-thermal or ground source heat pump
  3. Room AC
  4. No AC
  5. Other [SPECIFY: \_\_\_\_\_]
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]

- A24. [IF YES TO A15 1] What type of refrigerator did you recycle? Would you say it was... [READ LIST.]
1. Refrigerators and Refrigerator-freezers with manual defrost
  2. Refrigerator-Freezer--partial automatic defrost
  3. Refrigerator-Freezers--automatic defrost with top-mounted freezer without through-the-door ice service and all-refrigerators--automatic defrost
  4. Refrigerator-Freezers--automatic defrost with side-mounted freezer without through-the-door ice service
  5. Refrigerator-Freezers--automatic defrost with bottom-mounted freezer without through-the-door ice service
  6. Refrigerator-Freezers--automatic defrost with top-mounted freezer with through-the-door ice service
  7. Refrigerator-Freezers--automatic defrost with side-mounted freezer with through-the-door ice service
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]
- A25. [IF YES TO A15 2] What type of freezer did you recycle? Would you say it was... [READ LIST]
1. Upright Freezers with Manual Defrost
  2. Upright Freezers with Automatic Defrost
  3. Chest Freezers and all other Freezers except Compact Freezers
  4. Compact Upright Freezers with Manual Defrost
  5. Compact Upright Freezers with Automatic Defrost
  6. Compact Chest Freezers
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]
- A26. [IF "YES" TO A8 SUB-QUESTION 2 = A8 12] What type is your new water heater? Is it a... [READ LIST]
1. Gas storage water heater
  2. Condensing gas storage water heater
  3. Gas tankless water heater
  4. Heat pump water heater
  5. Other [SPECIFY] \_\_\_\_\_
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]
- A27. [IF YES TO A8 SUB-QUESTION 2 = A8 12] What is the efficiency rating (or, specifically, the energy factor) of your water heater? [DO NOT READ RESPONSES]
1. [SPECIFY: \_\_\_\_\_]
  2. (Not sure) [Does it have ENERGY STAR on the label]?
98. (Don't know)
99. (Refused)
- A28. [IF YES TO A8 SUB-QUESTION 2 = A8 12 AND A26 = 1,2,4] What is the tank size of your water heater? [DO NOT READ RESPONSES]
1. [SPECIFY: \_\_\_\_\_]
98. (Don't know)
99. (Refused)

- A29. [IF YES A8 SUB-QUESTION 2 = A8 15 AND A8e="b"] What is the capacity of your new dehumidifier? [DO NOT READ RESPONSES]  
1. [SPECIFY: \_\_\_\_\_]  
98. (Don't know)  
99.(Refused)
- A30. [IF A15 4 = YES] Earlier you mentioned you programmed your thermostat. When you programmed it, did you lower any thermostat settings during the winter? [DO NOT READ RESPONSES]  
1. Yes [SPECIFY CHANGE MADE: \_\_\_\_\_]  
2. No  
98. (Don't know)  
99. (Refused)
- A31. [IF A15 5=YES] Did you implement any of the energy efficiency measures recommended during the energy audit? [DO NOT READ RESPONSES]  
1. Yes  
2. No  
98. (Don't know)  
99. (Refused)
- A32. [IF YES TO A31] What energy efficiency measures did you implement? [DO NOT READ RESPONSES]  
1. [SPECIFY: \_\_\_\_\_]  
98. (Don't know)  
99. (Refused)

### Energy Efficiency Awareness and Attitudes

Now I have a few questions about energy use in your household.

- A33. How important is saving energy in your home? Would you say...  
1. Very important  
2. Moderately important  
3. Slightly important  
4. Not at all important  
98. (Don't know) [DO NOT READ]  
99. (Refused) [DO NOT READ]
- A34. What, if any, actions do you currently take to save energy in your home? [PROMPT IF NEEDED; ACCEPT MULTIPLE RESPONSES]  
1. Use programmable thermostat  
2. Use energy-efficient light bulbs  
3. Turn off lights and appliances when leaving a room  
4. (Other, [SPECIFY: \_\_\_\_\_])  
98. (Don't Know) [DO NOT READ]  
99. (Refused) [DO NOT READ]
- A35. How energy-efficient would you say your home is currently? Would you say...

1. Very inefficient
2. Somewhat inefficient
3. Somewhat efficient
4. Very efficient
98. (Don't know) [DO NOT READ] [SKIP TO A37]
99. (Refused) [DO NOT READ] [SKIP TO A37]

A36. Why do you say your home is [RESPONSE TO A35] [DO NOT READ RESPONSES; MARK ALL THAT APPLY]?

1. Older home
2. Newer home
3. Inefficient/older appliances
4. Efficient/newer appliances
5. Lacks insulation
6. Has insulation
7. Drafty/leaky
8. Old HVAC system
9. New HVAC system
10. Efficient lighting (CFL/LED)
11. Inefficient lighting
12. High or low energy bills
13. Have not made any upgrades
14. Needs new windows
15. From energy use assessment online tool or from contractor
16. Other [RECORD ANSWER]
98. (Don't know)
99. (Refused)

A37. What is the primary fuel used to heat your home? [DO NOT READ RESPONSES]

1. (Gas)
2. (Electric)
3. (Propane)
4. (Fuel oil)
5. (Other) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A38. What fuel does your water heater use? [DO NOT READ RESPONSES]

1. (Gas)
2. (Electric)
3. (Propane)
4. (Fuel oil)
5. (Other) [RECORD RESPONSE]
98. (Don't know)
99. (Refused)

A39. What is the best way for Ameren Illinois to provide you with information about energy-efficiency programs and rebates? [PROMPT IF NEEDED; ACCEPT MULTIPLE RESPONSES]

1. E-mail from Ameren Illinois
2. Act on Energy website
3. Bill Insert/Mailing
4. Telephone call
5. (Other) [SPECIFY: \_\_\_\_\_]
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]

A40. What challenges, if any, do you face in saving energy in your home? [DO NOT READ LIST, ALLOW MULTIPLE RESPONSES]

1. (Can't afford it/too expensive)
2. (Too hard to install/implement)
3. (Inconvenient/don't have time/too busy)
4. (Not confident it will save energy/be worth it)
5. (Afraid it will make home uncomfortable)
6. (Disruption to home/mess involved with installing improvements)
7. (Challenges with contractors)
8. (No Challenges/None)
9. (Challenges with home construction or age)
10. (Homes are already pretty efficient)
11. (Other [SPECIFY: \_\_\_\_\_])
98. (Don't know)
99. (Refused)

A41. On a scale from 0-10, where zero is not at all knowledgeable and 10 is extremely knowledgeable, how would you rate your understanding of ways to make your home more energy-efficient?

1. [RECORD ANSWER: \_\_\_\_\_]
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]

### Satisfaction

A42. Taking into consideration all aspects of your utility service experience, how would you rate your satisfaction with Ameren Illinois overall? Use a 0 to 10 scale where 0 means not at all satisfied and 10 means extremely satisfied.

1. [RECORD AN ANSWER FROM 0-10: \_\_\_\_\_]
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]

A43. [ASK IF ANSWER FROM A42≤7] Can you say more about why you gave this rating?

1. [RECORD ANSWER: \_\_\_\_\_]
98. (Don't know) [DO NOT READ]
99. (Refused) [DO NOT READ]

### Demographics

We are almost finished. I have a few final questions about your household. The answers to these questions will be kept confidential and will not be associated with you or your household.

- A44. Which of the following best describes the type of residence you live in? [READ LIST AND RECORD ONE RESPONSE]
1. Detached single-family home
  2. Townhouse or duplex which share adjacent walls
  3. Apartment or condo in a building with 4 or less units
  4. Apartment or condo in a building with 5 or more units
  5. Mobile or manufactured home
  6. (Other, [SPECIFY:\_\_\_\_\_])
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]
- A45. Do you own or rent your home? [DO NOT READ RESPONSES]
1. (Own)
  2. (Rent)
  98. (Don't know)
  99. (Refused)
- A46. When was your home built?
1. [RECORD NUMERIC ANSWER]
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]
- A47. Including yourself, how many people live in your home on a full-time basis?
1. [RECORD ANSWER:\_\_\_\_\_]
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]
- A48. What is the approximate square footage of your home? [READ RESPONSE CHOICES IF NECESSARY]
1. (Less than 1,000 sq. ft.)
  2. (1,000 to 1,499 sq. ft.)
  3. (1,500 to 1,999 sq. ft.)
  4. (2,000 to 2,499 sq. ft.)
  5. (2,500 to 2,999 sq. ft.)
  6. (3,000 sq. ft. or larger)
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]
- A49. Which of the following categories best describes your total annual household income before taxes?  
Stop me when I get to the right category.
1. Less than \$25,000
  2. \$25,000 to \$50,000
  3. More than \$50,000 up to \$100,000
  4. More than \$100,000 up to \$200,000
  5. More than \$200,000
  98. (Don't know) [DO NOT READ]
  99. (Refused) [DO NOT READ]

A50. [ASK IF A13<6 OR A14 >5 OR A18 <6 OR A19>5] We would like to know more about the energy efficiency improvements you made in the past year. You will receive a \$50 gift card for participating in a follow-up call. What is the best time during the week to reach you?

1. [SPECIFY: Contact name, number, and time to call]
98. (Don't know)
99. (Refused)

### Closing

Thanks for your time. Have a good day!



## Appendix B. Measure Savings Calculations

Table 6 in the section NPSO Analysis shows the measures for which the evaluation team actually gave NPSO savings. However, there were some measures that met all the spillover criteria (awareness of AIC’s energy efficiency, evidence measure was efficient, spillover score greater than 7.0) that, upon further investigation, we excluded from the spillover savings. Table 8 shows the full list of measures, why we excluded them, or notes that we found upon follow up calls.

**Table 8. Full NPSO Table with Notes from Follow Up**

Customer	Measure	Spillover Score	kWh Savings	Therms Savings	Notes from Follow Up
<i>Included in Spillover Savings</i>					
1	Water Heater Tank Wrap	10	-	6	-
1	Refrigerator Replacement	10	54	-	Originally said recycled two refrigerators without replacement; follow up call identified that only one recycled refrigerator which was replaced.
2	Programmable Thermostat	9	720	-	Could not reach, conservative assumptions
2	Efficient windows	10	12	-	Could not reach, so assumed one window with a size equal to example in TRM (2 x 4 ft.); heating and cooling type was known from the survey
3	Variable Speed Pool pump	7.5	828	-	Customer confirmed variable speed pool pump and baseline pool pump
4	Efficient windows	10	25	8.45	Customer provided area of windows and quantity; confirmed heating and cooling type
5	Programmable Thermostat	7.5	57	62	Confirmed programmable thermostat, heating type, and cooling type
<i>Excluded from Spillover Savings</i>					
6	Thermostat behavior change	10	-	-	Claimed large behavior change; tried to follow up (no response) but no evidence change persisted
7	Thermostat behavior change	10	-	-	Claimed large behavior change; tried to follow up (no response) but no evidence change persisted
8	Refrigerator Recycling	7.5	-	-	Customer said AIC recycled their refrigerator, thus participant of ARP and no spillover savings. Also, upon follow-up, refrigerator was replaced.
9	Showerheads	8	-	-	No savings because propane water heater
9	Kitchen Aerators	8	-	-	No savings because propane water heater
9	Efficient windows	8	-	-	No savings because propane heating and no air conditioning

10	Smart Thermostat	9.5			“Recognized” AIC efficiency programs, was not “aware” of AIC efficiency programs
11	Refrigerator Replacement	10			“Recognized” AIC efficiency programs, was not “aware” of AIC efficiency programs
11	Clothes washer	10			“Recognized” AIC efficiency programs, was not “aware” of AIC efficiency programs

The evaluation team tried to follow up with all eleven customers identified as potential spillover at least three times. We utilized conservative assumptions to estimate savings. In the following sections we provide the measure savings and assumptions for each of the seven final spillover measures.

### Water Heater Tank Wrap

The IL-TRM V5.0 does not have a water heater tank wrap measure, so we used the Iowa TRM<sup>25</sup> as a proxy to estimate the savings. Below, we show the equation for therms savings (as the only customer that installed this measure had a natural gas water heater):

$$\Delta \text{Therms} = ((A_{Base}/R_{Base} - A_{EE}/R_{EE}) * \Delta T * \text{Hours}) / (\eta \text{DHW}_{Gas} * 100,000)$$

The variable, definition, units, value, and notes or source are shown in Table 9.

**Table 9. Variable Inputs for Water Heater Tank Wrap**

Variable	Definition	Units	Value	Notes/Source
$A_{Base}$	Surface area of storage tank prior to adding tank wrap	ft <sup>2</sup>	31.84	TRM default for 80-gallon tank (tank size according to customer)
$R_{Base}$	Thermal resistance coefficient of uninsulated tank	((hr-°F-ft <sup>2</sup> )/BTU)	14	TRM default
$A_{EE}$	Surface area of storage tank after adding tank wrap	ft <sup>2</sup>	34.14	TRM default for 80-gallon tank (tank size according to customer)
$R_{EE}$	Thermal resistance coefficient after addition of tank wrap	((hr-°F-ft <sup>2</sup> )/BTU)	24	TRM default
$\Delta T$	Average temperature difference between tank water and outside air	°F	60	TRM default
Hours	Hours per year	Hours	8,766	TRM default
$\eta \text{DHW}_{Gas}$	Recovery efficiency of gas hot water heater	-	0.78	TRM default
100,000	Conversion from Btu to therms	Therms/Btu	100,000	TRM default

Inputting the values into the above equation:

<sup>25</sup> Iowa Utilities Board. *Iowa Energy Efficiency Statewide Technical Reference Manual*. Section 2.3.7. July 12, 2017. Available online: <https://efs.iowa.gov/cs/groups/external/documents/docket/mdax/njq1/~edisp/1645801.pdf>.

$$\Delta\text{Therms} = ((31.84/14 - 34.14/24) * 60 * 8,766)/(0.78 * 100,000) = 5.74$$

### Refrigerator Replacement

For this measure, we used the IL-TRM V5.0 section 5.1.6<sup>26</sup> to estimate savings. We assumed the refrigerator was a time of sale, Energy Star qualified refrigerator. We used the TRM default, and weighted the refrigerator types based on the distribution of Energy Star refrigerator types from the Energy Star Qualified Products List<sup>27</sup> as shown in Table 10.

**Table 10. Savings and for Refrigerator Replacements**

Product Category	ENERGY STAR Time of Sale kWh Savings	Weighting
1. Refrigerators and Refrigerator-freezers with manual defrost	36.9	0%
2. Refrigerator-Freezer--partial automatic defrost	43.1	0%
3. Refrigerator-Freezers--automatic defrost with top-mounted freezer without through-the-door ice service and all-refrigerators--automatic defrost	44.3	31%
4. Refrigerator-Freezers--automatic defrost with side-mounted freezer without through-the-door ice service	51.7	1%
5. Refrigerator-Freezers--automatic defrost with bottom-mounted freezer without through-the-door ice service	54.4	20%
5A Refrigerator-freezer--automatic defrost with bottom-mounted freezer with through-the-door ice service	62.8	37%
6. Refrigerator-Freezers--automatic defrost with top-mounted freezer with through-the-door ice service	51.7	0%
7. Refrigerator-Freezers--automatic defrost with side-mounted freezer with through-the-door ice service	56.8	10%
<b>Weighted Average</b>	54.5	-

### Programmable Thermostats

The evaluation team estimated savings for programmable thermostats by using the IL-TRM V5.0 section 5.3.11.<sup>28</sup> The equations used are:

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<sup>26</sup> Illinois Energy Efficiency Stakeholder Advisory Group. *Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 5.0, Volume 3: Residential Measures*. Section 5.1.6 February 11, 2016. Available online: [http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Version\\_5/Final/IL-TRM\\_Effective\\_060116\\_v5.0\\_Vol\\_3\\_Res\\_021116\\_Final.pdf](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final/IL-TRM_Effective_060116_v5.0_Vol_3_Res_021116_Final.pdf).

<sup>27</sup> Energy Star Qualified Products List. Accessed January 8, 2018: <https://data.energystar.gov/Active-Specifications/ENERGY-STAR-Certified-Residential-Refrigerators/p5st-her9/data>.

<sup>28</sup> Illinois Energy Efficiency Stakeholder Advisory Group. *Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 5.0, Volume 3: Residential Measures*. Section 5.3.11 February 11, 2016. Available online:

$$\Delta kWh = \%ElectricHeat * Elec_{HeatingConsumption} * Heating_{Reduction} * HF * Eff_{ISR} + (\Delta Therms * F_e * 29.3)$$

$$\Delta Therms = \%FossilHeat * Gas_{HeatingConsumption} * Heating_{Reduction} * HF * Eff_{ISR}$$

Table 11 shows the variables, definitions, units, value, and notes or sources used (note that it is coupled with smart thermostats since the equations are the same, only the heating reduction factors differ).

**Table 11. Variable Inputs for Smart and Programmable Thermostats**

Variable	Definition	Units	Value	Notes/Source
<i>%ElectricHeat</i>	Percentage of heating savings assumed to be electric	-	Varies	Depends on survey results
<i>Elec<sub>HeatingConsumption</sub></i>	Estimate of annual household heating consumption for electrically heated single-family homes	kWh	11,613	TRM Default for Heat Pump (assuming heat pump as it is more conservative)
<i>Heating<sub>Reduction</sub></i>	Assumed percentage reduction in total household heating energy consumption due to advanced thermostat	-	6.20%	Programmable thermostat savings factor
<i>HF</i>	Household factor	-	100%	Single-family home; all customers in single-family homes
<i>Eff<sub>ISR</sub></i>	Effective in-service rate	-	100%	Assume 100%
$\Delta$ Therms	Therms savings	Therms	Varies	Savings due to reduction in fan use
$F_e$	Furnace Fan energy consumption as a percentage of annual fuel consumption	-	3.14%	TRM Default
29.3	kWh per therm	kWh/therm	29.3	TRM Default
<i>Btuh</i>	Size of AC unit	Btuh	33,600	TRM Default
3412	Btu to kWh	kWh/Btu	3412	TRM Default
<i>SEER</i>	Cooling efficiency	kBtu/kWh	8.65	TRM Defaults weighed by RECS 2015 data (Table HC7.7 Air conditioning in Northeast and Midwest regions)

[http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Version\\_5/Final/IL-TRM\\_Effective\\_060116\\_v5.0\\_Vol\\_3\\_Res\\_021116\\_Final.pdf](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final/IL-TRM_Effective_060116_v5.0_Vol_3_Res_021116_Final.pdf)

$Ga_{HeatingConsumption}$	Estimate of annual household heating load	Therms	955	TRM Default
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For customer 2 (from Table 8 – electric heat, heat pump, single family home) the inputs to the equations above are as follows:

$$\Delta kWh = 100\% * 11,613 * 6.2\% * 100\% * 100\% + (0 * 3.14\% * 29.3) = 720.01$$

Customer 2 had no therms savings.

For customer 5 (gas furnace, single family home) the inputs to the equations above are as follows:

$$\Delta Therms = 100\% * 995 * 6.2\% * 100\% * 100\% = 61.69$$

$$\Delta kWh = 0\% * 0 * 6.2\% * 100\% * 100\% + (61.69 * 3.14\% * 29.3) = 56.76$$

### Efficient Windows

The Illinois TRM does not have this measure. We used the Iowa TRM<sup>29</sup> to estimate savings which relies on the following equations (note this is per window):

$$\Delta kWh = \Delta kWh_{cooling} + \Delta kWh_{heating}$$

$$\Delta kWh_{cooling} = ((U_{code} - U_{eff}) * A_{window} * CDD * 24 * DUA) / (1000 * \eta_{cool})$$

$$\Delta kWh_{heating} = ((U_{code} - U_{eff}) * A_{window} * HDD * 24 * ADJ_{window}) / (3412 * \eta_{heat}) + (\Delta Therms * F_e * 29.3)$$

$$\Delta Therms = ((U_{code} - U_{eff}) * A_{window} * HDD * 24 * ADJ_{window}) / (100,000 * \eta_{heat})$$

Table 12 shows the variables, definitions, units, values, and notes or sources used.

**Table 12. Variable Inputs for Efficient Windows**

Variable	Definition	Units	Value	Notes/Source
$U_{code}$	U-factor value of code baseline (IECC 2012) window assembly	Btu/ft2-°F-h	0.32	TRM Default for window assembly
$U_{eff}$	U-factor value of the efficient window assembly	Btu/ft2-°F-h	0.25	Actual value unknown, TRM uses this in an example
$A_{window}$	Area of insulated window	ft <sup>2</sup>	12.64 or 8	Weighted average of windows installed from follow ups or example used in TRM

<sup>29</sup> Iowa Utilities Board. *Iowa Energy Efficiency Statewide Technical Reference Manual*. Section 2.6.8. July 12, 2017. Available online: <https://efs.iowa.gov/cs/groups/external/documents/docket/mdax/njq1/~edis/1645801.pdf>.

Variable	Definition	Units	Value	Notes/Source
CDD	Cooling Degree Days	CDD 65	947	Average CDD in IL-TRM
HDD	Heating Degree Days	HDD 60	4860	Average HDD in IL-TRM
24	Converts days to hours	hours/days	24	TRM Default
DUA	Discretionary Use Adjustment	-	0.75	TRM Default
1000	Converts Btu to kBtu	kBtu/Btu	1000	TRM Default
$\eta_{cool}$	SEER	kBtu/kWh	11.51	Default SEER in IA TRM weighted by 2015 RECS data (Table HC7.7 Air conditioning in Northeast and Midwest regions)
$ADJ_{window}$	Adjustment for account for prescriptive engineering algorithms consistently overclaiming savings	-	63%	TRM Default
3412	Btu to kWh	kWh/Btu	3412	TRM Default
$\eta_{heat}$	Efficiency of heating system (electric)	COP estimate	1	Customer with electric heat had electric furnace
$\eta_{heat}$	Efficiency of heating system (gas)	-	74%	TRM Default
$F_e$	Furnace Fan energy consumption as a percentage of annual fuel consumption	-	3.14%	TRM Default
29.3	kWh per therm	kWh/therm	29.3	TRM Default
100,000	Conversion from Btu to therms	Therms/Btu	100,000	TRM Default

For customer 2 (in Table 8), we were unable to follow-up and verify information. Thus, we used the examples in the IA TRM to estimate savings (and assumed only one window was installed). This customer had no air conditioning and electric heating. The inputs to the equations above are:

$$\Delta kWh_{cooling} = 0$$

$$\Delta kWh_{heating} = ((0.32 - 0.25) * 8 * 4860 * 24 * 63%) / (3412 * 1) + (0 * 3.14% * 29.3) = 12.06$$

$$\Delta kWh = 0 + 12.06 = 12.06$$

For customer 4, we followed up and verified the heating type, cooling type, number of windows, and dimensions of windows. The customer did not know the U-values (but was told it was efficient by the contractor) so we assumed the ones used in the TRM. First the weighted average area of all the windows (Table 13):

**Table 13. Dimensions of Windows for Customer 5**

No. of Windows	Weight	Length (ft.)	Width (ft.)
10	77%	3.00	4.50
2	15%	2.33	2.50
1	8%	4.17	5.00
<b>Weighted Average Dimensions</b>		2.99	4.23
<b>Weighted Average Area = 2.99 * 4.33 = 12.64 square feet</b>			

The inputs to the equations for customer 4 are as follows:

$$\Delta\text{Therms} = ((0.32 - 0.25) * 12.64 * 4860 * 24 * 63\%) / (100,000 * 74\%) * 13 \text{ Windows} = 8.45$$

$$\Delta\text{kWh}_{\text{cooling}} = ((0.32 - 0.25) * 12.64 * 947 * 24 * 0.75) / (1000 * 11.51) * 13 \text{ Windows} = 17.03$$

$$\Delta\text{kWh}_{\text{heating}} = 0 + (8.45 * 3.14\% * 29.3) = 7.78$$

$$\Delta\text{kWh} = 17.03 + 7.78 = 24.81$$

### Variable Speed Pool Pumps

This measure was not in the IL-TRM. We the Pennsylvania TRM<sup>30</sup> to estimate savings which relied on the following equations:

$$\Delta kWh = kWh_{base} - kWh_{VFD}$$

$$kWh_{base} = HOU_{SS} * kW_{SS} * Days$$

$$kWh_{VFD} = [(HOU_{VFD, clean} * kW_{VFD, clean}) + (HOU_{VFD, filter} * kW_{VFD, filter})] * Days$$

Table 14 shows the variables, definitions, units, values, and notes or sources used.

**Table 14. Variable Inputs for Variable Speed Pool Pumps**

Variable	Definition	Units	Value	Notes/Source
$HOU_{SS}$	Hours of operation per day for Single Speed Pump. This quantity should be recorded by the applicant.	hours/day	11.4	TRM Default
$kW_{SS}$	Electric demand of single speed pump at a given flow rate	kW	0.946	Smallest motor size in PA TRM
$Days$	Pool pump days of operation per year	days	122	TRM Default
$HOU_{VFD, clean}$	Average daily hours of operation during peak period (between 2pm and 6pm) for Variable Frequency Drive Pump on cleaning mode	hours/day	2	TRM Default
$kW_{VFD, clean}$	Electric demand of variable frequency drive pump during cleaning mode	kW	0.25	TRM Default
$HOU_{VFD, filter}$	Average daily hours of operation during peak period (between 2pm and 6pm) for Variable Frequency Drive Pump on filtration mode	hours/days	10	TRM Default
$kW_{VFD, filter}$	Electric demand of variable frequency drive pump during filtration mode	kW	0.75	TRM Default

The inputs to above equations are:

$$kWh_{base} = 11.4 * 0.946 * 122 = 1,315.70$$

$$kWh_{VFD} = [(2 * 0.25) + (10 * 0.75)] * 122 = 488.00$$

$$\Delta kWh = 1,315.70 - 488.00 = 827.70$$

<sup>30</sup> State of Pennsylvania. *Technical Reference Manual*. Section 2.7.2. February 2017. Available online: [http://www.puc.state.pa.us/filing\\_resources/issues\\_laws\\_regulations/act\\_129\\_information/technical\\_reference\\_manual.aspx](http://www.puc.state.pa.us/filing_resources/issues_laws_regulations/act_129_information/technical_reference_manual.aspx).