Opinion Dynamics

THERMOSTAT ASSESSMENT FOR COOLING SAVINGS

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EXECUTIVE SUMMARY

The Illinois Technical Reference Manual (TRM) currently assumes that programmable thermostats do not save cooling energy based on a literature review of other programmable thermostat research. The evaluation team (Cadmus and Opinion Dynamics, Inc.) conducted two residential customer surveys and analyzed existing metering data to determine whether there is evidence of cooling energy savings from programmable thermostats.

We surveyed 150 customers who recently purchased programmable thermostats through the REEP program as well as 155 from the general population of manual thermostats users. We used a separate sample of 91 participants from various metering studies conducted in Ameren Illinois and Ameren Missouri service territories in 2010 and 2011 (metering program participant types are listed in the Methodology Section of this report. We analyzed the data from these studies to compare unit energy consumption (UEC) of central HVAC systems that appeared to operate to meet regularly scheduled thermostat settings to the energy consumption of HVAC systems operating manually (i.e., HVAC system did not operate to meet regular programmed thermostat setting changes)). We correlated this information with indoor temperatures to understand how these customers used their thermostat with their cooling system.

Our survey analysis found that programmable thermostats are not always programmed to save energy and those who purchase programmable thermostats are likely to have previously adjusted their manual thermostats regularly. Our metering analysis found that those who have regular setting changes, often only adjust it by a few degrees in the summer. Of all REEP participants surveyed, only 18% who were not already adjusting a manual thermostat regularly, program their thermostat for regular adjustments and set it to 75^{o}F or higher when they are not home in the summer.

In both the survey and the metering samples, we used the information gathered to separate thermostat users (both manual and programmable) into three discernible control strategies for the summer season:

1. Regularly scheduled changes in the thermostat setting, which result in increased temperatures during the day when unoccupied;
2. Manually controlled temperature settings with no regular schedule; and
3. Thermostat setting at a constant temperature for all hours.

Scenario 1 utilizes the capability of a programmable thermostat while scenarios 2 and 3 do not. Theoretically, those who operate their thermostat according to scenario 1 should save energy; however; our summer metering analysis found this was not true for the metered sample of customers. Table 1 presents the average summer UEC by control strategy. Energy consumption was normalized by cooling degree days (CDD) and system size (tons).

Table 1. Normalized Metered Unit Energy Consumption (UEC) with Sample Precision

Type	N	Normalized UEC (kWh/ton)	Precision (90% Confidence)	Upper kWh/ton (90% confidence)	Lower kWh/ton (90% confidence)	Average Occupied Temp	Average Un-occupied Temp
Programmed Schedule	39	656	±15.0%	754	557	72	75
Custom/ Manual Control	20	605	±20.2%	727	483	74	78
Constant Temp or System Off	32	514	±11.3%	572	456	77	N/A

We further investigated the lack of energy savings and found the following reasons for this difference:

- Homes with regularly scheduled temperature settings have an average indoor temperature lower than those who do not
- The temperature change during unoccupied periods is too minor and too short of a time period to result in savings
- Manually controlled thermostats are turned off for longer periods of time and these homes have higher average indoor temperatures
- Constant temperature set point homes tolerate higher average temperatures and turn off the HVAC system for longer periods of time than those following a program

Based on this analysis, we are not able to estimate cooling savings for programmable thermostat participants since those programming their thermostats for regular settings actually used more energy than other groups in this metering sample. We note that the metered population of customers may not be representative of all participants since they were customers who had previously participated in other AIC programs. We also did not have metering data from those with manual thermostats, but rather from the participants who used their programmable thermostat like a manual thermostat. A more definitive analysis would include a complete analysis of thermostat settings between the different populations at all hours of the day, before and after installation of programmable thermostats; however this may not be cost effective given the measure's savings potential. One challenge of such a study would be the possibility that study participants may behave differently than they would if they were not been part of a study.

A separate analysis using winter metering data is planned for summer 2013 to estimate the potential for using Illinois specific data to update the winter heating savings already in the TRM.

INTRODUCTION

The industry designs programmable thermostats to reduce energy consumption by raising cooling set points and decreasing heating set points during user-chosen periods, typically when occupants are away from the building or sleeping. Energy savings accrue when the building temperature is not controlled to a set temperature and the cooling or heating energy consumption is then reduced. Cooling savings occur under the following conditions: 1) the building thermostat setting must be higher than normal and 2) the cooling system must stay off for a relatively long period of time. No savings occur during mild-temperature periods or when the HVAC system is off for only short periods. For example, during mild temperatures, the air conditioner might only operate for 10 minutes in an hour. An increase in the set point of a few degrees for two hours would deliver very little savings. When an occupant re-sets the temperature to the comfort zone, the HVAC system operates longer to bring the home back down to the desired temperature.

The Illinois Technical Reference Manual (TRM) currently assumes that there are no savings from programmable thermostats because a literature review by the TRM consultants did not identify any secondary research quantifying cooling savings from this measure. Ameren Illinois Company (AIC) currently offers incentives for programmable thermostats through its Residential Energy Efficient Products (REEP) program which saves heating energy.

The evaluation team conducted research specific to AIC's territory to determine if there are cooling savings associated with customer purchases of programmable thermostats. A separate potential heating savings analysis is planned for summer 2013, after downloading recent winter metering data, which may be used to update the existing information in the TRM. We identified the following researchable questions for this study:

- How do REEP participants use their new programmable thermostats?
- How does the REEP participants' use of their new programmable thermostats compare to their use of their previous thermostat (i.e., did their behavior change)?
- Does the general population of manual thermostat users adjust their thermostat by adjusting the temperature when they are away to save cooling energy?
- Do REEP program participants use their new thermostats to increase set point temperatures in the summer more, on average, than customers with manual thermostats? If so, what savings are associated with the incremental adjustments?
- What are normalized cooling energy consumption estimates in homes where occupants program thermostats, adjust their systems manually, or leave thermostats at constant settings?

METHODOLOGY

Data Sources

The evaluation team used a combination of existing data and data we collected for this analysis. These data sources include the following five sets of metering data:

- 23 programmable thermostat users from AIC's Direct Load Control (DLC) program with data collected in 2010. (In the DLC program, all participants had programmable thermostats, although their use of the device varied.)
- 22 new heating, ventilation, and air conditioning (HVAC) and new air-source heat pump (ASHP) participants from the previous PY2 HVAC program with data collected in 2010 (In the PY2 HVAC program, information regarding programmable thermostat use was tracked.)
- 15 central air conditioning (CAC) systems from Ameren Missouri collected in 2011 (14 had programmable thermostats, use of device varied).
- 24 CAC homes from the PY4 HVAC program with data collected in 2012 (21 had programmable thermostats, use of device varied).
- 24 ASHP homes from the PY4 HVAC program with data collected during summer of 2012 (all had programmable thermostats, use of device varied).

Data sources also include the following two customer surveys:

- A survey of REEP participants from PY4 with data collected in 2012 (for a total of n=150 and 90% confidence with +/- 6.7% precision).
- A short general population survey of 155 AIC customers with data collected in 2012 (90% confidence with +/- 6.7% precision) who use manual thermostats with no programming capability.

We analyzed the following information to identify the home's set point strategy and included with the metering data:

- The power drawn by the compressor and the condenser fan for the central air conditioner or heat pump.
- The outdoor temperature and relative humidity in the vicinity of the condenser (using solar-shielded sensors).
- The indoor temperature and humidity near the thermostat to examine set points.
- The evaporator fan amperage with a spot measurement of true power in cooling mode.

Analysis

In analyzing our metered data, we followed these steps:

- Analyzed the indoor and outdoor temperature patterns to identify each customer's set point strategy.
- Grouped customers into similar set point strategies (i.e., programmed for savings, manually adjusted, or constant set point).
- Compared energy consumption of the set point strategy metering groups after normalizing the data for air conditioning efficiency, system size, and weather.

We analyzed the survey data to determine what proportion of REEP participants use their programmable thermostats in different set point strategies compared to the general population of manual thermostat users. We also asked the REEP participants how their use of the programmable thermostats compared to their previous thermostat.

We planned to calculate thermostat savings according to the following formula:

$$\sum \%i \text{ x } PTS_i - \sum \%j \text{ x } MTS_j$$

Where,

i	=	one of the set point strategies for programmable thermostats
%i	=	percentage of programmable thermostat survey participants using set point strategy i
PTSi	=	average normalized energy use of metered participants utilizing set point strategy i
j	=	one of the set point strategies for manual thermostats
% j	=	percentage of manual thermostat users from general population using set point strategy j
MTSj	=	average normalized energy use of metered participants using set point strategy j

This equation assumes that metering data will show savings between the "constant temperature" and "manual but changing set points" scenarios in comparison to the "regular scheduled set points scenario," which as explained below, did not occur.

SURVEY FINDINGS

The evaluation team used responses from surveys of both REEP participants and manual thermostat users to identify the proportion of those falling within each of the three set point strategies: regular scheduled set points, manual but changing set points, or constant temperature setting; compare thermostat settings of these three groups; and determine the proportion of REEP thermostat purchasers who are likely to save cooling energy.

Set Point Strategies

Using survey responses, we categorized the REEP participants' current programming behavior and previous thermostat behavior, along with the manual thermostat use, into the three set point strategies and looked for differences between them. The survey sample of manual thermostat users were more likely to change their set points manually and less likely to have a constant set point than either REEP participant's current behavior or REEP participant's previous behavior. None of the other comparisons shown in Table 2 are different by statistically significant amounts.

Table 2. REEP Programmable and Manual Thermostats Behavior Patterns

Behavior	REEP (Programmable thermost)	REEP Previous Use (Manual or Programmable)	Manual Gen Pop %
Regular, Scheduled Set Points	56% (+/- 6.9%)	50% (+/-6.7%)[NS]	48% (+/- 8.5%)[NS]
Manual, but Changing Set Points	14% (+/-1.7%)	17% (+/- 2.3%)[NS]	36% (+/- 6.3%)[S]
Constant Set Point	29% (+/-3.6%)	33% (+/- 4.4%) [NS]	16% (+/- 2.8%) [S]

NS= Difference between value and REEP population is not statistically significant
S= Difference between value and REEP population is statistically significant

Thermostat Setting Comparisons

We compared temperature set points at 4:00 p.m. on summer weekdays among the three groups (REEP participant's current behavior, REEP participant's previous behavior, and manual thermostats). Table 3 shows the reported temperatures are similar; while small differences exist, none of them are statistically significant.

Table 3. REEP and Manual Thermostat Reported Temperature at 4:00 p.m.

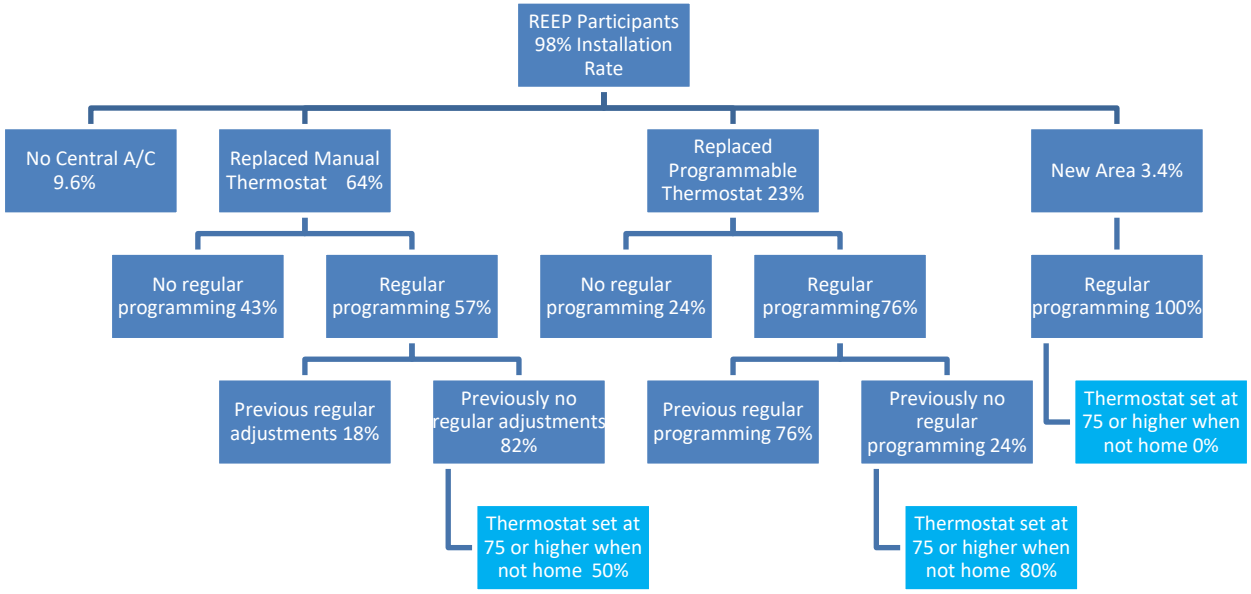
Type	REEP Participants Average Temperature Set Point	REEP Participants Previous Average Temperature Set Point	Manual Thermostats Average Temperature Set Point
Regular Scheduled Set Points	73.8°F	73.1°F	73.7°F
Manual but Changing Set Points	73.0°F	76.5°F	73.5°F
Constant Set Point or System Off	73.6°F	72.0°F	71.7°F
Average	73.6°F	73.3°F	72.1°F

REEP Participants' Saving Potential

To assume a thermostat purchased through the REEP program potentially saves energy, REEP participants would have to have: 1) purchased the programmable thermostat for a new area of the home that did not previously have a thermostat and actively program it, 2) replaced a manual thermostat with the programmable thermostat and actively program it, or 3) replaced an existing programmable thermostat that was not regularly programmed with one they actively program. For each of these, participants would have to set their thermostat at 75^{o}F or higher when they are not home at 4:00 p.m. on weekday afternoons. The survey questionnaires which contain the questions used to determine the frequencies shown in Figure 1 are provided in

Appendix A.

Figure 1.REEP Participants with Savings Potential



We multiplied out the frequencies of REEP participants who meet the criteria for savings potential, as outlined in this figure, to estimate the proportion that potentially save energy as 18%.[1]

[1] This is calculated as (64% x 57% x 82% x 50%) + (23% x 76% x 24% x 80%) + (3.4% x 100% x 0%) = 18%

METERING ANALYSIS FINDINGS

The evaluation team examined metering data taken during three summers (2010-2012) from 91 customers in the AIC service territory.[2] Eighty-four of the 91 customers used a programmable thermostat to control their system. However, when examining temperature set points, as well as the changes in temperature, it became clear that many of the participants were not using a scheduled program.

Our review of meter data shows there are three main types of thermostat operation:

1. *Residents setting their thermostat to change temperatures on a regularly scheduled basis.* The energy consumption of the HVAC systems at these sites was categorized as a "regular set points." This group consists of 43% of the 91 metering participants. The thermostat temperature settings followed a very predictable pattern.[3]
2. *Residents setting their thermostat inconsistently by manually controlling the system either on their manual thermostat or directly with air conditioning disconnected from the thermostat, throughout the summer*. The energy consumption of the HVAC systems at these sites was categorized as "manual but changing set points." This group consists of 22% of the 91 metering participants.
3. *Residents with thermostat settings nearly constant throughout the cooling season.* The energy consumption of the HVAC systems at these sites was categorized as a "constant set point." This group consists of 35% of the 91 metering participants.

The following three figures show examples of temperature logging data used to categorize systems into the three groups.

Figure 2 shows a "regular set points" home thermostat in operation. This particular home had relatively high energy consumption. The thermostat program was set to cool the home to approximately 67°F until midnight (low points on chart). The program would then allow the temperature to rise throughout the day to about 72°F until 5:00 p.m. (high point on chart). At this point, the program would then activate the system to cool the house back down. Each day at 5:00 p.m., the air conditioner would run nearly continuously until it cooled the home to the desired temperature set point, after which it would maintain the temperature within a specific temperature range. This particular home had high thermal mass and it required the air conditioner to run almost constantly to cool the home just a few degrees, especially during the hot late afternoon. We suspect if this home had simply left the thermostat constant it would have used a similar amount of energy.

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[2] Fourteen of these homes had received Ameren Missouri new CAC installations; these were added to the sample to increase precision.

[3] The team reviewed the tracked indoor-room temperature data from a logger placed at the thermostat to assess whether the thermostat was following a program or if the temperature adjustments occurred regularly.

Figure 2. Regular Set Points Thermostat Trend

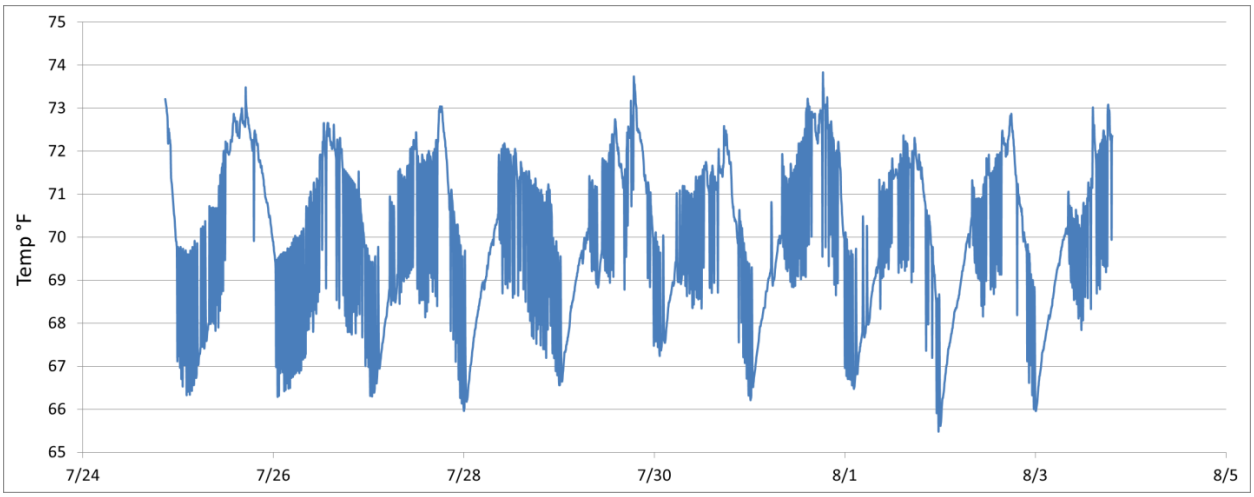


Figure 3 shows variable usage in a home with "manual but changing set points" during a hot period of the summer. This homeowner had a programmable thermostat, but did not run any programs. The homeowner set the desired temperature at various, inconsistent times. The following figure shows that the thermostat is controlling the cooling system with a dead-band range (the thermostat allows temperatures to vary slightly from the set point). This thermostat dead-band strategy cools the home to a temperature set point about 1°F cooler than the thermostat setting and allows the temperature in the home to rise about 1°F higher than the thermostat setting. The thermostat dead-band prevents over-cycling of the HVAC system, allowing it to run for longer periods of time and remain off for longer periods of time than it would if it tried to maintain a precise temperature. We also indicate in Figure 3 how the graph looks when the HVAC system is not cooling the home (labeled *cooling system off*). The line at this point is smooth. On August 4, for example, our interpretation of the data suggests the homeowner turned the thermostat down from 72°F or higher to about 69°F, then down again by approximately another degree, and then turned it off until the morning of August 5. We reviewed the HVAC power data to confirm this interpretation.

Figure 3. Manual Thermostat Operation

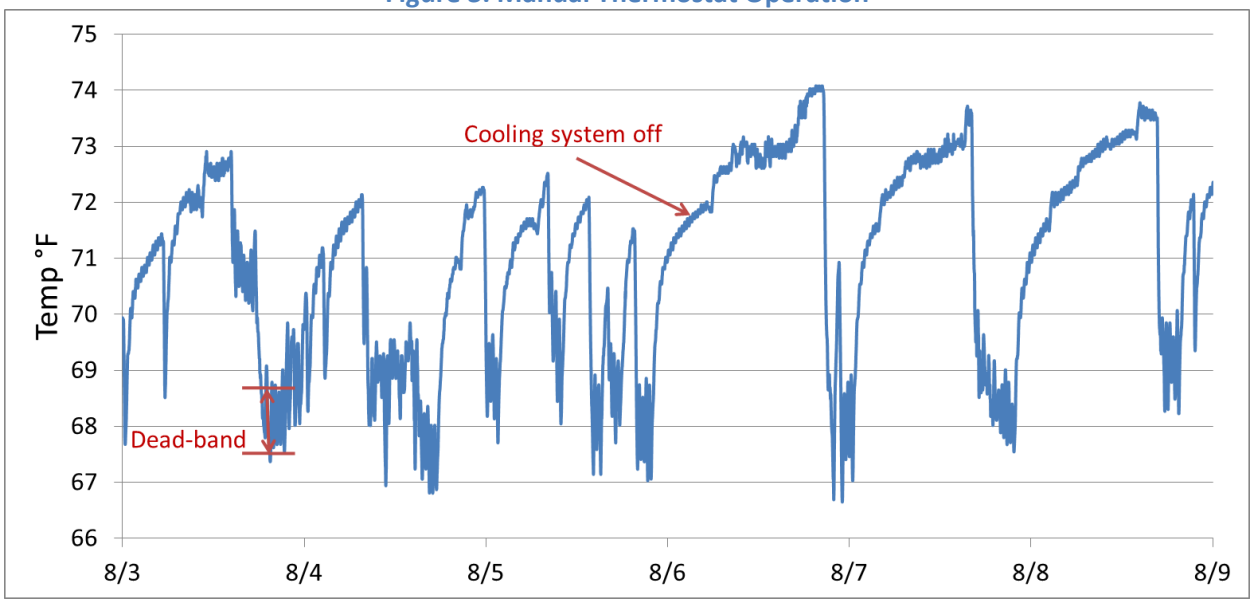
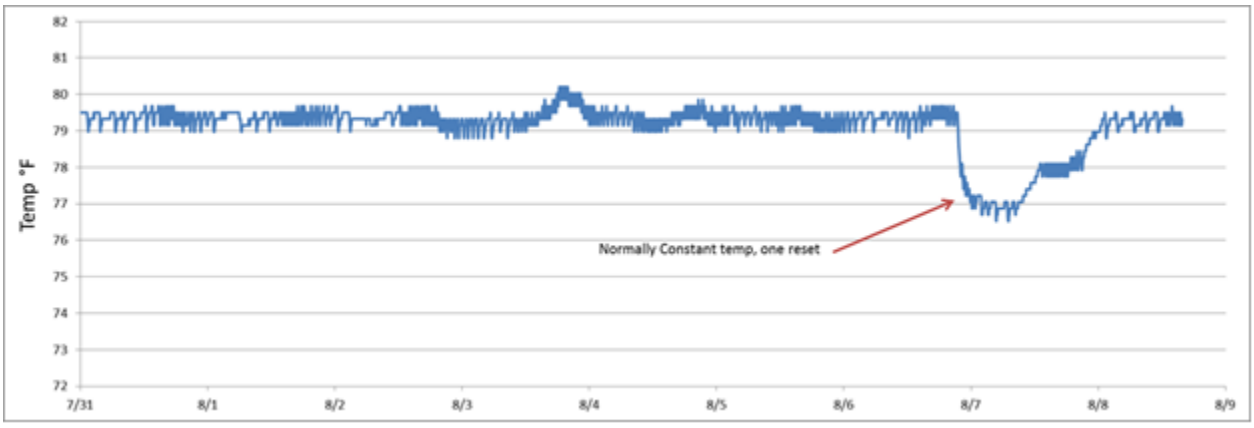


Figure 4 shows a "constant set point" thermostat set at 79°F, which was maintained for the majority of the cooling season. Some days it was turned off completely and the temperature rose above the set point (not shown). There is some variability in the temperature because the thermostat dead-band was approximately 2°F, which allowed the temperature to float a little below and a little above the actual set point. This figure also shows one day where the temperature was reduced for a day but then returned to the original set point. We consider this operation "constant set point" even with this manual reduction because the majority of the set points were constant.

Figure 4. Constant Set Point Thermostat Trend



The evaluation team categorized the 91 metering participants into the three groups described above. We compared the average weather (cooling degree days [CDD] during the season metered), HVAC efficiency (Air-Conditioning, Heating, and Refrigeration Institute [AHRI] Seasonal Energy Efficiency Rating [SEER] value), and size (tons) of each group. The groups were metered in similar climates on average;

they had nearly the same average CDD. To account for differences in efficiency (SEER), we normalized each meter data set by the average of the entire population of meter data.

Table 4 compares the normalized UECs for each of the three set point strategies. While it appears that the "regular scheduled set point group" uses the most energy, the differences between the three groups are not statistically significant. The UECs and statistically significant range are shown in the table along with the average occupied and unoccupied thermostat settings.

Table 4. Normalized Metered UEC with Sample Precision*

Type	N	Normalized UEC (kWh/ton)	Precision (90% Confidence)	Upper kWh/ton (90% confidence)	Lower kWh/ton (90% confidence)	Average Occupied Temp	Average Un-occupied Temp	% Time Drifting
Regular Scheduled Set Points	39	656	±15.0%	754	557	72	73	28%
Manual Changing Set Points	20	605	±20.2%	727	483	74	78	25%
Constant Temperatures	32	514	±11.3%	572	456	76	N/A	N/A

* The metering sample includes a higher proportion of heat pumps than occurs in the AIC population (7% of CACs are heat pumps[4] in the population versus 32% of the sample. However, we saw the same relative differences in normalized UEC between the three groups).

Because of the disparity in average temperature set points between the three groups in the metered sample, we further analyzed each group to better understand their energy usage.

4 http://www.eia.gov/consumption/residential/data/2009/xls/HC7.9%20Air%20Conditioning%20in%20Midwest%20Region.xls

Regular Scheduled Set Points

We found the daily temperature differential between set points in this group to be relatively small (average increase of 2.5°F). The time period the HVAC system operates at the higher temperature was also limited, mainly because the cooling required during the middle of the day (during unoccupied times when the temperature set point is increased) is less than the cooling required in the late afternoon and evening when the thermostat temperature is returned to its occupied set point (lower temperature). The unoccupied day-time set point was reached for less than two hours, on average, during a hot week of the summer. In other words, the temperature gain, on average, was about 2.5°F in seven hours and the upper limit was maintained for about two hours before the temperature was brought back to the lower set point. As a result, the savings from that group was lower than expected.

Manual Changing Set Points

In this group, we observed times when significant energy reduction occurred because the system was set back to a high temperature or turned off completely. But we also observed times when the temperature was not set back to a high temperature for extended periods of time.

Constant Temperatures

This group had the highest average indoor temperature. Over the course of the summer, this resulted in the lowest normalized energy consumption.

DISCUSSION AND CONCLUSIONS

It is possible that the metering sample is not representative of the REEP participant population (since we used existing metering data from other AIC programs), and the disparities between REEP participants before and after the program are greater than the metering indicates. The metering participants were primarily those who had purchased new efficient HVAC systems through AIC's program and may be using their thermostat to improve comfort rather than saving energy. According to survey data, however, only 18% of those purchasing thermostats through the REEP program are potentially saving energy. If we assume these 18% are currently following the Environmental Protection Agency's recommended settings and used previous manual settings as identified in Table 6, cooling energy savings would be .18 X 333 kWh or 60 kWh per year.

Table 5. EPA Assumptions for Programmable Thermostats

	Temperature Setting with Manual Thermostat	Temperature Settings with Programmable Thermostat
When no one was home	76.4	82.0
During the day when someone was home	75.0	75.0
During sleeping hours	75.3	79.0

The metering data does indicate different patterns of use for those who manually adjust their thermostat compared to those who program it. Consider the following two scenarios:

- *Scenario 1.* A person leaves the house every day and turns the air conditioning off when leaving for work at 8:00 a.m. The participant then turns the air conditioner back on when he or she returns, which could vary depending on the after-work schedule.
- *Scenario 2.* A person programs the thermostat to reach 80°F at 8:00 a.m. and then sets back the temperature starting at 3:30 p.m. so the home is at the desired set point by 5:00 p.m. when they may be home.

Homes using the set point strategy defined in Scenario 1 will use less energy because the home will stay hotter for a longer time period. There may be times when the homeowner simply tolerates a higher temperature set point upon returning home, does not come home until later, or does not turn on the HVAC system and just opens windows. Our review of the indoor temperature data suggested these scenarios were occurring at many homes. A possible further study could track thermostat settings during all hours before and after installing programmable thermostats. This may not be cost effective given the potential energy savings for this measure. One challenge of such a study would be the possibility that study participants may behave differently than they would if they were not been part of a study.

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APPENDIX A.

Programmable Thermostat

REEP Participants Survey

Ameren Illinois

Introduction

Hello, my name is _____ and I am calling from _____ on behalf of Ameren Illinois. We are calling today to gather information about your programmable thermostat use that will help Ameren Illinois improve their energy efficiency programs. This is not a sales call and should only take a few minutes. Would you have a few minutes to answer some questions now?

[If needed: Contact at Ameren Illinois to confirm survey legitimacy – Sharon Ruhland, 309-677-5192]

A1. We'd like to talk with the person who made the decision to buy a programmable thermostat that received a rebate from Ameren Illinois. Would that be you? Would you have a few minutes to answer some questions now?

1. Yes
2. No **[ASK TO SPEAK WITH PERSON WHO WAS PRIMARY DECISION MAKER. IF NOT AVAILABLE, THANK AND SET CALLBACK]**

D. DON'T KNOW **[THANK AND TERMINATE]**
R. REFUSED **[THANK AND TERMINATE]**

A2. Our records show that you received a rebate of [insert $25 X COUNT] for [INSERT COUNT] programmable thermostat(s) in the last year. Is that correct?

1. Yes
2. No **[THANK AND TERMINATE]**
8. DON'T KNOW **[THANK AND TERMINATE]**
9. REFUSED **[THANK AND TERMINATE]**

Program Awareness

B1. How did you first hear about Ameren Illinois' rebates for programmable thermostats? **[DO NOT READ; DO NOT PROMPT - ONE ANSWER ONLY]**

1. Saw rebate form at the store
2. Saw sign/display at the store
3. Salesperson or other store staff told me about it
4. Saw store advertising with Ameren logo
5. Ameren Website **[SKIP TO B3]**
6. Other Website **[SPECIFY]**
7. Personal Energy Report (PER)
8. E-mail from Ameren Illinois
9. Bill insert/information came in the mail with my bill
10. Friend, family member, co-worker (word of mouth)

00. Other **[SPECIFY]**
98. DON'T KNOW
99. REFUSED

[ASK IF B1 ≠ 5]

B2. Have you been to the Ameren Illinois Website?

1. Yes
2. No

8. DON'T KNOW
9. REFUSED

B3. Please think back to the time when you were deciding to buy a new programmable thermostat. What motivated you to purchase a new one? [MULTIPLE RESPONSE OF THREE]

1. (Old equipment didn't work)
2. (Old equipment working poorly)
3. (The incentive or rebate)
4. (The information or technical assistance I got from Ameren Illinois)
5. (Wanted to save energy)
6. (Wanted to reduce energy costs)
7. (Past experience with this program)
8. (Because of past experience with another Ameren program)
9. (Recommendation of dealer/retailer)
10. (Recommendation from friend/family)
11. (Saw advertisement for rebate program)
12. (Environmental concerns)
13. (Global warming)
14. (Keeping up with the latest technology or trends)

00. (Other) [SPECIFY]
98. (DON'T KNOW)
99. (REFUSED)

THERMOSTAT USAGE

C1. [IF COUNT>1, "Are all", ELSE "Is"] the programmable thermostat **[IF COUNT>1, THERMOSTATS]** for which you received a rebate installed in your home now?

1. Yes, [READ IN if prog them quantity>1 "ALL ARE"] currently installed in my home
2. **[IF COUNT >1]** Only one is currently installed in my home
3. No, None are currently installed **[THANK AND TERMINATE]**
8. DON'T KNOW **[THANK AND TERMINATE]**
9. Refused **[THANK AND TERMINATE]**

C1A. Does your home have central air conditioning?

1. Yes
2. No **[SKIP TO TC3]**
8. DON'T KNOW **[THANK AND TERMINATE]**
9. Refused **[THANK AND TERMINATE]**

C2. **[IF COUNT>1 AND C1=1]** Do any of your new thermostats **[ELSE IF COUNT=1]** Does this new thermostat installed in your home control when your air conditioning turns on and off, or do you manually turn on and off your air conditioning as needed?

1. Thermostat controls it
2. Manually control it **[THANK AND TERMINATE]**
8. DON'T KNOW **[THANK AND TERMINATE]**
9. Refused **[THANK AND TERMINATE]**

TC3. [IF COUNT>1 AND C1=1] Please think about the new thermostat that controls [**IF C1A=1, insert "air conditioning in"]** the largest amount of living space in your home to answer the next several questions.

C3. Does this thermostat also control your heating system?

1. Yes
2. No
8. DON'T KNOW
9. REFUSED

C4. Is your heating system fueled by gas, electricity, or something else?

01. (Gas)
02. (Electricity)
00. (Other) Specify _____
98. (Don't know)
99. (Refused)

C5. Approximately what percentage of your home's living space is controlled with this thermostat?

1. (100%)
2. (90-99%)
3. (80-89%)
4. (70-79%)
5. (60-69%)
6. (50-59%)
7. (40-49%)
8. (30-39%)
9. (20-29%)
10. (10-19%)
11. (10% or less)
98. (DON'T KNOW)
99. (REFUSED)

C5a. Did the new thermostat replace an existing thermostat or was it purchased for an area that did not previously have a thermostat?

1. (Replacement)
2. (New) **[SKIP TO C11]**
8. (DON'T KNOW) **[SKIP TO C11]**
9. (Refused) **[SKIP TO C11]**

C6. Did this thermostat replace a manual thermostat? A manual thermostat has only one setting for the internal temperature you want and must be manually adjusted.

1. Yes **[SKIP TO C7]**
2. No
8. (DON'T KNOW) **[SKIP TO C11]**
9. (REFUSED) **[SKIP TO C11]**

C6A. **[ASK IF C1a=1]** Did you control your central air conditioning with your previous programmable thermostat or did you manually turn the air conditioning on and off when you felt it was needed?

1. Previously used thermostat to control
2. Previously manually controlled **[SKIP TO C8]**
8. (DON'T KNOW) **[SKIP TO C11]**
9. (REFUSED) **[SKIP TO C11]**

C7. Did you ever **[IF C6=1 "adjust" IF C6=2 "program"]** your previous thermostat to save energy when you were gone or at night?

1. Yes
2. No **[SKIP TO C8]**
8. (DON'T KNOW) **[SKIP TO C8]**
9. (REFUSED) **[SKIP TO C8]**

NC7a. **[IF C6=1]** Approximately how often do you adjust this thermostat, would it be…?

01. Daily
02. 4-6 times a week
03. 2-3 times a week
04. Once a week
05. Once a month
06. Never
00. (Other: specify)
98. (Don't know)
99. (Refused)

C8. Do you program this new thermostat for regular temperature setting changes, do you manually adjust it, or do you leave it at the same temperature setting always? (PROBE TO FIND THE RESPONSE MOST ACCURATE, CHOOSE ONLY ONE)

1. (Program)
2. (Manually adjust) **[SKIP TO C12]**
3. (Leave at same setting) **[SKIP TO C12]**
8. (DON'T KNOW) **[SKIP TO C12]**
9. (REFUSED) **[SKIP TO C12]**

C9a. **[IF C6=1 and C7=1]** Do you generally program this new thermostat at the same temperature settings as your previous thermostat?

1. Yes
2. No
8. (DON'T KNOW)
9. (Refused)

C9b. **[IF C6=1 and C7=1]** Do you generally program this new thermostat during the same periods of time as your previous thermostat?

1. Yes
2. No
8. (DON'T KNOW)
9. (Refused)

[SKIP TO C11 if BOTH C9A & C9B=98,99]

C10. **[C9=1 or 2]**. Please describe how you set your previous thermostat. **[READ PROBE TO DETERMINE WHICH RESPONSE BELOW IS MOST ACCURATE OR READ IF DON'T KNOW]**

1. Adjust for night and daytime work hours both summer and winter
9. Adjusted only days, summer and winter
2. Adjusted only night, summer and winter
3. Adjusted only winter, days nights
5. Adjusted only winter, nights only

10. Adjusted only winter, days only
4. Adjusted only summer, days and nights
6. Adjusted only summer, nights only
11. Adjusted only summer, days only
7. Adjust for vacations only
8. Set at one temperature for summer and one temperature for winter
00. (Other) [Specify]
8. (DON'T KNOW) **[READ LIST ABOVE TO DETERMINE WHICH IS CLOSEST AND ATTEMPT TO CATEGORIZE]**
9. (REFUSED)

C11. **[SKIP IF C9b=1]**. Please describe how you program this new thermostat. **[READ, PROBE TO DETERMINE WHICH RESPONSE BELOW IS MOST ACCURATE OR READ IF DON'T KNOW]**

1. Adjust for night and daytime work hours both summer and winter
9. Adjusted only days, summer and winter
2. Adjusted only night, summer and winter
3. Adjusted only winter, days nights
5. Adjusted only winter, nights only
10. Adjusted only winter, days only
4. Adjusted only summer, days and nights
6. Adjusted only summer, nights only
11. Adjusted only summer, days only
7. Adjust for vacations only
8. Set at one temperature for summer and one temperature for winter
00. (Other) **[Specify]** _____
98. (DON'T KNOW) **[READ LIST ABOVE TO DETERMINE WHICH IS CLOSEST AND ATTEMPT TO CATEGORIZE]**
99. (REFUSED)

C11A. **[IF C9b=1 & C9a=1]** Just to confirm, this is the same way you program your new thermostat, is that correct?

1. Yes
2. No **[GO BACK TO C10]**
8. (DON'T KNOW) **[GO BACK TO C10]**
9. (REFUSED) **[GO BACK TO C10]**

C12. What temperature is this new thermostat typically set for at night in the winter, would it be…

1. Less than 62°F
2. 62-65°F
3. 66-69°F
4. 70-74°F
5. 75-79°F

6. 80°F or higher
96. (Not applicable/Did not have for this season)
98. (DON'T KNOW)
99. (REFUSED)

C13. **[SKIP IF C9A=1 OR C5A<>1]** What temperature was your old thermostat typically set for at night in the winter, would it be…

1. Less than 62
2. 62-65°F
3. 66-69°F
4. 70-74°F
5. 75-79°F
6. 80°F or higher
8. (DON'T KNOW)
9. (REFUSED

[SKIP TO H1 IF C1A=2]

C14. What temperature is this new thermostat typically set for at 4 p.m. in the summer on a weekday, would it be…

1. Less than 62°F
2. 62-65°F
3. 66-69°F
4. 70-74°F
5. 75-79°F
6. 80°F or higher
7. Off
96. (Not applicable/Did not have for this season)
98. (DON'T KNOW)
99. (REFUSED)

C15. **[SKIP IF C9A=1 OR C5A<>1]** What temperature was your old thermostat typically set for at 4 p.m. in the summer on a weekday, would it be…

1. Less than 62°F
2. 62-65°F
3. 66-69°F
4. 70-74°F
5. 75-79°F

6. 80°F or higher
7. Off
8. (DON'T KNOW)
9. (REFUSED

C16. **[ASK IF C14 or C15=1-6]** Is someone typically at home at 4pm on weekdays?

1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

Demographics

"Now I have just a few final questions about your home and energy awareness."

H1. How informed do you feel you are about ways to save energy, including buying and using energy efficient appliances and equipment? Would you say:

1. Very Informed
2. Somewhat Informed
3. Neither informed nor uninformed
4. Somewhat Uninformed
5. Very Uninformed
-98. Don't know
-99. Refused

H2. Which one of the following best describes the type of home in which you live? (READ)

1. A single-family detached **[no common walls]**
2. A single-family attached **[at least one common wall with the surrounding dwellings, such as a town home, patio home, or condo]**
3. Multi-family home, such as an apartment **[requires a different family living above or below, such as an apartment]**
4. A mobile home or trailer

00. Other **[SPECIFY]** _____
-98. Don't know
-99. Refused
-100.

H12. Do you own or rent your home?

1. Rent
2. Own
8. (Don't know)
9. (Refused)

H3. About how large is your home in square feet, excluding your garage and patio?

1. Under 1,000 square feet
2. 1,001 – 1,500 square feet
3. 1,501 – 2,000 square feet
4. 2,001 – 2,500 square feet
5. 2,501 – 3,000 square feet
6. More than 3,000 square feet [SPECIFY] _____square feet

-98. Don't know
-99. Refused

H4. What is the approximate age of your home? (Record in years)

____ **[record years]**

-98. Don't know
-99. Refused

H5. Is your home…

1. All electric
2. Gas and electric
3. Some other combination of energy sources

-98. Don't know
-99. Refused

H6. How many people live in your home year round, including yourself?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7+

-98. Don't know
-99. Refused

H7. In 2011, which of the following categories best describes your total annual household income before taxes? **[READ LIST] PLEASE STOP ME WHEN I READ YOUR CATEGORY**

1. Less than $15,000
2. $15,000 to less than $25,000
3. $25,000 to less than $35,000

4. $35,000 to less than $50,000
5. $50,000 to less than $75,000
6. $75,000 to less than $100,000
7. $100,000 to less than $150,000
8. $150,000 or more

-98. Don't know
-99. Refused

H10. Which of the following best describes your age?

1. Less than 18 years old
2. 18-24 years old
3. 25-34 years old
4. 35-44 years old
5. 45-54 years old
6. 55-64 years old
7. 65 or older

-98. Don't know
-99. Refused

H11. RECORD GENDER OF RESPONDENT **[DO NOT ASK]**

1. Male
2. Female

-98. Don't know

CADMUS

Manual Thermostat

General Population Survey

Ameren Illinois Company

November 2012

Introduction

Hello, my name is _____ and I am calling from _____ on behalf of Ameren Illinois. We are calling today to gather information about thermostat use that will help Ameren Illinois improve their energy efficiency programs. This is not a sales call and should only take a few minutes.

[If needed: Contact at Ameren Illinois to confirm survey legitimacy – Sharon Ruhland, 309-677-5192]

I. We'd like to talk with someone who knows about your home thermostats. Would that be you?

1. (Yes)
2. (No) [ASK IF SOMEONE ELSE IS THERE WHO CAN RESPOND]
8. (Don't know) [THANK AND TERMINATE]
9. (Refused) [THANK AND TERMINATE

Thermostats

T1. Does your home use one or more thermostats to control heating and/or cooling?

1. (Yes)
2. (No) [THANK AND TERMINATE]
8. (Don't know) [THANK AND TERMINATE]
9. (Refused) [THANK AND TERMINATE]

T2. How many programmable thermostats are in your home? These are ones that let you program a schedule in advance to set the temperature up or down at different times of the day and/or different days of the week.

_____ Record Number
98. (Don't know)
99. (Refused)

T3. How many manual thermostats are in your home? These are ones that you have to manually adjust and have only one setting for the internal temperature you want.

_____ Record Number
98. (Don't know) **[THANK AND TERMINATE]**
99. (Refused) **[THANK AND TERMINATE]**

[IF T3<1 or >97, THANK AND TERMINATE]

T3A. Does your home have central air conditioning?

3. Yes
4. No **[SKIP TO TT5]**
8. DON'T KNOW **[THANK AND TERMINATE]**
9. Refused **[THANK AND TERMINATE]**

[ASK IF T3>0]

T4. [If T3>1 Ask "Do any of your manual thermostats", If T3 =1, ask "Does your manual thermostat"] control when your air conditioning turns on and off in some or all areas of your home, or do you directly turn on and off your air conditioning without the thermostat, **[IF T2>0]** or is it controlled by a programmable thermostat, or some combination?

1. (Manual Thermostat controls it)
2. (Directly control air conditioning without thermostat)
3. (Programmable thermostat controls it) **[THANK AND TERMINATE]**
4. (Combination of manual and programmable thermostats control air conditioning in different parts of the home).
8. (Don't know) **[THANK AND TERMINATE]**
9. (Refused) **[THANK AND TERMINATE]**

TT5. [Ask IF T3 >1 or ask if T2>0 and T3>0] Please think about the MANUAL thermostat that controls [IF T4=1, READ-IN "air conditioning in"] the largest amount of living space in your home to answer the next several questions.

T5. Approximately what percentage of your home's living space has the temperature controlled with this thermostat? (if needed: Your best estimate is fine)

1. (100%)
2. (90-99%)
3. (80-89%)
4. (70-79%)
5. (60-69%)
6. (50-59%)
7. (40-49%)
8. (30-39%)
9. (20-29%)
10. (10-19%)
11. (Less than 10%)
98. (Don't know)
99. (Refused)

T6. Does this thermostat also control your heating system?

1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

[SKIP TO C7 IF T6<>1]

T7. Is your heating system fueled by gas, electricity, or something else?

01. (Gas)
02. (Electricity)
00. (Other) Specify _____
8. (Don't know)
9. (Refused)

C7. Do you ever adjust your thermostat to save energy when you are gone or at night?

1. Yes
2. No
8. (Don't know)
9. (Refused)

[SKIP TO T10 IF C7<>1]

NT8. Approximately how often do you adjust this thermostat, would it be…?

01. Daily
02. 4-6 times a week
03. 2-3 times a week
04. Once a week
05. Once a month
06. Never [SKIP TO QT10]
00. (Other: specify)
98. (Don't know) [SKIP TO QT10]
99. (Refused) [SKIP TO QT10]

T9. Please describe how you regularly adjust your thermostat. [READ, PROBE TO DETERMINE WHICH RESPONSE BELOW IS MOST ACCURATE, CHOOSE ONLY ONE]

1. Adjust for night and daytime work hours both summer and winter
9. Adjusted only days, summer and winter
2. Adjusted only night, summer and winter
3. Adjusted only winter, days nights
5. Adjusted only winter, nights only
10. Adjusted only winter, days only
4. Adjusted only summer, days and nights
6. Adjusted only summer, nights only
11. Adjusted only summer, days only
7. Adjust for vacations only
8. Set at one temperature for summer and one temperature for winter
00. (Other) [Specify] _____
98. (Don't Know)
99. (Refused)

[ASK IF T6=1]

T10. What temperature setting is your thermostat typically set for at night in the winter, would it be…

1. Less than 62
2. 62 to 65°F
3. 66-69°F
4. 70-74°F
5. 75-79°F
6. 80°F or higher
8. (Don't know)
9. (Refused)

T11. What temperature setting is your thermostat typically set for at 4 p.m. on a weekday in the summer, would it be…

1. Less than 62
2. 62 to 65°F
3. 66-69°F
4. 70-74°F
5. 75-79°F
6. 80°F or higher
7. Off
8. (Don't know)
9. (Refused)

T12. [ASK IF T11=1-6] Is someone typically home at 4pm on weekdays?

1. (Yes)
2. (No)
8. (Don't know)
9. (Refused)

Demographics

Now I have just a few final questions about your home and energy awareness.

D1. How informed do you feel you are about ways to save energy, including buying and using energy efficient appliances and equipment? Would you say you are:

1. Very Informed
2. Somewhat Informed
3. Neither informed nor uninformed
4. Somewhat Uninformed
5. Very Uninformed
8. Don't know
9. Refused

D2. Which one of the following best describes the type of home in which you live? (READ)

1. A single-family detached [no common walls]
2. A single-family attached [at least one common wall with the surrounding dwellings, such as a town home, patio home, or condo]
3. Multi-family home, such as an apartment [requires a different family living above or below, such as an apartment]
4. A mobile home or trailer
00. Other [SPECIFY] _____
8. (Don't know)
9. (Refused)

D12. Do you own or rent your home?

1. Own
2. Rent
8. (Don't know)
9. (Refused)

D3. About how large is your home in square feet, excluding your garage and patio?

1. (Under 1,000 square feet)
2. (1,001 – 1,500 square feet)
3. (1,501 – 2,500 square feet)
4. (2,501 – 3,000 square feet)
00. (More than 3,000 square feet) [SPECIFY] _____ square feet
8. (Don't know)
9. (Refused)

D4. What is the approximate age of your home?

____ [record years]
8. (Don't know)
9. (Refused)

D5. Is your home…

1. All electric
2. Gas and electric
3. Some other combination of energy sources
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D6. How many people live in your home year round, including yourself?

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1. Less than $15,000
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D10. Which of the following best describes your age?

1. Less than 18 years old
2. 18-24 years old
3. 25-34 years old
4. 35-44 years old
5. 45-54 years old
6. 55-64 years old
7. 65 or older
8. (Don't know)
9. (Refused)

D11. RECORD GENDER OF RESPONDENT [DO NOT ASK]

1. (Male)
2. (Female)
98. Don't know

That is all the questions we have. Thank you for participating.