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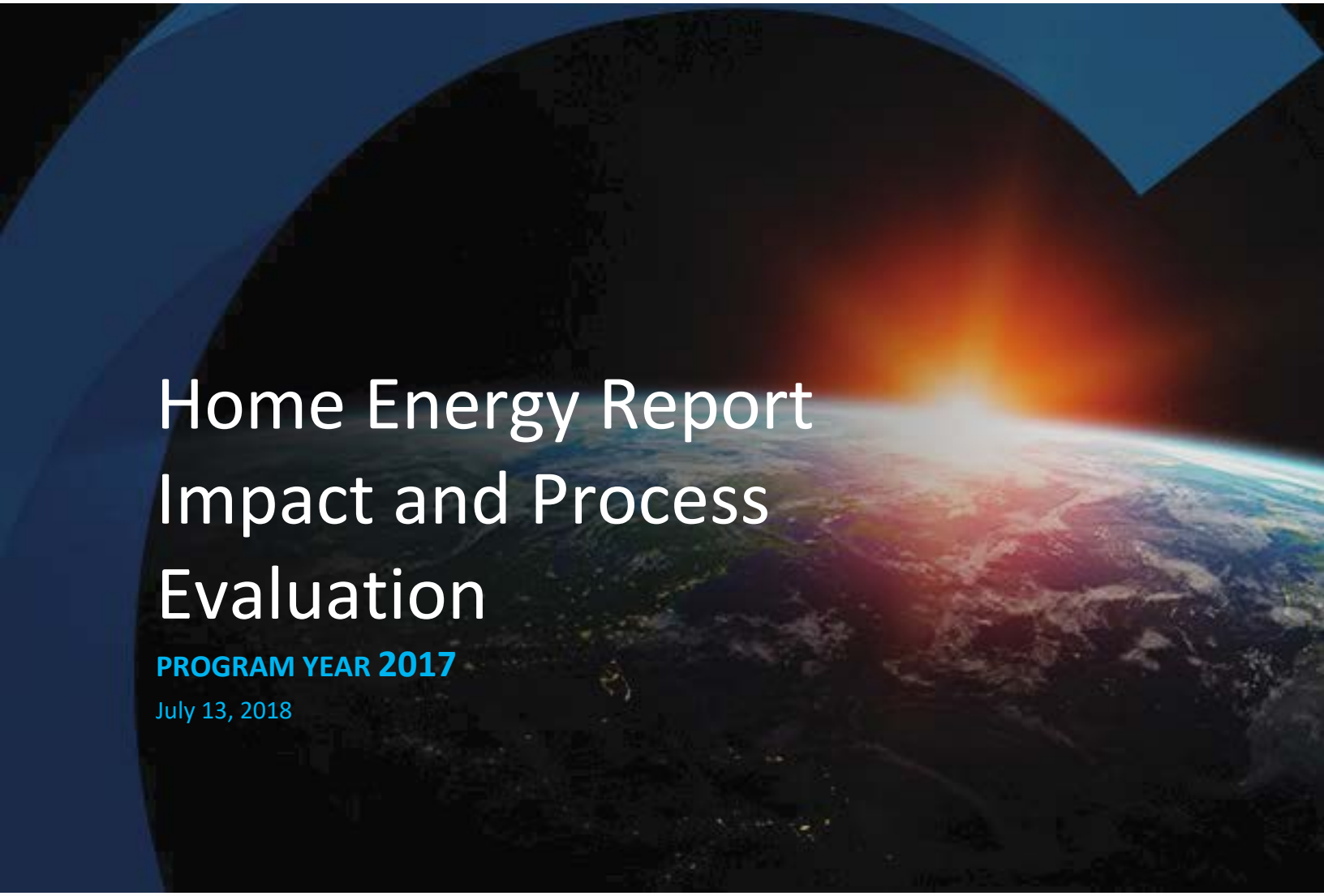

# Home Energy Report Impact and Process Evaluation

**PROGRAM YEAR 2017**

July 13, 2018

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# Executive Summary

Ameren Missouri engaged Cadmus to perform annual process and impact evaluations of the Home Energy Reports program (HER program) for a three-year period, from 2016 through 2018. This annual report covers the impact and process evaluation findings for Program Year 2017 (PY17), the period from March 1, 2017 through February 28, 2018, the second year of the three-year program cycle.

## *Program Description*

The program objective is to provide mailed home energy reports (HER reports) that encourage customers to reduce their energy consumption through behavioral changes. Ameren Missouri designed the program so that a sample of residential customers received home energy reports using a randomized control trial (RCT) experimental design.

In PY16, Cadmus sampled and randomized customers into Wave 1 treatment and control groups. During PY16, a number of customer accounts were closed and a small number of treatment group customers opted out of receiving the HER reports. To replace customers no longer in the Wave 1 treatment and control groups and in anticipation of additional closed accounts during PY17, Ameren Missouri and the program implementer, ICF, selected eligible residential customers to replace them. Cadmus randomized customers into Wave 2 treatment and control groups. In PY17, there were 231,509 treatment group and 77,477 control group customers combined in Wave 1 and Wave 2. Wave 2 treatment group customers began receiving reports in May 2017.

The implementer produced and distributed five mailed paper HER reports in PY17. The reports contained information about customers' home energy consumption and encouragement to adopt energy-saving home improvements and behaviors. ICF forecasted and tracked savings throughout the program year. Cadmus analyzed savings after the third quarter and again after the end of the program year.

## *Key Impact Evaluation Findings*

Cadmus summarized key findings for the PY17 evaluation period below.

### Net Impacts and Savings

Table 1 summarizes the HER program's PY17 participation and savings. The total *ex post* net savings values reflect total estimated savings for Wave 1 and Wave 2. The HER program was established as an experimental design, utilizing a control group in the regression and thus the savings estimate is considered "net". Therefore, a separate NTG estimation was unnecessary. Cadmus found that Wave 1 saved an estimated 9,159 MWh and that Wave 2 did not save energy in PY17. The total *ex post* net savings adjusted for uplift values reflect the estimated savings for Wave 1 and Wave 2 after subtracting savings that resulted from increased participation in other programs due to the HER reports (uplift).

**Table 1. PY17 HER Program Summary: *Ex Post* Program Gross Savings**

| Measure | PY17 Participation | Per-Unit *Ex Post* Savings (kWh/ customer/day) | Number Verified Participants | Total *Ex Post* Net Savings (MWh/yr) | Realization Rate | Total *Ex Post* Net Savings (MWh/yr) Adjusted for Uplift | Realization Rate | Relative Precision at 90% Confidence |
|---|---|---|---|---|---|---|---|---|
| Wave 1 | 210,724 | 0.124 | 210,724 | 9,159 | 29% | 9,079 | 29% | 37% |
| Wave 2 | 20,785 | 0.000 | 20,484 | 0 | 0% | -57 | -2% | >100% |
| **Total** | **231,509** | **0.115** | **231,208** | **9,159** | **27%** | **9,021** | **27%** | **38%** |

As shown in Table 2, the PY17 program annual net energy and demand savings target were 33,750 MWh and 15,774 kW, respectively, as specified in the Ameren Missouri's residential tariff. The TRM assumption was that the program would result in average savings of 150 kWh per year per customer. Cadmus calculated the total *ex ante* savings by multiplying the TRM total annual savings of 150 kWh per customer by the number of customers in the Wave 1 and Wave 2 treatment groups at the start of PY17, adjusting for the number of days until the first PY17 HER report for Wave 2 customers. The *ex ante* gross savings were 34,041 MWh and 15,866 kW, respectively, and the *ex ante* net savings were zero

**Table 2. PY17 HER Program Savings Comparisons**

| Metric | MPSC-Approved Target | *Ex Ante* Net Savings Reported | *Ex Post* Net Savings Determined by EM&V | *Ex Post* Net Savings Determined by EM&V Adjusted for Uplift | Percent of Goal Achieved |
|---|---|---|---|---|---|
| Energy (MWh) | 33,750 | 0 | 9,159 | 9,021 | 27% |
| Demand (kW) | 15,774 | 0 | 4,269 | 4,205 | 27% |

## *CSR Impact Evaluation Requirements*

According to the Missouri Code of State Regulations (CSR), demand-side programs that operate as part of a utility's preferred resource plan are subject to ongoing process and impact evaluations that meet certain criteria. Specifically, the CSR requires that impact evaluations satisfy the requirements listed in Table 3, which also includes the appropriate method to utilize. We provide a summary of process CSR requirements in Table 4 at the end of the next section.

**Table 3. Summary Responses to CSR Impact Evaluation Requirements**

| CSR Requirement[1] | Method Used | Description of Program Method |
|---|---|---|
| **Approach: The evaluation must use one or both of the following comparisons to determine the program impact:** | | |
| Comparisons of pre-adoption and postadoption loads of program participants, corrected for the effects of weather and other intertemporal differences | ✓ | Regression analysis controlling for customer heating and cooling degree days. |
| Comparisons between loads for program participants and an appropriate control group over the same period | ✓ | Regression analysis of customers assigned to randomized control trial (RCT). |
| **Data: The evaluation must use one or more of the following types of data to assess program impact:** | | |
| Monthly billing data | ✓ | Regression analysis modeled monthly billing data. |
| Hourly load data | | |
| Load research data | | |
| End-use load metered data | | |
| Building and equipment simulation models | | |
| Survey responses | | |
| **Audit and survey data on:** | | |
| Equipment type/size efficiency | | |
| Household or business characteristics | | |
| Energy-related building characteristics | | |

[1] State of Missouri. "Administrative Rules: Missouri Code of State Regulations." Missouri 4 CSR 240-20.093, 4 CSR 240-20.094, 4 CSR 240-22.070(8). Revised January 2016. Available online: http://www.sos.mo.gov/adrules/csr/csr.asp

## *Key Process Evaluation Findings*

Cadmus summarized key findings for the PY17 evaluation period below.

## Marketing and Outreach

In PY17, Ameren Missouri continued to maintain a program-affiliated web page and the HER reports provide a link to this web page. It serves as a source for frequently asked questions and answers rather than a portal with customer-specific HER-related information. Ameren Missouri added new marketing and outreach material to the HER reports delivered in PY17, including the following:

- A Dozen Easy Ways to Save PDF accessible via a link provided in the HER reports
- How to Read Your HER Report section providing additional details to orient customers to the material in the reports
- Home Health Checklist section with recommendations and steps to save energy, improve indoor air quality, and prevent pests from entering homes
- A link to the utility customer portal (Stay in the Know)

It removed cross-program promotions from the HER reports mid-way through PY17 to focus customers on behavior-based efficiency savings.

## HER Report Frequency and Timing

In PY17, Ameren Missouri sent five mailed HER reports to treatment group customers throughout the year, with two sent in the summer during the peak cooling energy-usage season.

## HER Participant Feedback

Report readership increased dramatically from 63% in PY16 to 90% in PY17. Higher proportions of customers recalled the similar-home comparison and more customers reported being familiar with other Ameren Missouri energy efficiency programs than in PY16. Fewer customers recalled the customer-specific comparison than in PY16 and the perceived usefulness of the reports was lower.

As in PY16, Cadmus found high customer satisfaction with Ameren Missouri and with the HER reports program specifically—over 90% of customers were very or somewhat satisfied. Customer satisfaction in previously benchmarked programs were reported using different scales and metrics across programs and could not be directly compared. Three programs assessed results on a ten-point-scale where satisfaction was on average 6.4 for an Ameren Illinois program, 8.1 for a Consumers Energy program, and 7.5 for an IPL program. Satisfaction was 82% for a Vectren Indiana program.

## *CSR Process Evaluation Requirements*

As previously discussed, the Missouri CSR requires that demand-side programs, functioning as part of a utility's preferred resource plan, are subject to ongoing process and impact evaluations that meet certain criteria. Process evaluations must address, at a minimum, the five questions listed in Table 4 which also includes a summary response for each specified requirement.

**Table 4. Summary Responses to CSR Process Evaluation Requirements**

| CSR Requirement Number[1] | CSR Requirement Description | Summary Response |
|---|---|---|
| 1 | What are the primary market imperfections common to the target market segment? | Primary market imperfections that the program is designed to include customers not connecting behaviors with saving energy and not being motivated to change the behaviors to save energy. However, Cadmus found that nonparticipant Ameren Missouri customers are decreasing energy consumption almost as much as HER participants. Therefore, the additional savings potential from additional behavior and education changes may be limited. The lower than expected savings resulting from the program are also consistent with a neighboring utility's results for participants starting to receive reports at about the same time. Cadmus also found that HER treatment group customers with higher energy consumption save more energy than those with lower energy consumption prior to receiving HER reports. |
| 2 | Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments? | To improve the program cost-effectiveness, we recommend the target market be updated to include only customers in the top 50$^{th}$ percentile of energy consumption instead of all residential customers. |
| 3 | Does the mix of end-use measures included in the program appropriately reflect the diversity of end-use energy service needs and existing end-use technologies within the target market segment? | This program does not incent end-use measures directly but does use tips in the HER reports to promote energy saving behaviors and measures. The tips target energy savings that could result from behaviors including changing settings on clothes dryers, cleaning the area around AC units, and changing thermostat settings—including most end uses that residential customers have in their homes. |
| 4 | Are the communication channels and delivery mechanisms appropriate for the target market segment? | The communication channel for HER reports is mailing paper reports. Other similar utility programs supplement paper HER reports with emailed HER reports and web portals to engage customers more often and in more depth, which may result in deeper savings. Ameren Missouri plans to launch an email channel in PY18 for HER report delivery in addition to the mailed version. . |
| 5 | What can be done to more effectively overcome the identified market imperfections and to increase the rate of customer acceptance and implementation of each end-use measure included in the program? | Cadmus found that HER treatment group customers with higher energy consumption save more energy than those with lower energy consumption. To increase cost effectiveness, we recommend Ameren Missouri target higher usage customers to receive HER reports and implement the planned email report delivery channel. |

[1] State of Missouri. "Administrative Rules: Missouri Code of State Regulations." Missouri 4 CSR 240-20.093, 4 CSR 240-20.094, 4 CSR 240-22.070(8). Revised January 2016. Available online: http://www.sos.mo.gov/adrules/csr/csr.asp

## *Key Conclusions and Recommendations*

Cadmus offers the following conclusions and recommendations for improving the program.

**Conclusion 1. Customers received the HER reports for a full year in PY17, resulting in increased savings.** Evaluated energy savings increased from 0.040 kWh per customer per day, or 0.11%, in PY16 to 0.115 kWh per customer per day, or 0.32%, in PY17.

**Recommendation 1. Ameren Missouri should continue to deliver the HER reports every other month in PY18 to continue to increase savings.** Recognizing that this recommendation has already been implemented, starting in January, 2018, Cadmus recommends that Ameren Missouri proceed with its plan to deliver HER reports in March, May, July, September, and November in 2018 and January in 2019 to further increase savings.

**Conclusion 2. Ameren Missouri plans to add an email channel in PY18.** Ameren Missouri, like benchmarked programs, used paper mailed reports to deliver their HER programs. However, other utility programs supplement the paper HER reports with emailed HER reports and web portals. Multiple channels serve as opportunities to engage the customer more often and in more depth, which may result in deeper savings.

**Recommendation 2. Launch an email channel to deliver HER reports in addition to the mailed version.** Recognizing that the first emailed HER (eHER reports) reports were delivered in March 2018, Cadmus recommends Ameren Missouri continue to deliver HER reports via email to all Wave 1 and Wave 2 treatment customers as well as to a new wave of customers that will receive eHER reports only in PY18.

**Conclusion 3. Similar to PY16, customers with the highest energy usage saved the most energy as a result of the HER program.** Customers in the top 50$^{th}$ percentile of energy usage (i.e., greater than 11,900 kWh per year) prior to receiving the HER reports saved 0.4% to 0.5%, or 0.160 to 0.315 kWh per customer per day, whereas customers in the bottom 50$^{th}$ percentile did not save energy due to the program.

**Recommendation 3. Stop sending HER reports to customers with low usage.** Recognizing that Ameren Missouri removed low-usage customers from the Wave 1 and Wave 2 treatment groups in March 2018, Cadmus recommends it follow through with its plan to stop sending HER reports to customers with low energy usage and to identify eligible customers as those with high usage for the PY18 HER reports backfill and PY18 eHER reports treatment group. Through limited benchmarking in 2017, Cadmus identified that KCP&L targeted high users for one wave of customer participants in its program. The RCT framework will be robust so this change and future analyses can omit customers in the lower quartiles to result in an unbiased estimate of savings.

**Conclusion 4. Ameren Missouri HER program savings are similar to a neighboring utility for customers receiving reports starting at a similar time and with similar climate and customer base.** In a review of the Ameren Illinois program, we found that Illinois customers that began receiving reports in 2016 saved 46 kWh or 0.45% (accounting for uplift) in the program year from June 2015 to May 2016, despite earlier program participants (2010-2014) saving over 1% (kWh savings not provided in report). Further, Cadmus' PY16 and PY17 general population survey and analysis of nonparticipant spillover (of both like and non-like measures) indicated that nonparticipant customers are responding to Ameren Missouri's general efficiency marketing. This finding is supported by Cadmus' impact analysis that found, in the

absence of the HER program, energy consumption in the control groups decreased by 2% to 3%, or 0.7 to 1.1 kWh per customer per day, in PY16 and PY17.

**Recommendation 4. Revise HER program savings targets and TRM savings in future program years.**, Cadmus expects HER program savings to increase from the program total of 0.3% up to between 0.4% and 0.5%, or between 1.5 to 2.2 kWh per customer per day, in future HER program years if Ameren Missouri targets high usage customers only and continues with plans to implement the email reports. Ameren Missouri should continue to monitor HER program savings, especially with the addition of the eHER delivery channel in PY18, and update its savings targets and TRM savings according to PY16-PY18 results.

## *PY16 Recommendation Tracking*

The HER program is a new program offered by Ameren Missouri in program years 2016–2018 (PY16–PY18). Cadmus began providing conclusions and recommendations in PY16 and recommendation tracking in PY17, as summarized in Table 5.

**Table 5. PY16 Recommendation Tracking**

| PY16 Recommendation | Recommendation Status | Ameren Missouri Explanation |
|---|---|---|
| Update the HER report schedule. | Complete. | Ameren Missouri sent five HER reports in PY17: one in the spring, two in the summer, one in the fall, and one in the winter. |
| Include a customer-specific progress tracker in the HER reports. | Complete. | Ameren Missouri included the Track Your Progress module starting with HER 4. Beginning with HER 6, it was included in all delivered HER reports. |
| Launch an email channel to deliver HER reports in addition to the mailed version. | Incomplete. Planned for PY18. | Ameren Missouri plans to launch the email HER reports in Spring PY18 using the same report design as the paper HER reports. |
| Add more detail to the HER report energy savings tips. | Complete. | Ameren Missouri updated the text associated with the tips to provide specific instructions on how to implement the tips. |
| Ameren Missouri should consider updating the photos to align with the tip more closely and studying the impact of the HER report design on customer satisfaction and energy savings. | Complete. | Ameren Missouri updated the visual content associated with energy savings tips to better align with the specific action in the tip. |

# Introduction

Ameren Missouri engaged Cadmus to perform annual process and impact evaluations of the Home Energy Report program (HER program) for a three-year period, from 2016 through 2018. This annual report covers impact and process evaluation findings for Program Year 2017 (PY17): the period from March 1, 2017, through February 28, 2018 (the second year of the three-year program cycle).

## *Program Description*

A new behavioral program offered by Ameren Missouri from 2016–2018, (PY16–PY18), the HER program seeks to encourage customers, via mailed home energy reports (HER reports), to reduce their energy consumption through behavioral changes.

The program used a randomized control trial (RCT) experimental design that randomly assigned customers to a treatment group (i.e., recipients of HER reports) or a control group (i.e., non-recipients). The randomization process served to identify two equivalent groups that could be compared to estimate differences in energy use (following receipt of HER reports) resulting from the program's intervention.

The program implementer, ICF, and Ameren Missouri selected customers eligible for the program. ICF produced and distributed the HER reports to treatment group customers and took responsibility for forecasting and tracking savings.

## *Program Activity*

In PY17, the HER program's population initially contained 308,986 customers between both waves, as shown in Table 6. Mailed HER reports informed treatment group customers about their home energy consumption and encouraged them to adopt energy-saving home improvements and behaviors. The first home energy report was sent in May 2017, followed by reports sent in July, August, and November 2017. The last report was sent in January 2018.

**Table 6. PY17 HER Program Activity**

| Wave | Measure | Delivery Frequency | PY17 Total Number of Customers |
|---|---|---|---|
| Wave 1 | Treatment Group | Five paper HER reports | 210,724 |
| | Control Group | -- | 70,200 |
| Wave 2 | Treatment Group | Five paper HER reports | 20,785 |
| | Control Group | -- | 7,277 |
| **Total** | | | **308,986** |

# Program Accomplishments

The HER program focuses on influencing energy consumption behaviors to reduce electricity consumption. Table 7 shows the HER program achievements against its goals in PY17. Annual savings

targets were 33,750 MWh and 15.774 MW in PY17, and 101,250 MWh and 47.322 MW for the threeyear cycle.[1]

**Table 7. PY17 HER Program Goals and Achievements**

| Metric | | PY17 Target | PY17 Verified* | Difference from Target** |
|---|---|---|---|---|
| Participation | | 225,000 | 231,208 | -6,962 |
| MWh Savings | | 33,750 | 9,021 | 24,729 |
| MW Savings | | 15.774 | 4.205 | 12 |
| | * PY17 ex post net savings adjusted for uplift.<br>** Negative (red) differences indicate that PY17 verified values exceeded PY17 targets. | | | |

[1] State of Missouri. "In the Matter of Union Electric Company d/b/a Ameren Missouri's 2nd Filing to Implement Regulatory Changes in Furtherance of Energy Efficiency as Allowed by MEEIA." File No. EO-2015-0055. February 5, 2016. Refer to Appendix B.

# Evaluation Methodology

In evaluating Ameren Missouri's HER program, Cadmus identified similar objectives in PY17 as in PY16.

## *Impact Evaluation Objectives*

- Estimate net energy savings
- Estimate the program's effect on participation in other Ameren Missouri programs
- Assess coincident peak net demand savings using Ameren Missouri's load shapes and estimation method

## *Process Evaluation Objectives*

- Assess program design and implementation and opportunities for improvements
- Determine readership of and satisfaction with the HER reports
- Identify specific energy-saving improvements and actions taken by customers
- Evaluate customer satisfaction with the HER reports and Ameren Missouri
- Track changes in key progress indicators
- Meet evaluation requirements of Missouri Code[2]

In Table 8, we list the evaluation activities and briefly explain the purpose of each activity; we include a check mark to indicate whether the activity was part of the process or impact evaluation. Further descriptions of each activity follow the table.

[2] State of Missouri. "Administrative Rules: Missouri Code of State Regulations." 4 CSR 240-22.070(8). Revised January 2016. Available online: http://www.sos.mo.gov/adrules/csr/csr.asp

**Table 8. PY17 HER Program Process and Impact Evaluation Activities and Rationale**

| Evaluation Activity | Process | Impact | Description |
|---|---|---|---|
| Program Material and Marketing Review | ✓ | | Review program materials to understand the structure and implementation of the program. The HER program does not have additional marketing materials for treatment group participants, apart from the HER reports themselves; these were reviewed as part of the program material review. |
| Benchmarking Research | ✓ | | Review similar programs and estimated savings. |
| Program Manager and Implementer Interviews | ✓ | | Conduct interviews with the Ameren Missouri's program manager and the implementer to gather insights into the program design, challenges faced, and expected savings. |
| Randomization and Equivalency Analysis | | ✓ | Use randomization to assign customers to treatment and control groups. Verify that average energy consumption in the year preceding the program is equivalent in the treatment and control groups. |
| **Evaluation Activity** | **Process** | **Impact** | **Description** |
| Customer Surveys | ✓ | | Survey customers in the treatment groups to collect data on perceptions about recent behavior changes, energy efficiency awareness, attitudes towards energy efficiency, customer satisfaction, and the HER reports. |
| Calculation of Savings Impact | | ✓ | Determine energy savings using regression analysis of monthly billing data. |
| Uplift Analysis | | ✓ | Use uplift analysis to estimate the HER program's influence on participation in Ameren Missouri's other efficiency programs, based on program data for treatment group and control group customers. |
| Key Progress Indicators | ✓ | | In PY17, update the key progress indicators to track progress compared to PY16. |
| Cost-Effectiveness Analysis | | ✓ | Review DSMore inputs and cost-effectiveness results to improve accuracy and verify reasonableness. |

## *Program Material and Marketing Review*

Cadmus reviewed program materials to better understand the program's structure and implementation. The HER program does not use additional marketing materials for treatment group participants, apart from the HER reports themselves.

## *Benchmarking Research*

As part of the PY16 evaluation, Cadmus completed benchmarking research to compare the Ameren Missouri HER program with six behavior programs offered by other utilities. We examined the HER report content and frequency, delivery channels, and participant satisfaction of each program. As part of the PY17 evaluation, we completed benchmarking research on two additional utility programs, offered by utilities in a similar climate region as Ameren Missouri. We identified utilities that had recently been evaluated using metrics we could benchmark, including the following utility programs:

- Ameren Illinois Company (AIC) 2014-2017 Behavior Modification Program

- Entergy Arkansas, Inc. 2015 Behavioral Benchmarking Program

## *Stakeholder Interviews*

In December 2017, Cadmus interviewed Ameren Missouri's HER program stakeholders. We designed these interviews to achieve the following:

- Gather information on program design and delivery
- Identify challenges that program staff or implementers have encountered
- Determine appropriate solutions

As shown in Table 9, Cadmus spoke with one program stakeholder from Ameren Missouri and one from ICF. Appendix C provides the stakeholder interview guide.

**Table 9. PY17 HER Program Completed Stakeholder Interviews**

| Stakeholder Group | Interviews Conducted |
|---|---|
| Ameren Missouri Program Management | 1 |
| ICF Program Management | 1 |
| **Total** | **2** |

Throughout PY17, we regularly spoke with Ameren Missouri program staff to discuss program operations and to coordinate evaluation activities.

## *Randomization and Equivalency Analysis*

Ameren Missouri used a randomized control trial (RCT) study design and analysis to enable non-biased estimation of the HER program's impacts. Ameren Missouri added a second RCT, or wave of customers in PY17 to replace customers from the PY16 (Wave 1) RCT with closed accounts that would not receive the HER reports in PY17. As in PY16, the implementer determined which customers were eligible for program participation and included all residential customers except those living in apartments or multifamily housing. Cadmus randomly selected eligible customers and assigned them to Wave 2 treatment and control groups in PY17. We used customer and billing data from ICF for randomization. Only customers with 12 months of historic billing data were randomized. After randomizing customers into treatment and control groups, we verified the equivalence of pre-program electricity consumption in the treatment and control groups and provided the randomized customer list to the implementer. Some customers randomized into Wave 2 were already Wave 1 treatment group customers. We retained these customers in Wave 1 but removed them from Wave 2. As in PY16, we removed solar customers from Wave 2.

## Customer Surveys

As shown in Table 10, Cadmus completed 249 online surveys in PY17. Appendix D provides the survey instruments.

**Table 10. Survey Targets and Completes**

| Population | Survey Mode | PY17 Target Surveys | PY17 Completed Survey |
|---|---|---|---|
| Treatment Group Customers | Online | 180 | 249 |

We asked customers a series of questions regarding familiarity with energy efficiency and Ameren Missouri's other efficiency programs, energy-saving improvements made, energy-saving actions taken, attitudes and barriers surrounding energy efficiency, satisfaction with Ameren Missouri, and satisfaction with and content of the HER reports.

## Energy and Demand Savings Calculations

Cadmus estimated electricity savings to date for each wave in PY17 using a panel regression analysis of treatment and control customer energy consumption, collected through billing data.[3] The billing analysis conformed to IPMVP Option C whole facility methods[4] and the approaches described in the Uniform Methods Project protocols.[5] Because the HER program had been established using an RCT experimental design, regression analysis provided an unbiased savings estimate of net savings. Hence, a separate net-to-gross (NTG) analysis was unnecessary.

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[3] Reference the "PY16 Review of Home Energy Reports Savings Estimation in the Missouri Technical Resource Manual" document for full details on the billing analysis methodology: Cadmus. "PY16 Review of Home Energy Reports Savings Estimation in the Missouri Technical Resource Manual." Submitted to Ameren Missouri on February 17, 2017.

[4] Efficiency Valuation Organization. International Performance Measurement and Verification Protocol, Concepts and Options for Determining Energy and Water Savings, Volume 1. January 2012. Page 25. (EVO 10000 – 1:2012) Available online: http://www.evo-world.org/

[5] Agnew, Ken, and M. Goldberg. Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol. U.S. Department of Energy, National Renewable Energy Laboratory. April 2013. (NREL/SR-7A30-53827) Available online: http://www1.eere.energy.gov/office_eere/de_ump_protocols.html.

Stewart, James and A. Todd. Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 17: Residential Behavior Protocol. U.S. Department of Energy, National Renewable Energy Laboratory. August 2014. (NREL/SR-7A40-62497) Available online: http://www1.eere.energy.gov/office_eere/de_ump_protocols.html

Cadmus used the same methods as described in the PY16 evaluation report to estimate regression models, aggregate savings, and estimate uplift. Cadmus reports the savings in this report with precision at 90% confidence.

## *Uplift Analysis*

HER program savings estimates reflect behavioral changes due to customers receiving HERs and from other investments in energy-efficient products. Some customers invest in and install efficient products through other efficiency programs from which they receive rebates from Ameren Missouri. In such cases, savings from the HER program and other rebate programs is confounded. To disambiguate HER program-related savings from savings from other programs, Cadmus conducted an uplift analysis. We compared cross-program participation among treatment group customers to participation among control group customers and subtracted cross-program savings from the HER program total savings. Cadmus reported total estimated savings and total HER savings net of uplift.

## *Key Progress Indicators*

Cadmus started tracking the following key progress indicators in PY16 for the HER program across the three-year program cycle: program year electric savings, number of home energy report recipients, number of opt-outs, home energy report readership, uplift, and customer satisfaction with HER reports and with Ameren Missouri. We reported on progress since PY16 in PY17.

## *Cost-Effectiveness Analysis*

Using final PY17 HER program participation and implementation data, as well as the *ex post* gross and net savings estimates presented in this report, Ameren Missouri determined the program's cost effectiveness using DSMore (a financial analysis tool designed to evaluate the costs, benefits, and risks of demand-side management [DSM] programs and services) and Cadmus reviewed the results. As shown in the Cost-Effectiveness Results section, Ameren Missouri assessed cost-effectiveness using all five of the standard perspectives produced by DSMore:

- Total Resource Cost (TRC)
- Utility Cost Test (UCT)
- Societal Cost Test (SCT)
- Participant Cost Test (PART)
- Ratepayer Impact Test (RIM)

# Process Evaluation Findings

In this section, we describe the process evaluation findings for Ameren Missouri's HER program. We organized the findings in six sections: program design, program delivery, HER report influence, participant experience, and customer surveys.

## *Program Design*

In 2017, Ameren Missouri implemented the HER program to inform customers about their home energy consumption and to encourage adoption of energy-saving home improvements and behaviors. The HER reports were seasonally focused and contained the information described in Table 13. Not all Ameren Missouri customers received HER reports. The program used an experimental RCT design to randomly assign customers to treatment or control groups. Although enrollment in the treatment group was automatic, customers could contact Ameren Missouri to opt out of receiving the HER reports.

## *Program Delivery*

The PY16 HER program evaluation recommended that program managers and implementers update the schedule to send more reports at strategic times of the year. In PY17, more reports were sent. The schedule of reports and delivery dates in PY16 and PY17 is listed in Table 11.

A total of five HER reports were sent in PY17. The first, HER 4 was sent in May 2017, followed by two summer reports, HER 5 and HER 6, in July and August 2017, to target seasonal cooling savings. HER 7 and HER 8 were sent in November 2017 and January 2018. Note that at the outset of PY17, Ameren Missouri planned to send all HER reports except HER 6, which it added in late August to increase the impact of the program during the peak cooling season—it expected customers to be more responsive during the summer when peak cooling energy consumption occurs.

**Table 11. PY16 and PY17 HER Report Schedule**

| Program Year and Quarter | HER Report | | |
|---|---|---|---|
| | HER Report | Delivery Month and Year | Seasonal Focus |
| PY16 Q1 | - | - | - |
| PY16 Q2 | HER 1 | August 2016 | Summer |
| PY16 Q3 | HER 2 | November 2016 | Fall |
| PY16 Q4 | HER 3 | February 2017 | Winter |
| PY17 Q1 | HER 4 | May 2017 | Spring |
| PY17 Q2 | HER 5 | July 2017 | Summer |
| | HER 6 | August 2017 | Late Summer |
| PY17 Q3 | HER 7 | November 2017 | Fall |
| PY17 Q4 | HER 8 | January 2018 | Winter |

Table 12 describes the RCT waves in PY16 and PY17. Customers with active accounts in the Wave 1 and Wave 2 treatment groups received HER reports in PY17.

**Table 12. Customer Waves in PY16 and PY17**

| Program Year | Wave | Group Description |
|---|---|---|
| PY16 | 1 | Residential customers randomly selected from the customer population and assigned to treatment and control groups. Customers in the treatment group received HER paper reports. |
| PY17 | 2 | Residential customers randomly selected from the customer population and assigned to treatment and control groups to replace customers with closed accounts in PY16 and anticipated in PY17. Customers in the treatment group received HER paper reports. |

## PY17 HER Report Design

The PY16 evaluation recommended providing additional detail in the HER report tips, updating the photos to align with the tip more closely, and studying the impact of the HER report design on customer satisfaction and energy savings. Ameren Missouri and the implementer addressed all three recommendations. Ameren Missouri and the implementer made a number of updates to the HER report content in PY17 based on findings from additional research and an HER 2.0 Customer Panel (n=642) conducted throughout PY17. In the additional research, Ameren Missouri and the implementer developed new components to include in the HER reports and omitted other components. They assessed which customer segments were included in the HER program's RCT treatment and control groups—additional details on this area are provided below. As part of the HER 2.0 Customer Panel, customers received an email invitation to take a survey in which the objective was to solicit feedback on the clarity, usefulness, likelihood to change behavior, and trust of the HER reports. Ameren Missouri and the implementer used the customer feedback to make additional updates the design of the HER reports incrementally. Table 13 outlines the incremental changes over the course of PY17 and details are provided below.

**Table 13. PY17 HER Report Design**

| Content | HER 4 | HER 5 | HER 6 | HER 7 | HER 8 |
|---|---|---|---|---|---|
| Account information in place of persona photos | ✓ | ✓ | ✓ | ✓ | ✓ |
| Similar home comparison | ✓ | ✓ | ✓ | ✓ | ✓ |
| Track Your Progress module (customer-specific comparison) | ✓ | | ✓ | ✓ | ✓ |
| Cross-program promotion | ✓ | ✓ | | | |
| A Dozen Easy Ways to Save PDF* | | | ✓ | ✓ | ✓ |
| How to Read Your Home Energy Report* | | | ✓ | ✓ | ✓ |
| Stay in the Know (link to utility customer portal) | | | | ✓ | |
| Do-It-Yourself (DIY) lighting audit | | | | ✓ | |
| Interactive Landing Page | | | | | ✓ |

* A Dozen Easy Ways to Save PDF and How to Read Your Home Energy Report documents were included online for HER6, HER7, and HER8 and updated seasonally to reflect new tips. The link was provided in HER6.

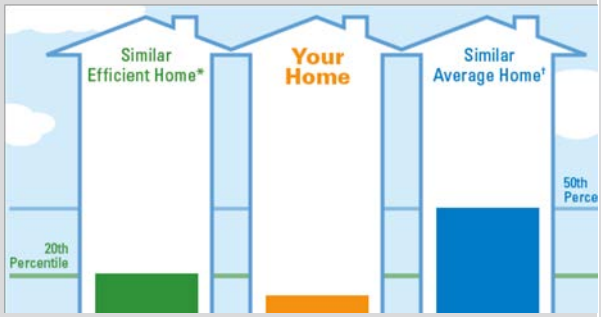
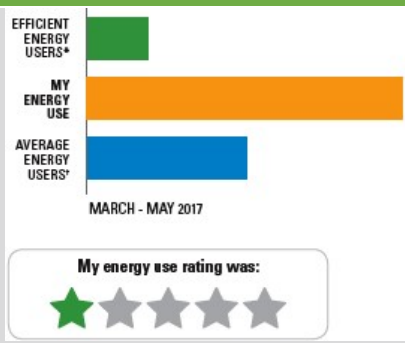
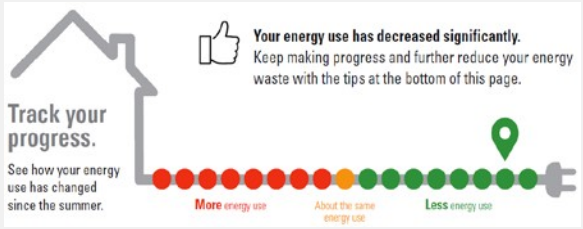
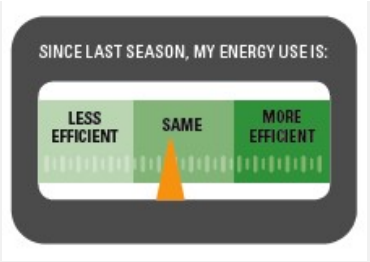
In PY17, Ameren Missouri and the implementer discontinued cross-program promotion after HER 5 to focus on influencing customer behavior with the HER reports rather than through other programs. In HER 6, they introduced a link to a PDF with twelve actionable energy savings tips entitled “A Dozen Easy Ways to Save" in place of the cross-program promotions. They started promoting Ameren Missouri’s existing customer portal in HER 7, labeled as “Stay in the know”, which informs customers about free tools available to help them manage energy use. HER 8 introduced a Test Your Knowledge section with one true/false question regarding the efficiency of leaving heat in the home on low all day.

The PY16 HER program evaluation also found that whereas other utilities’ behavior-based program HER reports contained customer-specific progress trackers, Ameren Missouri’s HER report did not. In PY17, Ameren Missouri and the implementers included the Track Your Progress module (customer-specific comparison) starting with HER 4. Initially, Ameren Missouri planned to include the customer-specific comparison and similar home comparison in alternating reports. However, beginning with HER 6, both were included in all delivered HER reports because the HER 2.0 customer panel results indicated that almost 90% of surveyed customers found the comparisons useful and wanted to see both in every HER report. Ameren Missouri replaced the persona photos in the header area with account information and information about the customer’s personalized report. Additionally, the visual content associated with energy savings tips was altered to better align with the specific action and the text associated with the tips was updated to provide specific instructions on how to implement the tips. Figure 1 shows how the layout of the personalized energy savings tips changed in PY17.

**Figure 1. Evolution of PY17 Personalized Energy Savings Tips**


Figure 2 shows how the design of the similar home and customer-specific comparisons changed over the course of PY17. Findings from the HER 2.0 customer panel showed that Ameren Missouri customers did not have a strong preference between text and star ratings in the similar home comparison graphic. However, customers were more likely to trust the text to give them an accurate depiction of their energy use compared to similar homes. Further, they preferred the red, yellow, or green exclamation points over the clipboard graphic, which they found "too wordy", to show levels of possible improvement in energy usage. Ameren Missouri and the implementer substituted the clipboard graphic with the exclamation point graphic and a concise synopsis of each customer's HER report summary.

**Figure 2. Evolution of PY17 HER Report Design**

| HER Report | HER 4 | HER 8 |
|---|---|---|
| Similar Home Comparison |  |  |
| Customer-Specific Progress Tracker |  |  |
| HER Report Summary |  |  |

## Successes and Program Achievements

Stakeholders reported that the following aspects of the program worked particularly well in PY17:

- **Positive customer feedback.** Cadmus' customer surveys indicated that customer satisfaction with the HER program remained high and, based on Ameren Missouri's HER 2.0 Customer Panel, Ameren Missouri and the implementer expect positive customer feedback to continue.
- **Low Attrition.** The reported opt-out rate was very low in PY17 (forty-seven customers).
- **Increased HER report cadence.** In combination with the other updates, the increased number of HER reports in PY17 was successful in increasing the resulting energy savings.
- **Updating the HER report design.** In combination with the other updates, strategic changes to the HER report design occurred throughout PY17 and were successful in increasing resulting energy savings.

## Program Implementation Challenges

Program stakeholders identified the following remaining challenges:

- **Understanding customer preferences.** Ameren Missouri would like to better understand the most effective modes of communication with its customers so that it could consider increasing the types of messaging (e.g., emails, text alerts). It noted that this seems like a future area for research that could be incorporated into HER program delivery. Efforts to understand which type of customer will respond best to a tactic are being pursued by Ameren Missouri, using their internal analysis to map likely communication preferences to customer profile segments among customers in the HER treatment and control groups (e.g., mapping email communication with the "Digital Starter" segment).
- **Leveraging existing online tools.** Program implementers anticipate that using eHER reports will help to drive more customers online and that they will be able to glean more information on customer online behavior by tracking the associated click rates and subsequently enable them to enhance the program design and delivery and increase savings. However, they anticipate challenges with the limited number of web tools available on the existing Ameren Missouri website, which uses an older database (Aclara).
- **Time required to adjust the HER report design and delivery.** Ameren Missouri noted that most of PY17 was spent developing and designing the improvements to subsequent HER reports and that, although they think the improvements have helped, the time lag between delivering the reports and observing increases in savings that result from changes is a challenge. Any delay in decision making or processes will cause delays to implementing changes in report delivery or design. Energy savings resulting from such changes may not be detected until months after it is sent, or possibly in the next program year.

## PY18 HER Planning

As part of PY17 interviews, we learned about planning currently underway for the PY18 HER program.

### *Customer Segmentation Analysis*

In PY17, Ameren Missouri conducted an analysis of customer profile segments. As expected from a balanced RCT study design, the distributions of customers were similar in the treatment and control groups. The results showed the following:[6]

- Almost 80% of the customers assigned to the treatment and control groups belonged to three profile segments:
  - Almost 30% of customers were categorized as "autopilot"–a segment that does not typically engage in energy efficient efforts.
  - Almost 30% of customers were categorized as "proud providers" —a pride-oriented segment motivated to keep family members or business customers pleased.

[6] Informal documentation provided by Ameren Missouri that included compiled study results.

    - Almost 20% of customers were categorized as "eco-aspirers"—an idealist segment that wants to do good for the environment but may not have the information, time, money, or commitment to act.
- The remaining 20% of customers belonged to the Skeptical Saver (10%), Digital Starter (7%), and No Segment (1%) profile segments.
- No statistically significant trend was identified but savings estimates appeared to increase from skeptical savers (lowest) to digital starters to autopilot to eco-aspirer to proud provider (highest), where proud provider savings were significant but just above 50 kWh per customer per year, or roughly 30% of the HER program's targets.

Based on these findings, Ameren Missouri and the implementer will consider additional updates (described below) to the HER report designs and delivery strategies in PY18.

### *PY18 Program Delivery*

In Spring 2018, Ameren Missouri and the implementer plan to include trivia in the HER report footer and a Home Health Checklist with four ways to save energy, improve indoor air quality, and prevent pests from entering the home in HER 9.

Ameren Missouri and the implementer plan to launch the eHER reports in PY18 using the same report design as the paper HER reports.

Ameren Missouri and the implementer plan to promote an interactive landing page that includes infographics and how to videos as part of a marketing strategy to further engage customers with Ameren Missouri and the HER reports in PY18.

## *Process Evaluation*

Because this program's delivery has not changed significantly, we are not reporting detailed process evaluation results unless we identified a significant area of difference or concern among the key survey questions discussed below. Results of the participant survey including all survey questions are included in appendix.

## Home Energy Report Influence

In PY17, the HER program continued to deliver seasonally focused HER reports to encourage Ameren Missouri's customers to reduce their energy consumption through behavioral changes.

Cadmus compared responses in PY17 to PY16 using two-sided t-tests for differences in proportions. We reported differences that were significant at 90% confidence (p-value ≤ 0.10). Cadmus applied weights

to survey responses to adjust for survey-mode differences between the phone and web surveys observed in PY16.[7]

### *Awareness of Ameren Missouri Programs*

In comparison to PY16, the PY17 Ameren Missouri customer survey results indicated a 9% increase from 48% (n=465) in PY16 to 57% in PY17 (n=219), in familiarity with other energy efficiency programs, indicating that the HER reports continued to cross promote other Ameren Missouri energy efficiency programs in PY17.

### *Satisfaction with Ameren Missouri*

Cadmus found that a majority of treatment group customers reported were very or somewhat satisfied with Ameren Missouri, although the proportion of satisfied customers decreased from 95% (n=435) in PY16 to 90% in PY17 (n=229).

## Participant Experience

Cadmus asked treatment group customers about HER report readership, content, and satisfaction with the HER reports. In PY17, we asked additional questions about changes to the similar home comparison content and the customer-specific progress tracker and home health checklist content launched during the program year.

### *Readership of HER reports*

Report readership, ease of understanding, and customers involving others in their households to save energy remained similar as in PY16.

In PY17, fewer customers agreed that the information in the HER reports is useful, decreasing from 94% (n=428) in PY16 to 85% (n=234) in PY17. There was no difference between Wave 1 and Wave 2, indicating that customers received more HER reports did not find the information more or less useful than customers who received fewer.

The percent of customers who recalled the personalized recommendations (tips) to save energy decreased from 55% in PY16 (n=425) to 53% in PY17 (n=218). More Wave 1 customers recall the personalized recommendations than Wave 2 customers, indicating that customers who have received more HER report and for a longer period of time have higher recall of this component of the report.

### *Similar Home Comparison*

The percent of customers who recalled the similar home comparison component of the HER report increased from 75% (n=453) in PY16 to 88% (n=238) in PY17.

The appearance of the similar home comparison component of the HER reports was updated over the course of PY17. Cadmus surveyed customers to determine what ratings customers reported on average

[7] https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936095363

and whether or not they believed the similar home comparison was accurate. The majority of customers, 75% (n=48), reported receiving ratings of three or more stars and the majority, 82% (n=66) found the rating helpful as shown in Figure 3 and Figure 4. These results are provided and in Appendix E, Table 40 and Table 41.

**Figure 3. Customer Ratings**

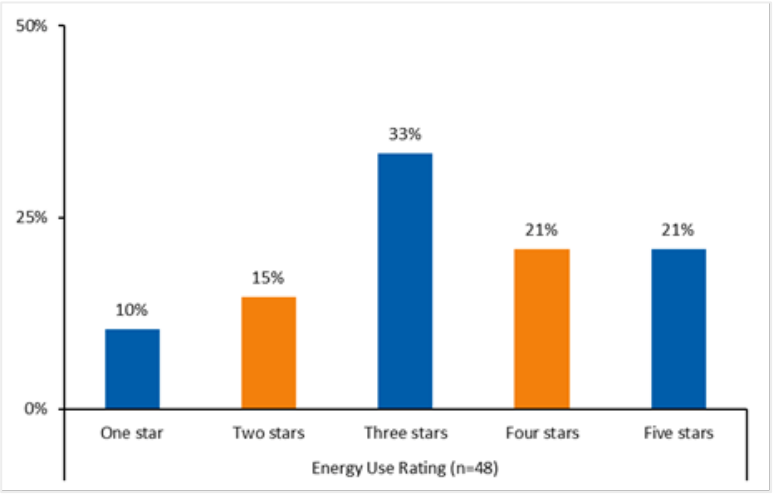
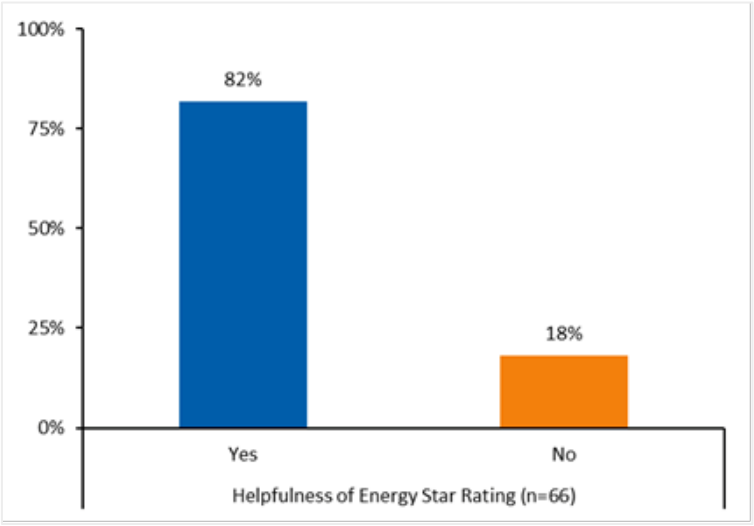


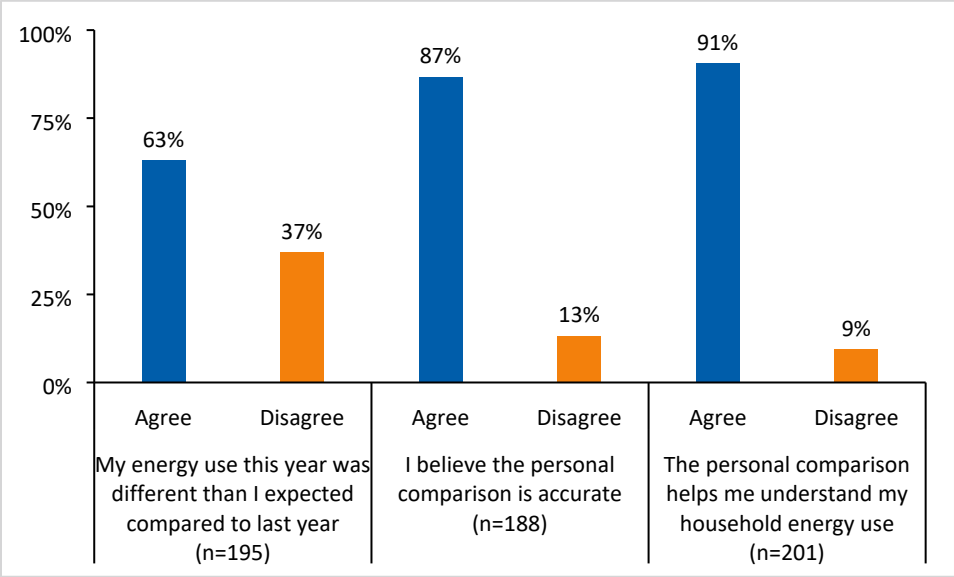

**Figure 4. Helpfulness of Rating**




### *Customer-Specific Tracker*

The customer-specific tracker was added to the HER reports in PY17. Cadmus surveyed customers to determine if they recalled the tracker and what they thought about it. We found that 92% (n=232) of customers recalled the tracker and 63% (n=195) agreed that their energy use was different than they expected, compared to last year. A majority of customers, 87% (n=188) believed their energy use was accurate and 91% (n=201) agreed that it helps them understand their household energy use. These results are summarized in Figure 5.

**Figure 5. Feedback on Customer-Specific Tracker**

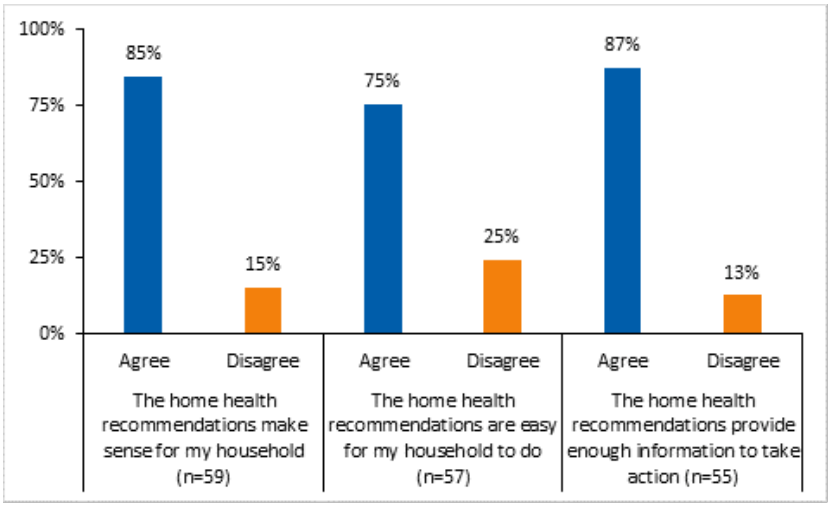



### *Home-Health Checklist*

The home-health checklist was added to the HER reports in the last HER report sent in PY17. Cadmus surveyed customers to determine if they recalled the checklist and what they thought about it. Just over half of customers, 58% (n=106), recalled the home-health checklist. Of those, most customers agreed that the information made sense for their homes, that the recommendations were easy for their households to do, and that the recommendations provided enough information for them to take action, as shown in Figure 6.

Overall, Cadmus found that customers responded favorably to the home-health checklist content, although less than a third of customers took action on the recommendations 29% (n=56) reported taking action on any of the recommendations.

**Figure 6. Feedback on Home-Health Checklist**



### *HER Program Satisfaction*

The proportion of respondents who expressed satisfaction with the HER reports in PY17 was similar to PY16.

## *Key Progress Indicators*

Cadmus will track the following key progress indicators for the HER program across the three-year program cycle: program year electric savings; number of HER report recipients; number of opt-outs; readership; uplift of Ameren Missouri programs; and recipient satisfaction with HER reports and with Ameren Missouri. Table 14 shows the baseline key metrics.

**Table 14. PY16-PY17 HER Program Key Progress Indicators**

| Key Metric | PY16 | PY17 |
|---|---|---|
| Electric savings | 220.5 MWh/month | 754.5 MWh/month |
| Number of HER report recipients | 225,000 | 231,509 |
| Number verified HER report recipients | 215,278 | 230,962 |
| Number of opt-outs* | 9 | 47 |
| HER reports readership | 89% (n=461) | 90% (n=249)** |
| Awareness of energy efficiency programs | 48% (n=465) | 57% (n=219) |
| Uplift programs | Efficient Products<br>Heating and Cooling<br>Multifamily Low Income | Efficient Products<br>Heating and Cooling<br>Multifamily Low Income |
| Agreement with following statement "Overall, I am satisfied with the Home Energy Reports." | 95% agree (n=435) | 91% (n=232) |
| Satisfaction with Ameren Missouri | 95% (n=453) | 90% (n=243) |

* At the time of the stakeholder interviews.
** Indicates a significant difference in PY17 compared to PY16 at 90% confidence.

# Net Impact Evaluation Results

To evaluate the HER program's electric energy savings and demand reduction, Cadmus conducted an impact evaluation of the HER program that included the following activities:

- Database review
- Equivalency analysis
- *Ex post* savings estimation using a billing analysis
- Demand reduction estimation using a load-shape coincidence factor
- Uplift analysis
- Realization rate estimation to compare *ex post* to *ex ante* savings

Cadmus performed the impact evaluation in June and again in November to estimate HER program cumulative savings over the course of its implementation. To do so, we used the SAS macro developed in PY16 to process customer and billing data, estimate regression models, and evaluate savings for the program to date. This report provides details on the partial year program, including savings over time and customer-specific results.

## *Total Ex Ante Savings*

Per Attachment A of the 2017 Missouri TRM Appendix, the HER program total *ex ante* per-household, annual electric savings and demand reduction are 150 kWh and 0.07 kW, respectively,[8] as shown in Table 15.

**Table 15. Behavior Measures for MEEIA Cycle 2016–2018***

| Measure Reference No. | Start Date | End Date | Incremental Cost | Cost Unit | Gross Annual Demand Reduction (kW) | Gross Annual Electric Savings (kWh) | Savings Unit | Measure Life |
|---|---|---|---|---|---|---|---|---|
| 1223 | 1/1/16 | - | 0 | Per Home | 0.0669 | 150 | Per Home | 1 |

*2017 Ameren Missouri TRM Appendix: Attachment A. Cadmus used average daily savings of 0.41095890 kWh per day per customer to calculate *ex ante* savings.

To calculate total 2017 *ex ante* savings for the program in PY17, Cadmus calculated the total *ex ante* savings by multiplying the TRM total annual savings of 150 kWh per customer by the number of customers in the Wave 1 and Wave 2 treatment groups at the start of PY17, adjusting for the number of days since the first PY17 HER report for Wave 2 customers. In the *ex ante* savings calculation, Cadmus assumed Wave 1 customers had received HER reports prior to the start of PY17 that impacted their

[8] Measure reference number 1223, start date January 1, 2016. Gross annual demand reduction listed in the TRM spreadsheet was 0.0669 kW per home.

energy consumption continuing into the start of the program year and thus received 365 days of the treatment out of the 365 days in PY17 (or 100% of the TRM *ex ante* savings). We adjusted the Wave 2 *ex ante* because the first PY17 HER report they received was sent in May 2017, after the start of the program year; we assumed customers in Wave 2 received their first HER report prior to May 15, 2017 and thus received 289 days of the treatment out of 365 days in PY17 (or 79.178% of the TRM *ex ante* savings). Table 16 provides the details and results of these calculations.

**Table 16. PY17 HER Program Ex Ante Savings**

| Wave | *Ex Ante* Number Treatment Days | *Ex Ante* Participation | *Ex Ante* TRM Energy Savings per Customer (kWh/year) | *Ex Ante* TRM Energy Savings Total (MWh/year) | *Ex Ante* TRM Demand Savings per Customer (kW/year) | *Ex Ante* TRM Demand Savings Total (kW/year) |
|---|---|---|---|---|---|---|
| Wave 1 | 365 | 210,724 | 150 | 31,609 | 0.0669 | 14,732 |
| Wave 2* | 289 | 20,484 | 119 | 2,433 | 0.0554 | 1,134 |
| **Total** | **-** | **231,208** | **-** | **34,041** | **-** | **15,866** |

* Wave 2 ex ante calculations account May being the first month of participation, after the beginning of the program year.

## *Database Review*

Program data for the HER program evaluation consisted of customer data and billing data, which included the following variables relevant to the evaluation:

- Customer data: customer account number, premise number, premise zip code
- Billing data: customer account number, premise number, monthly usage, read date, and days in period

The implementer provided the data sets that Cadmus used to randomize customers into treatment and control groups. Out of the original 328,134 randomized customers in Wave 1 and 2, approximately 4% were missing from the customer and billing data used in this interim analysis.

## *Equivalency*

As in PY16, Cadmus verified the integrity of the program's experimental design by conducting an equivalency analysis for both waves in PY17. We compared average pre-treatment daily energy consumption between treatment and control group customers to ensure that the groups were balanced using a t-test for the difference in means. In the analysis, a p-value greater than 0.10 indicated the groups were well balanced and adequately randomized. The difference in average daily consumption in the treatment and control groups was not significant in either wave. Thus, customers in the analysis dataset were balanced.

## *Energy Savings Estimation*

Cadmus estimated savings for Wave 1 and Wave 2 in PY17 to provide an estimate of program total savings to-date. Cadmus estimated *ex post* energy savings using a panel regression analysis of monthly

billing data from customers in the HER program treatment and control groups. The findings from the analysis are described in this section.[9]

We estimate that Ameren Missouri's HER program saved a total of 9,159 MWh between March 2017 and February 2018 (38% precision at 90% confidence). Wave 1 treatment group customers saved an average of 0.12 kWh per day (i.e., 0.34%) compared to control group customers' energy consumption during the same period. The Wave 1 savings estimate was significant at the 90% confidence level with 37% precision.

Wave 2 treatment group customers saved an average of -0.02 kWh (i.e., -0.05%) per day. This savings estimate was not significant at 90% confidence level (greater than 100% precision) and thus Cadmus concluded that Wave 2 energy savings were zero.

The two waves combined saved an average of 0.115 kWh per day (i.e., 0.32%) in PY17. Cadmus multiplied average daily savings for each wave by the total number of treatment days in each wave's treatment period to estimate cumulative total savings to date, as shown in Figure 7 and Figure 8, with the 90% confidence interval around the monthly savings in each month. Comparing evaluated savings to the TRM assumption of 150 kWh per year per customer (i.e., 0.4110 kWh per day per customer), the average daily savings realization rate is 28%.

Figure 9 shows the program's cumulative savings over the history of the program with a 90% confidence interval. The regression model specification and estimates are provided in Appendix F Billing Regression Model Specification and Estimation Results.

[9] The HER program was established as an experimental design, utilizing a control group in the regression and thus the savings estimate is considered "net". Therefore, a separate NTG estimation was unnecessary.

**Figure 7. Wave 1 HER Program Savings per Month**

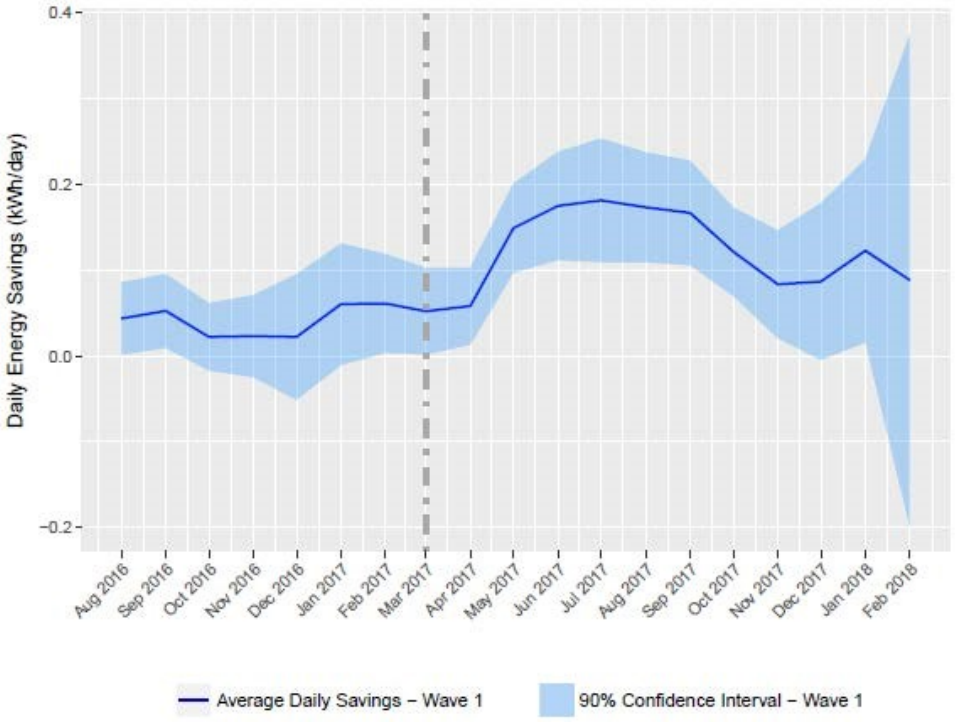



**Figure 8. Wave 2 HER Program Savings per Month**

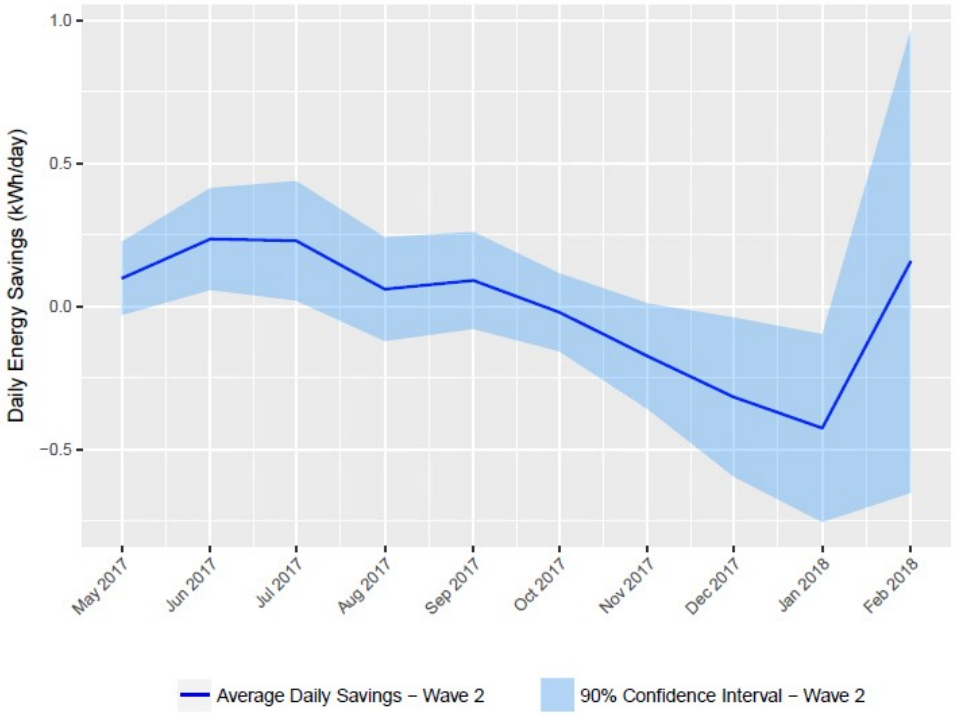
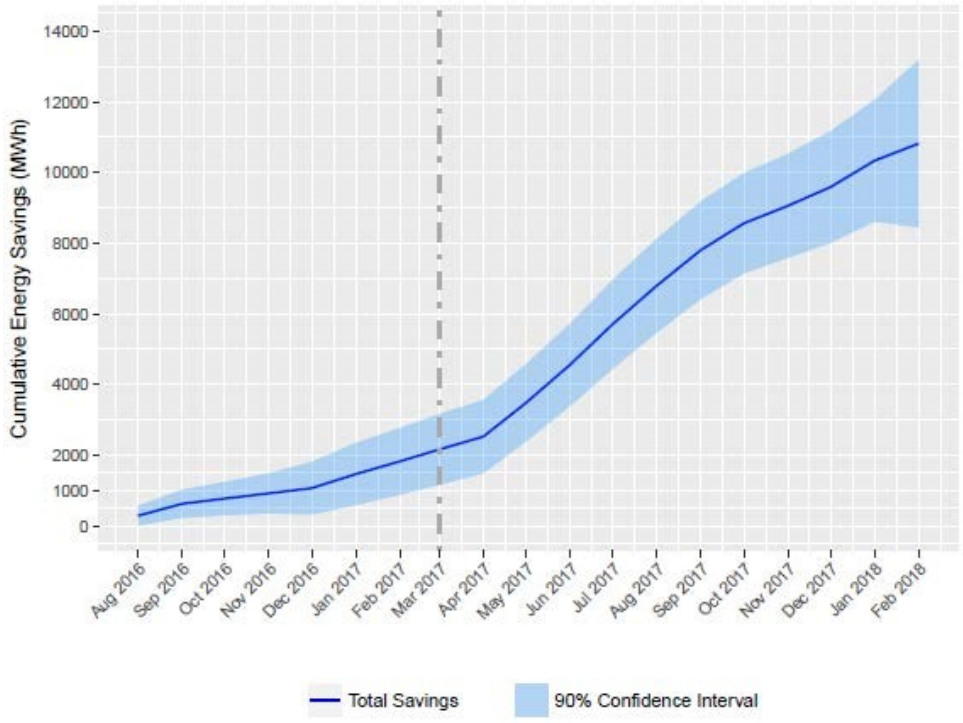


**Figure 9. HER Program Cumulative Savings**




## *Demand Reduction Estimation*

Cadmus used the residential Building Shell coincident peak demand factor to estimate the HER program's impact on customers' demand.[10] We applied the coincidence peak demand factor of 0.000466 to the HER program's energy savings to estimate demand reduction. Total demand reduction was 4,269 kW/year, resulting in a 27% realization rate when compared to *ex ante* savings of 16,185.3 kW/year. Demand savings have the same confidence and precision as energy savings.

## *Customer-Specific Savings*

Table 17 report average daily savings per customer per day, in each pre-usage quartile, for Wave 1. The values in brackets are the 90% confidence intervals for each estimate. In Wave 1, customers with the highest energy consumption--in the third and fourth quartiles—drove program savings with statistically significant savings of 0.160 kWh and 0.142 kWh per customer per day, respectively, while customers with lower usage achieved nonsignificant savings.

[10] See 2017 Ameren Missouri TRM, Appendix E.

**Table 17. Wave 1 PY17 HER Program Savings by Quartile**

| Pre-Usage Quartile* | Daily Savings to Date** | |
|---|---|---|
| | kWh/day | % kWh/day |
| Quartile 1: < 8,541 kWh/year | 0.008 [-0.015, 0.031] *** | 0.0% [-0.1%, 0.2%] *** |
| Quartile 2: 8,542 - 11,899 kWh/year | 0.014 [-0.015, 0.043] *** | 0.0% [-0.1%, 0.1%] *** |
| Quartile 3: 11,900 - 16,608 | 0.160 [0.122, 0.198] | 0.4% [0.3%, 0.5%] |
| Quartile 4: > 16,609 | 0.315 [0.261, 0.369] | 0.5% [0.4%, 0.6%] |

*Customers were assigned to quartiles based on their total annual consumption (kWh/year) in the pre-period.
**The brackets represent 90% confidence intervals around the savings estimate.
***These average daily savings estimates are not statistically significant at the 90% confidence level, and so we concluded that zero savings resulted from the HER program in these quartiles.

As shown in Table 18, Wave 2 savings estimates are not statistically significant at the 90% confidence level in any quartile. The savings estimate in the highest and lowest usage quartiles are positive, while the savings estimates are negative (i.e., energy consumption increased) in the middle two quartiles.

**Table 18. Wave 2 PY17 HER Program Savings by Quartile**

| Pre-Usage Quartile* | Daily Savings to Date** | |
|---|---|---|
| | kWh/day | % kWh/day |
| Quartile 1: < 8,432 kWh/year | 0.048 [-0.043, 0.138] *** | 0.2% [-0.2%, 0.7%] *** |
| Quartile 2: 8,433 - 10,987 kWh/year | -0.069 [-0.169, 0.030] *** | -0.3% [-0.7%, 0.1%] *** |
| Quartile 3: 10,988 - 17,812 | -0.156 [-0.311, 0.000] *** | -0.4% [-0.7%, 0.0%] *** |
| Quartile 4: > 17,813 | 0.118 [-0.060, 0.297] *** | 0.2% [-0.1%, 0.6%] *** |

*Customers were assigned to quartiles based on their total annual consumption (kWh/year) in the pre-period.
**The brackets represent 90% confidence intervals around the savings estimate.
***These average daily savings estimates are not statistically significant at the 90% confidence level, and so we concluded that zero savings resulted from the HER program in these quartiles.

## *Uplift Results*

HER program savings estimates reflected customers' behavioral changes and other investments in energy-efficient products resulting from the HER program. Some customers invested in and installed efficient products received rebates from Ameren Missouri through other efficiency programs. In such cases, HER program savings and those from other rebate programs were confounded, meaning both would be included in the total net savings estimate for the residential portfolio.

To disambiguate program-related savings from other programs' savings, Cadmus assessed the HER program's effect on customers participating in other programs (i.e., "uplift" or "channeling"). We analyzed participation uplift (i.e., the rate at which treatment group customers participated in other programs compared to the control group) and savings uplift (i.e., the amount energy customers saved through other programs, compared to the control group).

The participation uplift value is the difference between treatment group and control group participation rates, e.g., if 3% of treatment customers participated in Efficient Products and 2% of control customers did, then participation uplift is equal to the difference, or 1%. The percent participation uplift value is participation uplift divided by control group participation rates. Using the example above, if participation uplift is 1% and control group participation is 2%, then percent participation uplift is 1% divided by 2%, or 50%.

As shown in Table 19, the Wave 1 had positive participation uplift. The difference between treatment and control groups participation in Heating Cooling is 0.07%, which means treatment group customers are 2.88% more likely to participate in the program. The Multifamily Low-Income program has very low participation in the treatment and control groups, which is the why the participation uplift is effectively zero. Wave 2 had negative uplift for Heating and Cooling and Efficient Products, which is likely due to the wave receiving reports for the first time this year.

**Table 19. PY17 HER Program Participation Uplift**

| Program | Wave 1 | | | Wave 2 | | |
|---|---|---|---|---|---|---|
| | Participation per 1,000 Customers | Participation Uplift | % Participation Uplift | Participation per 1,000 Customers | Participation Uplift | % Participation Uplift |
| Heating Cooling | 24 | 0.07% | 2.88% | 9 | -0.07% | -8.50% |
| Efficient Products | 16 | 0.08% | 5.19% | 7 | -0.02% | -3.62% |
| Multifamily Low-Income | 0 | 0.00% | -33.37% | 3 | 0.00% | 1.31% |

As shown in Table 20, both Wave 1 and Wave 2 had positive savings uplift. The only program with negative savings uplift was Heating Cooling among Wave 1 customers, where the control group homes saved an average of 0.17 kWh/year more than treatment group customers. Participation uplift for Wave 1 Heating Cooling was positive—control group customers participated on average less but installed measures with higher savings. Wave 1 treatment customer homes saved on average 0.55 kWh/year more than control group customers. Although Wave 2 had negative participation uplift, it had positive savings uplift for every program—in this case, treatment group customers participated on average less but installed measures with higher savings. The program with the highest uplift was Heating Cooling.

**Table 20. PY17 HER Program Savings Uplift**

| Program | Wave 1 | | Wave 2 | |
|---|---|---|---|---|
| | Savings per Home per Year (kWh) | Total Savings (MWh) | Savings per Home per Year (kWh) | Total Savings (MWh) |
| Heating Cooling | -0.17 | -36.33 | 2.50 | 51.17 |
| Efficient Products | 0.55 | 116.52 | 0.22 | 4.52 |
| Multifamily Low-Income | 0.00 | 0.06 | 0.08 | 1.60 |
| **Total** | **0.38** | **80.25** | **2.80** | **57.30** |

*Savings uplift is measured as the difference in average daily cross-program savings (kWh/day) between treatment and control group customers in the post period. There is no sampling uncertainty associated with this estimate because we observe the population of program participants.

Wave 1 and Wave 2 had positive total uplift of 80.25 MWh and 57.30 MWh, respectively. To adjust for potential double-counted savings across the portfolio, these savings values are subtracted out from total HER program savings, as shown in Table 1.

## *Benchmarking*

Cadmus compared Ameren Missouri's savings per customer to a similar program implemented by Ameren Illinois—Illinois Power Agency (IPA). The Ameren Illinois program includes HER reports, similar to the Ameren Missouri program, but emails reports in addition to the mailed reports and web portal. We included results (verified net savings adjusted for uplift) for participants who began receiving reports in the past three program years, 2014-2015, 2015-2016, and 2016-2017, in Table 21. We also reviewed Entergy Arkansas' 2015 Behavioral Modification pilot, which included an HER report, as well as an online portal through which customers could earn points for energy-efficient behaviors that qualified for gift cards at certain retailers.

Savings resulting from Ameren Missouri's program are similar to Ameren Illinois' results for participants joining the program in 2016. Ameren Illinois treatment customers from the previous two years had higher average savings per customer than those in the 2016 year. This indicates that other factors may be a part of the lower than expected savings for Ameren Missouri's HER program and that the target estimates of 150 kWh per customer may be too optimistic for the program.

**Table 21. Benchmarked Program Energy Savings**

| Utility | Program Name | Year Began Receiving Reports | Evaluation Period | Number of Participants (Treatment) | Verified Net Savings* (MWh/yr) | Average kWh Savings per Customer* |
|---|---|---|---|---|---|---|
| Ameren Illinois – Illinois Power Agency | Behavior Modification | 2014 | 2016-2017 | 45,359 | 4,596 | 101.3 |
| Ameren Illinois – Illinois Power Agency | Behavior Modification | 2015 | 2016-2017 | 27,716 | 2,355 | 85.0 |
| Ameren Illinois – Illinois Power Agency | Behavior Modification | 2016 | 2016-2017 | 46,179 | 2,105 | 45.6 |
| Entergy Arkansas | Behavioral Benchmarking Pilot** | 2015 | 2015 | 108,532 | 8,424 | 77.6 |
| **Ameren Missouri** | **Home Energy Reports** | **2016** | **2016-2017** | **230,962** | **9,159** | **39.1** |

* Savings adjusted for uplift.
** Entergy Arkansas' program included promotional incentives for customers making energy-efficiency improvements.

Cadmus also reviewed a similar program by KCP&L, which began in 2014 and added an additional wave in each of 2015 and 2016. The report did not break out results by the starting year of each wave, and therefore results are not included in Table 21. One of the waves targeted high energy users only. Average 2016 savings for the program was 136 kWh per participant – lower than Ameren Missouri's targeted savings of 150 kWh/customer.

## *Additional Analysis*

Cadmus performed additional analysis to determine if other factors could explain the impact of Ameren Missouri's HER program resulting in smaller savings than expected. We examined energy consumption in the control group to determine whether energy consumption is decreasing in general, due to factors outside of the program. We also examined energy consumption in different regions of Ameren Missouri's service territory to determine if changes in energy consumption differed depending on location.

### Changes in Energy Consumption

Using a regression analysis that compared control group energy consumption before and after the start of each program year, Cadmus estimated average changes in energy consumption among control group customers who had not received HER reports. We hypothesized that, in the absence of receiving HER reports, control group energy consumption during each program year should be roughly equivalent to pre-program consumption, after controlling for the effects of weather. However, we found that control group energy consumption has decreased substantially since the start of the HER program in 2016.

Although consumption among treatment group customers decreased to a greater degree, the reduction in control group energy consumption was of the same order of magnitude. Table 22 shows that in PY17, energy consumption decreased by 3.2% among control group customers which is only slightly less than the 3.5% decrease among treatment group customers.

These results show that energy consumption decreased in PY16 and PY17 compared to 2015 among customers that did not receive HER reports. There were no rate changes during this time period and no known phenomenon that occurred to explain the general decline. One explanation could be Ameren Missouri's ongoing promotion of energy efficiency over the past 10 years. Cadmus' nonparticipant spillover (NPSO) analysis estimated significant levels of NPSO savings—19,446 MWh in PY16 (like and non-like)[11] and 6,212 MWh in PY17 (like). (See NPSO sections in non-HER PY16 and PY17 reports). The evaluation team estimated combined like and non-like spillover in 2016 and 2017 (non-like spillover wasn't measured in 2017) of approximately 35 kWh/nonparticipant customer.[12] One effect of this is a reduction in the potential of behavior-based programs to save energy at previously expected levels on top of decreasing baseline usage.

[11] Cadmus NPSO analysis utilized conservative assumptions, such as only including respondents that rated the program as very important for non-like spillover and reducing savings of certain measures by half for appliances where ENERGY STAR market shares are high.

[12] 19,446 + 6,212 = 25,658 MWh/customer / 731,725 nonparticipant customers x 1000 kWh/MWh = 35 kWh per customer

**Table 22. Changes in Energy Consumption**

| Program Year | Wave | Changes in Consumption (Compared to Baseline) | | | | HER Program Savings | |
|---|---|---|---|---|---|---|---|
| | | Treatment Group (kWh/day/customer) | % of Baseline | Control Group (kWh/day/customer) | % of Baseline | Difference in Differences (kWh/day/customer) | Difference in % |
| PY17 | Wave 1 | -1.269 | -3.5% | -1.141 | -3.2% | -0.127 | -0.4% |
| PY17 | Wave 2 | -0.795 | -2.2% | -0.760 | -2.1% | -0.035 | -0.1% |
| PY16 | Wave 1 | -0.705 | -2.0% | -0.669 | -1.9% | -0.036 | -0.1% |

## Regional Energy Consumption

Cadmus grouped control group and treatment group customers based on their zip codes and categorized them into Northeast, Northwest, Southeast, Southwest, and St. Louis regions. We combined this with data from the U.S. Census Bureau[13] on the percent of the population designated as rural and mean income in each zip code. Table 23 summarizes the distributions of the percent of rural populations and mean household income across zip codes in each region. All regions include some zip codes designated as entirely urban (i.e., where percent rural is zero) but the regions are predominantly rural, except for St. Louis, which is entirely urban. Similarly, mean household income is similar across all regions—Northwest and Southeast regions include zip codes with higher mean incomes on average but are similar in minimum and maximum to the other regions—except for St. Louis, where the range of mean income is considerably lower than the other regions.

**Table 23. Regional Demographics**

| Region | Percent Rural | | | Mean Household Income | | |
|---|---|---|---|---|---|---|
| | Minimum | Average | Maximum | Minimum | Average | Maximum |
| Northeast | 0% | 90% | 100% | 21,634 | 51,046 | 110,081 |
| Northwest | 0% | 68% | 100% | 18,510 | 58,012 | 156,460 |
| Southeast | 0% | 71% | 100% | 22,567 | 56,222 | 218,572 |
| Southwest | 0% | 85% | 100% | 20,098 | 49,644 | 203,304 |
| St. Louis | 0% | 0% | 0% | 21,735 | 46,522 | 64,068 |

We hypothesized that, in the absence of receiving HER reports the combination of urban or rural designation and mean income level could help to identify where energy consumption is decreasing in the general population and where it is not.

Using a regression analysis similar to the one described above, Cadmus estimated changes in control group energy consumption after the start of each program year in each of the five regions. Further, we

[13] U.S. Census 2010 and 2007-2011 American Community Survey

estimated the savings as the difference in differences between the treatment and control groups to determine if savings varied by region. Note that not all estimates are significant at a 90% confidence level and positive changes in energy consumption indicate energy consumption increased in the program year, compared to the baseline.

The results in Table 24show that in PY17, Wave 1 customers in the control group decreased their energy consumption by between 0.4% to 4.3%. The lowest decrease was in the Southwest and that estimate was not significantly different from zero. The highest decrease was in St. Louis. Savings were similar in regions where there were savings (Northeast, Southeast, and St. Louis) and were negative in the Northwest region (i.e., customers increased energy consumption). The changes in consumption are similar among control group customers in Wave 2 in PY17 and in Wave 1 in PY16, except that in PY16, the increases in energy consumption in the Southwest are significant. Most of Ameren Missouri's HER customers reside in the Southeast and therefore, overall program savings are driven by those results.

The results indicate that although there is variation in the estimated changes in energy consumption between St. Louis and the other regions, they are consistent between the treatment and control groups and do not result in consistent differences in the savings between regions.

**Table 24. Changes in Regional Energy Consumption**

| Program Year | Wave | Region | Change in Consumption | | | | HER Program Savings | |
|---|---|---|---|---|---|---|---|---|
| | | | Treatment Group | % of Baseline | Control Group | % of Baseline | Difference in Differences (kWh/day/customer) | Difference in % |
| PY17 | Wave 1 | Northeast | -1.015 | -2.6% | -0.861 | -2.2% | -0.154 | -0.4% |
| | | Northwest | -0.636 | -1.8% | -0.795 | -2.2% | 0.159 | 0.5% |
| | | Southeast | -1.295 | -3.6% | -1.157 | -3.2% | -0.139 | -0.4% |
| | | Southwest* | -0.072 | -0.2% | -0.189 | -0.4% | 0.117 | 0.3% |
| | | St. Louis | -1.457 | -4.6% | -1.367 | -4.3% | -0.090 | -0.3% |
| PY17 | Wave 2 | Northeast | -0.668 | -1.6% | -0.331 | -0.8% | -0.337 | -0.8% |
| | | Northwest* | -0.298 | -0.8% | -0.420 | -1.1% | 0.121 | 0.4% |
| | | Southeast | -0.759 | -2.1% | -0.745 | -2.1% | -0.014 | 0.0% |
| | | Southwest* | 1.170 | 2.8% | 0.726 | 1.7% | 0.444 | 1.1% |
| | | St. Louis | -1.476 | -4.7% | -1.433 | -4.5% | -0.044 | -0.1% |
| PY16 | Wave 1 | Northeast | 0.663 | 1.7% | 0.825 | 2.1% | -0.162 | -0.4% |
| | | Northwest* | 0.074 | 0.2% | -0.150 | -0.4% | 0.225 | 0.6% |
| | | Southeast | -0.798 | -2.2% | -0.755 | -2.1% | -0.043 | -0.1% |
| | | Southwest | 2.414 | 5.5% | 2.123 | 4.8% | 0.291 | 0.7% |
| | | St. Louis | -1.103 | -3.5% | -1.109 | -3.5% | 0.006 | 0.0% |

* Indicates the results are not statistically significant at 90% confidence.

## *Recommendations*

Cadmus recommends that Ameren Missouri monitor savings over time as the HER program matures and consider incorporating new strategies into the program. Our analysis of energy consumption through

February 2018 shows that energy savings gradually increased over time and indicate that savings may increase through continued implementation of the HER program. However, we also found that customers are decreasing their energy consumption in the absence of the HER program and due to this, potential for additional energy savings may be lower than targeted.

Cadmus recommends that Ameren Missouri execute plans to send eHER reports. Doing so would require outreach to increase the number of customers that opt-in to receive Ameren Missouri emails or inviting customers to opt in to receive eHERs specifically. Customer-specific results indicate that customers with lower energy usage did not save energy in either PY16 or PY17. Thus, Cadmus recommends that the HER program should target customers with high usage in future program years to maximize savings and minimize costs.

# Cost-Effectiveness

Ameren Missouri assessed cost-effectiveness using the following five tests, as defined by the California Standard Practice Manual:[14]

- Total Resource Cost (TRC) Test
- Utility Cost Test (UCT)
- Ratepayer Impact Measure Test (RIM)
- Participant Test (PART)
- Societal Cost Test (SCT)

DSMore takes hourly prices and hourly energy savings from specific measures installed through the HER program, and correlates prices and savings to 33 years of historic weather data. Using long-term weather ensures that the model captures low-probability, high-consequence weather events, and appropriately values these. As a result, the model produces an accurate evaluation of the demand-side efficiency measure relative to other alternative supply options.

Key assumptions include the following:

- Discount Rate = 6.46%
- Line Losses = 5.72%
- Summer Peak would occur during the 16$^{th}$ hour of a July weekday, on average
- Avoided Electric costs from the 2014 Integrated Resource Plan (IRP) filing were used because the first Home Energy Reports were sent to all participants prior to the 2017 IRP being filed
- Escalation rates for different costs occur at the component level, with separate escalation rates for fuel, capacity, generation, T&D, and customer rates carried out over 25 years

Ameren Missouri used evaluation results as model inputs (e.g., PY17-specific HER program participation counts, per-unit gross savings, NTG, NPSO).

Particularly, measure load shapes drove model assumptions, as indicated when the model should apply savings during the day. This ensured that the load shape for an end use matched the system peak impacts of that end use, and provided the correct summer coincident savings. Ameren Missouri used measure lifetime assumptions and incremental costs based on the program database, the Ameren Missouri TRM, or the original Batch Tool.

A key step in the analysis process required PY17 Ameren Missouri program-spending data: actual spending, broken down into contractor administration, incentives, and marketing costs. Ameren Missouri applied these costs at the program level. Other costs—including R&D, EM&V, Educational Outreach, Portfolio Administration, Potential Study, and Data Tracking—were allocated to programs

[14] California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects. October 2001.

based upon program benefits. DSMore reports results in 2016 dollars and any inputs and outputs reported by DSMore are discounted from the 2017 spending inputs.

Table 25 summarizes cost-effectiveness findings by test. Any benefit-cost score above 1.0 passed the test as cost-effective. As shown, the HER program did not pass the UCT, TRC, Societal, and PART tests.

**Table 25. PY17 HER Program Cost-Effectiveness Results**

| Program | UCT | TRC | RIM | SCT | PART |
|---|---|---|---|---|---|
| Home Energy Reports | 0.59 | 0.59 | 0.30 | 0.59 | N/A |

* Participant cost test is N/A because there are no participant costs for this program.

# Appendix A. End Use Load Shapes and Coincidence Factors

Appendix E

**End-Use Category Energy Load Shapes**

**% Energy by Month**

| | Residential End-Use Category Load Shape | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Building Shell** | **Cooling** | **Freezer** | **HVAC** | **Lighting** | **Miscellaneous** | **Pool Spa** | **Refrigeration** | **Water Heating** |
| January | 11.1297% | 0.1200% | 7.9579% | 11.1297% | 10.1182% | 8.4893% | 8.6451% | 7.7053% | 10.3527% |
| February | 9.3077% | 0.1100% | 7.2518% | 9.3077% | 8.8441% | 7.7366% | 7.1145% | 7.2169% | 9.0720% |
| March | 7.0042% | 0.3130% | 8.1080% | 7.0042% | 9.2879% | 8.4863% | 8.6052% | 8.0272% | 9.5543% |
| April | 3.7116% | 1.5047% | 7.9918% | 3.7116% | 8.4645% | 8.2144% | 8.0702% | 7.8752% | 8.4799% |
| May | 4.0888% | 6.5410% | 8.4083% | 4.0888% | 7.9393% | 8.4847% | 8.6052% | 8.5646% | 8.3600% |
| June | 10.3973% | 21.0823% | 8.5730% | 10.3973% | 6.8508% | 8.2122% | 8.0702% | 8.9112% | 7.7065% |
| July | 14.0100% | 28.4780% | 9.6095% | 14.0100% | 6.7864% | 8.4883% | 8.6451% | 9.4239% | 6.7712% |
| August | 13.3207% | 27.0766% | 9.6095% | 13.3207% | 7.0565% | 8.4840% | 8.5653% | 9.4212% | 6.3688% |
| September | 6.6759% | 12.6605% | 8.4277% | 6.6759% | 7.3792% | 8.2136% | 8.3032% | 8.4971% | 6.9373% |
| October | 3.7011% | 1.8472% | 8.2582% | 3.7011% | 8.4539% | 8.4869% | 8.6052% | 8.5653% | 7.9644% |
| November | 5.9593% | 0.1444% | 7.8465% | 5.9593% | 8.9880% | 8.2122% | 8.1088% | 7.8717% | 8.4752% |
| December | 10.6937% | 0.1222% | 7.9579% | 10.6937% | 9.8312% | 8.4915% | 8.6619% | 7.9204% | 9.9577% |

**End-Use Category Energy to Coincident Peak Demand Factors**

| | **Building Shell** | **Cooling** | **Freezer** | **HVAC** | **Lighting** | **Miscellaneous** | **Pool Spa** | **Refrigeration** | **Water Heating** |
|---|---|---|---|---|---|---|---|---|---|
| | 0.0004660805 | 0.0009474181 | 0.0001685722 | 0.0004660805 | 0.0001492529 | 0.0001148238 | 0.0002354459 | 0.0001285253 | 0.0000887318 |

Source: Ameren Missouri 2016-2018 Energy Efficiency Plan. MPSC file number EO-2015-0055 Appendix E to evaluated energy saving

# Appendix B. Bibliography

Entergy Arkansas, Inc. 2016. “Arkansas Energy Efficiency Program Portfolio Annual Report.” Docket Number 07-085-TF. 2015 Program Year.

Opinion Dynamics. 2018. “Impact and Process Evaluation of 2016 (PY9) Illinois Power Agency Behavioral Modification Program.” Prepared for Ameren Illinois Company.

# Appendix C. Stakeholder Interview Guide

Respondent name:_____

Respondent phone:_____

Interview date:_____ Interviewer initials:_____

For the PY16-PY18 evaluation, Cadmus will interview stakeholders annually. The interview will focus on identifying recommendations for improving subsequent program years and informing the survey instrument.

## *Roles and Responsibilities*

1. Have your roles and responsibilities changed in the second year of the program?
2. Last year, you told me about coordinating with ICF and the types of communication you have with them. Has that remained the same?
3. Prior to the program start, you discussed how Ameren ran the program through a focus group panel. You mentioned that you may do so for an email cohort as well. Do you have plans to?

## *Program Implementation*

4. Last year, you told us about how the program came to fruition (interest of Ameren Illinois and KC Power & Light and that there was a push to run a program that touches more customers). Do you think that the program has addressed these interests in the past two years?
5. Last year, you told us about the program theory (normative comparison and customer specific, or self-comparison). Have there been any changes to program theory in PY17? Are you planning any for PY18?

## *Program Goals*

6. Appendix B[15] showed 225,000 people for estimated participation and an estimated annual savings target of 33,750 MWh and 15.7MW. The PY16 and PY17 interim impact evaluation analysis monitored progress in terms of savings throughout the year. Are you monitoring progress in any other ways? If so, how? And what are you finding?
    a. Have you identified triggers to signal when goals are not being met and contingency plans in case this happens?
    b. Last year, nine customers had opted out of receiving the HER reports at the end of the year. How many have opted out during this program year?

[15] State of Missouri. "In the Matter of Union Electric Company d/b/a Ameren Missouri's 2nd Filing to Implement Regulatory Changes in Furtherance of Energy Efficiency as Allowed by MEEIA." File No. EO-2015-0055. February 5, 2016. Refer to Appendix B.

## *Program Delivery*

7. In PY17, Cadmus randomized customers into treatment and control groups for the "backfill" to replace customers whose accounts had been closed in PY16. We received a list of customers from Ameren to do this.
    a. Can you tell me what customer characteristics were used to identify eligible customers? For example, usage history, high or low energy use customers, size of home, bill-pay history, income, etc.
    b. Were they the same characteristics as those used in PY16?
8. How many HER reports will be sent out in PY17?
    a. Can you please list the dates that the PY7 HER reports were sent?
    b. Last year, there were delays due to the focus group panel and the election. Did you face other challenges with timing in PY16?

## *Home Energy Report Design and Delivery*

9. Can you confirm that there was still no web-portal component or any other delivery mechanism for home energy reports apart from mailed reports in PY17?
10. It sounds like the program is considering offering emailed reports next program year. What is the motivation behind adding this delivery channel?
    a. What will the frequency be (i.e., monthly, bi-monthly, combination of both)?
    b. If emailed reports are offered, will you select new customers or send them to the PY16 treatment group?
11. What changes have been implemented to the report design in addition to the customer-specific comparison?
    a. Can you confirm that the customer-specific comparison was included in all of the PY17 HER reports?
12. Are any other changes being planned or considered for PY 2018? For example, do you expect to begin sending the email version of HER reports or to stop sending paper HER reports to lower usage customers?

## *Program Marketing*

13. Can you confirm that cross-program marketing has continued in the home energy reports?
    a. Did it include the same programs as in the previous year (pool pumps, smart thermostats, HVAC tune-ups, heat pump water heaters)?
    b. Why or why not?
14. Were any other reminder tools provided to customers in PY17?
    a. [IF YES] What were they? What were their purpose?
    b. [IF NO] Were these considered?

## *Successes, Challenges, Suggestions for Improvement*

15. What would you say is working particularly well so far in PY17? Why is that?
16. What are the biggest challenges with the program?
17. What would you like the evaluation to help you solve?
18. Overall, do you have any suggestions for how to improve the program?
    a. Do you anticipate any areas that might need improvement next year?
19. Do you have any feedback about last year's evaluation and what you might like to see differently?

## *Wrap Up*

20. Do you have any specific questions that you want to make sure are included in the customer survey?

Those are all the questions I have for you. Is there anything else you would like to add or questions you'd like to ask?

# Appendix D. Survey Instruments

Survey instruments in PY16 were the same as in PY17 with the following edits to additional questions:

**Household Efficiency Comparison**

C3. Below the similar home comparison, the newest Home Energy Report includes an energy use rating with stars. What rating did you receive?

1. One star
2. Two stars
3. Three stars
4. Four stars
5. Five stars
6. Don't know

C4. Did you find the rating helpful?

1. Yes
2. No
3. Not applicable
4. Don't know

**How Has My Efficiency Changed?**

C5. The most recent Home Energy Report tracks your progress by comparing your home's energy use to itself in the same time period of the previous year. Do you remember seeing this tracker?

1. Yes
2. No [SKIP TO C8]
3. Don't know [SKIP TO C8]
4. Skipped [SKIP TO C8]

C6. How much do you agree with the following statements? Please select a response from the dropdown menu. [RANDOMIZE ORDER]

A. My energy use this year was different than I expected compared to last year
B. I believe the personal comparison is accurate
C. The personal comparison helps me understand my household energy use

MENU OPTIONS:

1. Strongly agree
2. Somewhat agree
3. Somewhat disagree
4. Strongly disagree
5. Don't know

C7. Did you find the comparison helpful?

1. Yes
2. No
3. Not applicable
4. Don't know

**Home Health Checklist**

C8. The most recent Home Energy Report contains a "home health checklist" with recommendations or steps you can take to save energy, improve indoor air quality and prevent pests from entering your home. Do you remember seeing this information?

1. Yes
2. No [SKIP TO C12]
3. Don't know [SKIP TO C12]

C9. How much do you agree with the following statements? Please select a response from the dropdown menu. [RANDOMIZE ORDER]

A. The home health recommendations make sense for my household
B. The home health recommendations are easy for my household to do
C. The home health recommendations provide enough information to take action

MENU OPTIONS:

1. Strongly agree
2. Somewhat agree
3. Somewhat disagree
4. Strongly disagree
5. Don't know

C10. Did you or anyone in your household complete any of the home health recommendations?

1. Yes
2. No [SKIP TO D1]
3. Don't Know [SKIP TO D1]

# Appendix E. Survey Frequencies

This appendix provides the responses to questions in the Home Energy Reports Program survey. This survey was sent by email at two points in time during PY17, once in October 2017 and March 2018, to randomly selected HER treatment group customers. The results below represent aggregated responses from both surveys.

The tables below provide the number of responses to the answers for each survey question. They also provide the percentage of customers that selected each response, excluding customers who answered "don't know" or "not applicable". Note: these frequencies are not weighted to account for survey mode differences. Also, although the counts corresponding to don't know and not applicable reposes are included in the tables, they are not used to calculate the percent of respondents in each response.

## *Introduction and Screener*

**Table 26. Survey Question A1 Responses (n=290)**

| Are you involved in managing energy use in your home or paying your home's utility bills? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 281 | 97% |
| No | 9 | 3% |

**Table 27. Survey Question A2 Responses (n=281)**

| Are you, or any members of your household, employed by Ameren Missouri? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes, I or someone in my household works for Ameren Missouri | 2 | 1% |
| No, no one in my household works for Ameren Missouri | 279 | 99% |

**Table 28. Survey Question A3 Responses (n=279)**

| Our records show that you received documents in the mail called Home Energy Reports. These reports included personalized recommendations on ways to cut your energy costs and take advantage of Ameren Missouri rebates. Do you recall seeing one of these reports or hearing someone in your household talking about these reports? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 249 | 89% |
| No | 30 | 11% |

## *Home Energy Report Readership, Engagement, and Reception*

**Table 29. Survey Question B1 Responses (n=249)**

| Which of the following statements best describes what you did with the Home Energy Report you received? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| I read the report thoroughly | 142 | 57% |
| I read some of the report | 58 | 23% |
| I skimmed the report | 44 | 18% |
| I did not read the report | 5 | 2% |

**Table 30. Survey Question B2_1 Responses (n=234)**

| How much do you agree with the following statements about the Home Energy Reports? The information in the reports is useful. | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 113 | 48% |
| Somewhat agree | 101 | 43% |
| Somewhat disagree | 13 | 6% |
| Strongly disagree | 7 | 3% |
| Don't know | 2 | |
| Not applicable | 1 | |

**Table 31. Survey Question B2_2 Responses (n=235)**

| How much do you agree with the following statements about the Home Energy Reports? The reports are easy to understand. | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 137 | 58% |
| Somewhat agree | 88 | 37% |
| Somewhat disagree | 7 | 3% |
| Strongly disagree | 3 | 1% |
| Don't know | 1 | |

**Table 32. Survey Question B2_3 Responses (n=170)**

| How much do you agree with the following statements about the Home Energy Reports? The reports get other in my household involved in saving energy. | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 33 | 19% |
| Somewhat agree | 71 | 42% |
| Somewhat disagree | 36 | 21% |
| Strongly disagree | 30 | 18% |
| Don't know | 14 | |
| Not applicable | 49 | |

**Table 33. Survey Question B3_1 Responses (n=232)**

| Have you completed any of these actions after receiving the Home Energy Reports? Looked for opportunities to save energy. | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 194 | 84% |
| No | 38 | 16% |
| Don't know | 2 | |
| Not applicable | 5 | |

**Table 34. Survey Question B3_2 Responses (n=200)**

| Have you completed any of these actions after receiving the Home Energy Reports? Talked about the report with other living in your home. | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 130 | 65% |
| No | 70 | 35% |
| Not applicable | 37 | |

**Table 35. Survey Question B3_3 Responses (n=227)**

| Have you completed any of these actions after receiving the Home Energy Reports? Talked about the report with other people outside your home. | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 70 | 31% |
| No | 157 | 69% |
| Don't know | 1 | |
| Not applicable | 9 | |

## *Report Content*

**Table 36. Survey Question C1 Responses (n=238)**

| Each Home Energy Report compares your energy use to that of similar homes. Do you remember seeing this comparison? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 218 | 92% |
| No | 20 | 8% |
| Don't Know | 10 | |

### Table 37. Survey Question C2_1 Responses (n=193)

| How much do you agree with the following statements? My household energy use was different than I expected, compared to similar homes | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 57 | 30% |
| Somewhat agree | 84 | 44% |
| Somewhat disagree | 34 | 18% |
| Strongly disagree | 18 | 9% |
| Don't know | 21 | |
| Note: these frequencies are not weighted to account for survey mode differences. | | |

### Table 38. Survey Question C2_2 Responses (n=189)

| How much do you agree with the following statements? I believe the comparison of my home to similar homes is accurate | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 53 | 29% |
| Somewhat agree | 87 | 47% |
| Somewhat disagree | 22 | 12% |
| Strongly disagree | 22 | 12% |
| Don't know | 27 | |
| Note: these frequencies are not weighted to account for survey mode differences. | | |

### Table 39. Survey Question C2_3 Responses (n=189)

| How much do you agree with the following statements? The comparison of my home to similar homes motivated me to read the rest of the Home Energy Report | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 62 | 33% |
| Somewhat agree | 78 | 41% |
| Somewhat disagree | 30 | 16% |
| Strongly disagree | 19 | 10% |
| Don't know | 20 | |
| Note: these frequencies are not weighted to account for survey mode differences. | | |

### Table 40. Survey Question C3 Responses (n=48)

| Below the similar home comparison, the newest Home Energy Report includes an energy use rating with stars. What rating did you receive? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Five stars | 10 | 21% |
| Four stars | 10 | 21% |
| Three stars | 16 | 33% |
| Two stars | 7 | 15% |
| One star | 5 | 10% |
| Don't know | 59 | |

### Table 41. Survey Question C4 Responses (n=66)

| Did you find the rating helpful?<br>I believe th : comparison of my home to similar homes is accurate | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 54 | 82% |
| No | 12 | 18% |
| Don't know | 34 | |
| Not applicable | 7 | |

### Table 42. Survey Question C5 Responses (n=232)

| The most recent Home Energy Report tracks your progress by comparing your home's energy use to itself in the same time period of the previous year. Do you remember seeing this tracker? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 214 | 92% |
| No | 18 | 8% |
| Don't know | 16 | |

### Table 43. Survey Question C6_1 Responses (n=195)

| How much do you agree with the following statements?<br>My energy use this year was different than I expected compared to last year | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 47 | 24% |
| Somewhat agree | 76 | 39% |
| Somewhat disagree | 54 | 28% |
| Strongly disagree | 18 | 9% |
| Don't know | 16 | |

### Table 44. Survey Question C6_2 Responses (n=188)

| How much do you agree with the following statements? I believe the personal comparison is accurate | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 79 | 42% |
| Somewhat agree | 84 | 45% |
| Somewhat disagree | 17 | 9% |
| Strongly disagree | 8 | 4% |
| Don't know | 20 | |

### Table 45. Survey Question C6_3 Responses (n=201)

| How much do you agree with the following statements? The personal comparison helps me understand my household energy use | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 103 | 51% |
| Somewhat agree | 79 | 39% |
| Somewhat disagree | 12 | 6% |
| Strongly disagree | 7 | 3% |
| Don't know | 8 | |

### Table 46. Survey Question C7 Responses (n=99)

| Did you find the comparison helpful? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 88 | 89% |
| No | 11 | 11% |
| Don't know | 10 | |
| Not applicable | 1 | |

### Table 47. Survey Question C8 Responses (n=106)

| The most recent Home Energy Report contains a "home health checklist" with recommendations or steps you can take to save energy, improve indoor air quality and prevent pests from entering your home. Do you remember seeing this information? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 62 | 58% |
| No | 44 | 42% |
| Don't know | 21 | |

### Table 48. Survey Question C9_1 Responses (n=59)

| How much do you agree with the following statements? The home health recommendations make sense for my household | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 19 | 32% |
| Somewhat agree | 31 | 53% |
| Somewhat disagree | 7 | 12% |
| Strongly disagree | 2 | 3% |
| Don't know | 2 | |

### Table 49. Survey Question C9_2 Responses (n=57)

| How much do you agree with the following statements? The home health recommendations are easy for my household to do | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 12 | 21% |
| Somewhat agree | 31 | 54% |
| Somewhat disagree | 10 | 18% |
| Strongly disagree | 4 | 7% |
| Don't know | 2 | |

### Table 50. Survey Question C9_3 Responses (n=55)

| How much do you agree with the following statements? The home health recommendations provide enough information to take action | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 17 | 31% |
| Somewhat agree | 31 | 56% |
| Somewhat disagree | 4 | 7% |
| Strongly disagree | 3 | 5% |
| Don't know | 5 | |

### Table 51. Survey Question C10 Responses (n=56)

| Did you or anyone in your household complete any of the home health recommendations? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 16 | 29% |
| No | 40 | 71% |
| Don't know | 6 | |

**Table 52. Survey Question C12 Responses (n=218)**

| Each Home Energy Report contains three personalized recommendations or tips about how to save energy. Do you remember seeing these tips? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 153 | 70% |
| No | 65 | 30% |
| Don't Know | 31 | |

**Table 53. Survey Question C13_1 Responses (n=148)**

| Have you completed any of these actions after receiving the Home Energy Reports? The personalized tips make sense for my household | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 48 | 32% |
| Somewhat agree | 64 | 43% |
| Somewhat disagree | 26 | 18% |
| Strongly disagree | 10 | 7% |
| Don't know | 3 | |

**Table 54. Survey Question C13_2 Responses (n=143)**

| Have you completed any of these actions after receiving the Home Energy Reports? The personalized tips are easy for my household to do | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 38 | 27% |
| Somewhat agree | 64 | 45% |
| Somewhat disagree | 30 | 21% |
| Strongly disagree | 11 | 8% |
| Don't know | 7 | |

**Table 55. Survey Question C13_3 Responses (n=141)**

| Have you completed any of these actions after receiving the Home Energy Reports? The personalized tips provide enough information to take action | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 47 | 33% |
| Somewhat agree | 61 | 43% |
| Somewhat disagree | 27 | 19% |
| Strongly disagree | 6 | 4% |
| Don't know | 8 | |

**Table 56. Survey Question C14 Responses (n=131)**

| Did you or anyone in your household complete any of the personalized tips in the Home Energy Reports? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 51 | 39% |
| No | 80 | 61% |
| Don't Know | 22 | |

**Table 57. Survey Question C16 Responses (n=50)**

| How important would you say the Home Energy Reports are in prompting you to make energy-saving improvements? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Very important | 22 | 44% |
| Somewhat important | 26 | 52% |
| Not too important | 2 | 4% |
| Don't Know | 1 | |

## *Energy-Savings Improvements*

**Table 58. Survey Question D1_1 Responses (n=237)**

| Have you made any of the following energy-saving improvements in the last 12 months? Purchased and installed LEDs (LEDs are light emitting diodes and they are the super long- lasting light bulbs.) | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 192 | 81% |
| No | 45 | 19% |
| Don't know | 3 | |

**Table 59. Survey Question D1_2 Responses (n=235)**

| Have you made any of the following energy-saving improvements in the last 12 months? Installed a programmable or smart thermostat (A programmable thermostat allows you to set the temperature for different times of the day. A smart thermostat learns your temperature setting behaviors and self-adjusts the temperature for you.) | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 78 | 33% |
| No | 157 | 67% |
| Don't know | 3 | |

**Table 60. Survey Question D1_3 Responses (n=230)**

| Have you made any of the following energy-saving improvements in the last 12 months? Purchased and installed ENERGY STAR or high-efficiency appliances | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 82 | 36% |
| No | 148 | 64% |
| Don't know | 7 | |

**Table 61. Survey Question D1_4 Responses (n=236)**

| Have you made any of the following energy-saving improvements in the last 12 months? Purchased and installed new heating or cooling equipment | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 50 | 21% |
| No | 186 | 79% |
| Don't know | 2 | |

**Table 62. Survey Question D1_5 Responses (n=234)**

| Have you made any of the following energy-saving improvements in the last 12 months? Installed extra insulation to ceiling, ducts, walls, attic or basement | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 46 | 20% |
| No | 188 | 80% |
| Don't know | 3 | |

**Table 63. Survey Question D1_6 Responses (n=233)**

| Have you made any of the following energy-saving improvements in the last 12 months? Added caulking, spray foam, weather stripping, or plastic sheeting | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 88 | 38% |
| No | 145 | 62% |
| Don't know | 2 | |

**Table 64. Survey Question D1_7 Responses (n=233)**

| Have you made any of the following energy-saving improvements in the last 12 months? Installed a water/energy-saving showerhead, faucet head or aerator | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 70 | 30% |
| No | 163 | 70% |
| Don't know | 4 | |

**Table 65. Survey Question D1_8 Responses (n=233)**

| Have you made any of the following energy-saving improvements in the last 12 months? Installed high-efficiency doors or windows | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 44 | 19% |
| No | 189 | 81% |
| Don't know | 2 | |

## *Energy-Savings Behaviors*

**Table 66. Survey Question E1_1 Responses (n=237)**

| How often have you taken these actions in your home over the past 12 months? Replace air filters for your air conditioners and heating systems | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 194 | 82% |
| Sometimes | 41 | 17% |
| Never | 2 | 1% |
| Don't know | 2 | |
| Not applicable | 5 | |

**Table 67. Survey Question E1_2 Responses (n=241)**

| How often have you taken these actions in your home over the past 12 months? Turn off lights in rooms that are unoccupied | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 201 | 83% |
| Sometimes | 38 | 16% |
| Never | 2 | 1% |
| Don't know | 1 | |
| Not applicable | 2 | |

**Table 68. Survey Question E1_3 Responses (n=235)**

| How often have you taken these actions in your home over the past 12 months? Wash laundry in cold water | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 83 | 35% |
| Sometimes | 134 | 57% |
| Never | 18 | 8% |
| Don't know | 3 | |
| Not applicable | 2 | |

### Table 69. Survey Question E1_4 Responses (n=234)

| How often have you taken these actions in your home over the past 12 months? Unplug electronic equipment or appliances when not in use | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 44 | 19% |
| Sometimes | 130 | 56% |
| Never | 60 | 26% |
| Don't know | 1 | |
| Not applicable | 5 | |

### Table 70. Survey Question E1_5 Responses (n=236)

| How often have you taken these actions in your home over the past 12 months? Adjust thermostat settings when leaving or sleeping | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 149 | 63% |
| Sometimes | 68 | 29% |
| Never | 19 | 8% |
| Don't know | 1 | |
| Not applicable | 5 | |

### Table 71. Survey Question E1_6 Responses (n=235)

| How often have you taken these actions in your home over the past 12 months? Take shorter showers | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 47 | 20% |
| Sometimes | 149 | 63% |
| Never | 39 | 17% |
| Don't know | 2 | |
| Not applicable | 4 | |

### Table 72. Survey Question E1_7 Responses (n=218)

| How often have you taken these actions in your home over the past 12 months? Turn down water heater temperature | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 40 | 18% |
| Sometimes | 51 | 23% |
| Never | 127 | 58% |
| Don't know | 11 | |
| Not applicable | 13 | |

**Table 73. Survey Question E1_8 Responses (n=221)**

| How often have you taken these actions in your home over the past 12 months? Use energy-saving or "sleep" features of your computer | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 150 | 68% |
| Sometimes | 48 | 22% |
| Never | 23 | 10% |
| Don't know | 3 | |
| Not applicable | 20 | |

## *Awareness of Energy Efficiency Programs*

**Table 74. Survey Question F1 Responses (n=219)**

| Are you familiar with any energy-efficiency rebates or programs offered by Ameren Missouri to help you use less energy? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 122 | 56% |
| No | 97 | 44% |
| Don't Know | 29 | |

**Table 75. Survey Question F2 Responses (n=121)**

| Which Ameren Missouri energy-efficiency or rebate programs have you heard about? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| **Heating and Cooling**: Rebate for installing efficient AC, heat pump or geothermal system | 89 | 74% |
| **EnergyStar Certified Products**: Rebate for buying EnergyStar certified products such as pool pumps, air purifiers and more | 69 | 57% |
| **Smart Thermostat**: Rebate for installing a smart thermostat | 66 | 55% |
| **Energy Efficient Lighting**: Purchasing energy-efficient LED bulbs at reduced prices at local retailers or at the Ameren Missouri online store | 60 | 50% |
| **CommunitySavers**: Energy saving opportunities for income eligible Multifamily housing (advertised through low income agencies) | 13 | 11% |
| **School Energy Education**: Schools voluntarily sign up to distribute free energysavings kits to 6$^{th}$ grade students and their parents each school year | 6 | 5% |

**Table 76. Survey Question F3 Responses (n=245)**

| Have you visited Ameren Missouri's website to look for ways to save money on your bill? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Yes | 39 | 16% |
| No | 206 | 84% |
| Don't Know | 3 | |

## *Attitudes Toward Energy Efficiency*

**Table 77. Survey Question G1_1 Responses (n=239)**

| It is i portant to conserve energy as much as possible | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 158 | 66% |
| Somewhat agree | 74 | 31% |
| Somewhat disagree | 5 | 2% |
| Strongly disagree | 2 | 1% |
| Don't know | 6 | |

**Table 78. Survey Question G1_2 Responses (n=239)**

| Using energy to keep the home comfortable is my top priority | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 79 | 33% |
| Somewhat agree | 118 | 49% |
| Somewhat disagree | 34 | 14% |
| Strongly disagree | 8 | 3% |
| Don't know | 5 | |

**Table 79. Survey Question G1_3 Responses (n=231)**

| I am ommitted to actions that help the environment | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 99 | 43% |
| Somewhat agree | 121 | 52% |
| Somewhat disagree | 6 | 3% |
| Strongly disagree | 5 | 2% |
| Don't know | 13 | |

**Table 80. Survey Question G1_4 Responses (n=223)**

| I would lik to save more energy but do not know where to start | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 34 | 15% |
| Somewhat agree | 72 | 32% |
| Somewhat disagree | 69 | 31% |
| Strongly disagree | 48 | 22% |
| Don't know | 18 | |

**Table 81. Survey Question G1_5 Responses (n=231)**

| I have alrea y done as much as possible to save energy in my home | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 49 | 21% |
| Somewhat agree | 107 | 46% |
| Somewhat disagree | 58 | 25% |
| Strongly disagree | 17 | 7% |
| Don't know | 11 | |

**Table 82. Survey Question G1_6 Responses (n=219)**

| :nergy-efficient products are too expensive | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 57 | 26% |
| Somewhat agree | 103 | 47% |
| Somewhat disagree | 45 | 21% |
| Strongly disagree | 14 | 6% |
| Don't know | 23 | |

## *Satisfaction*

**Table 83. Survey Question H1 Responses (n=243)**

| Thinking about your overall experiences with Ameren Missouri as your utility, how satisfied would you say you are with Ameren Missouri? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Very satisfied | 105 | 43% |
| Somewhat satisfied | 120 | 49% |
| Not too satisfied | 14 | 6% |
| Not satisfied at all | 4 | 2% |
| Don't know | 5 | |

**Table 84. Survey Question H3 Responses (n=232)**

| Over ll, I am satisfied with the Home Energy Reports. | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Strongly agree | 103 | 44% |
| Somewhat agree | 109 | 47% |
| Somewhat disagree | 14 | 6% |
| Strongly disagree | 6 | 3% |
| Don't know | 14 | |

**Table 85. Survey Question H4 Responses (n=229)**

| As a result of receiving the Home Energy Reports, would you say your satisfaction with Ameren Missouri has… | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Increased | 59 | 26% |
| Stayed the same | 164 | 72% |
| Decreased | 6 | 3% |
| Don't Know | 16 | |

**Table 86. Survey Question I1_1 Responses (n=197)**

| How often do you check you utility bill sent by mail? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 138 | 70% |
| Sometimes | 19 | 10% |
| Never | 40 | 20% |
| Don't know | 1 | |
| Not applicable | 28 | |

**Table 87. Survey Question I1_2 Responses (n=174)**

| How often do you check your utility bill sent by email? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 92 | 53% |
| Sometimes | 29 | 17% |
| Never | 53 | 30% |
| Don't know | 5 | |
| Not applicable | 47 | |

**Table 88. Survey Question I1_3 Responses (n=128)**

| How often do you check you utility bill sent by text? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Always | 24 | 19% |
| Sometimes | 12 | 9% |
| Never | 92 | 72% |
| Don't know | 6 | |
| Not applicable | 70 | |

### Table 89. Survey Question I2 Responses (n=249)

| Which of the following best describes your home… | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| A single-family detached residence | 210 | 84% |
| Attached house (such as a townhouse, row house, or twin) | 14 | 6% |
| Multifamily apartment or condo building with 4 or more units | 9 | 4% |
| Mobile or manufactured home | 14 | 6% |
| Other | 2 | 1% |

### Table 90. Survey Question I3 Responses (n=249)

| Do you own or rent this home? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Own/buying | 219 | 89% |
| Rent/lease | 28 | 11% |
| Other | 2 | |

### Table 91. Survey Question I4 Responses (n=213)

| Counting yourself, how many people live in your home for most of the year? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| 1 | 47 | 22% |
| 2 | 83 | 39% |
| 3 | 32 | 15% |
| 4 | 28 | 13% |
| 5 | 13 | 6% |
| 6 | 7 | 3% |
| 7 | 3 | 1% |

**Table 92. Survey Question I5 Responses (n=232)**

| How old are you? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| 18-24 | 1 | 0% |
| 25-34 | 15 | 6% |
| 35-44 | 44 | 19% |
| 45-54 | 44 | 19% |
| 55-64 | 61 | 26% |
| 65-74 | 53 | 23% |
| 75 and older | 14 | 6% |
| I prefer not to answer this question | 17 | |

**Table 93. Survey Question I6 Responses (n=174)**

| What is the total combined income of all members of your household over the past 12 months? | | |
|---|---|---|
| **Response** | **Count of Response** | **Percentage of Respondents** |
| Less than $20,000 | 12 | 7% |
| $20,000 to less than $50,000 | 61 | 35% |
| $50,000 to less than $75,000 | 36 | 21% |
| $75,000 to less than $100,000 | 33 | 19% |
| $100,000 to less than $150,000 | 17 | 10% |
| $150,000 to less than $200,000 | 6 | 3% |
| $200,000 or more | 9 | 5% |
| I prefer not to answer this question | 75 | |

# Appendix F. Billing Regression Model Specification and Estimation Results

This appendix provides details on the regression model Cadmus selected for the analysis and the estimation results.

Cadmus used both the difference-in-differences approach and the post-only approach to fit numerous regression models.[16] We selected the fully specified post-only model as the final evaluation model, which included the following:

- A program treatment group indicator variable
- Month-by-year fixed effects
- Pre-treatment consumption
- Pre-treatment consumption interacted with the month-by-year fixed effects

By including aggregated pre-treatment consumption in the regression, Cadmus controlled for differences between customers with respect to average energy use in the pre-period.

We specified the post-only model assuming average daily consumption (ADC) of electricity for customer 'i' in month 't' depended on pre-usage and weather variables as shown in Equation 1:

$$\begin{aligned} ADC_{it} = \; & \beta_1 \, PART_i \times PY_{it} + \beta_2 \, Pre\text{-}Usage_i + \beta_3 \, Pre\text{-}Summer_i + \beta_4 \, Pre\text{-}Winter_i \\ & + \beta_5 \, Pre\text{-}Usage_i \times \tau_t + \beta_6 \, Pre\text{-}Summer_i \times \tau_t + \beta_7 \, Pre\text{-}Winter_i \times \tau_t \\ & + W'\gamma + \tau_t + \varepsilon_{it} \end{aligned}$$

**Equation 1**

Where:

| | | |
|---|---|---|
| $\beta_1$ | = | Vector of coefficients representing the program's conditional average treatment effect on electricity use (average kWh per customer per day) during each given program year |
| $PART_i$ | = | Indicator variable for program participation (equaling 1 if customer 'i' is in the treatment group and 0 otherwise) |
| $PY_{it}$ | = | Indicator variable for each given program year (equaling 1 if month '*t*' occurred in the given program year for customer '*i*' and 0 otherwise). |
| Pre-Usage | = | Mean household energy consumption across all pretreatment months |

[16] The post-only approach is described in Alcott and Rogers (2014). Allcott, Hunt, and T. Rogers. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." *American Economic Review*. 2014. 104(10): 3003-37.

Pre-Summer= Mean household energy consumption during June, July, August, and September of the pretreatment period

Pre-Winter = Mean household energy consumption during December, January, February, and March of the pretreatment period

W = Vector using CDD and HDD variables to control for weather impacts on energy use

$\gamma$ = Vector of coefficients representing the weather variables' average impact on energy use

$\tau_t$ = Average energy use in month 't' reflecting unobservable factors specific to the month also referred to as "month-by-year fixed effects"

$\varepsilon_{it}$ = Error term for home 'i' in month 't'

The error term $\varepsilon_{it}$ remains uncorrelated with program participation ($PART_i$) and other observable variables due to random assignment of customers to the treatment and control groups. Ordinary least squares resulted in an unbiased estimate of the average daily savings.[17] The estimated coefficient $\beta_1$ represents the program's average treatment effect (i.e., the daily kWh savings impact) on the population of customers in the treatment group.

Table 94 lists the regression estimates for each parameter in the final regression model for Wave 1 customers and Table 95 lists them for Wave 2 customers.

**Table 94. Regression Model Estimates (Wave 1)**

| Variable | Estimate | Standard Error | 95% Confidence Limits | | z-statistic | Pr>\|z\| |
|---|---|---|---|---|---|---|
| | | | Lower | Upper | | |
| pre_adc | -0.4752 | 0.0116 | -0.4979 | -0.4525 | -41.04 | <.0001 |
| pre_winter | 0.1958 | 0.0051 | 0.1857 | 0.2058 | 38.10 | <.0001 |
| pre_summer | 1.2833 | 0.0054 | 1.2727 | 1.2940 | 236.13 | <.0001 |
| yr2016_month_8 | -7.1189 | 0.1408 | -7.3949 | -6.8428 | -50.55 | <.0001 |
| yr2016_month_9 | -8.0189 | 0.1312 | -8.2760 | -7.7618 | -61.12 | <.0001 |
| yr2016_month_10 | -7.0774 | 0.1361 | -7.3441 | -6.8107 | -52.02 | <.0001 |
| yr2016_month_11 | -9.5139 | 0.1737 | -9.8543 | -9.1735 | -54.78 | <.0001 |
| yr2016_month_12 | -15.6302 | 0.1919 | -16.0064 | -15.254 | -81.44 | <.0001 |

[17] The random assignment of customers to treatment and control groups were tested by comparing the means of observable characteristics of customers in each group or by regressing a dummy variable for participation ($PART_i$) on observable variables. The group means were not significantly different and the coefficients of the variables in the regression were not be significant. Correlation will occur in each customer's consumption over time and the estimated standard errors were corrected for this correlation.

| Variable | Estimate | Standard Error | 95% Confidence Limits | | z-statistic | Pr>\|z\| |
|---|---|---|---|---|---|---|
| | | | Lower | Upper | | |
| yr2017_month_1 | -14.2483 | 0.1858 | -14.6125 | -13.8842 | -76.70 | <.0001 |
| yr2017_month_2 | -9.9527 | 0.1697 | -10.2852 | -9.6202 | -58.66 | <.0001 |
| yr2017_month_3 | -7.9442 | 0.1638 | -8.2653 | -7.6231 | -48.49 | <.0001 |
| yr2017_month_4 | -6.6586 | 0.1437 | -6.9403 | -6.3769 | -46.33 | <.0001 |
| yr2017_month_5 | -8.0763 | 0.1353 | -8.3416 | -7.8111 | -59.68 | <.0001 |
| yr2017_month_6 | -6.8277 | 0.1428 | -7.1075 | -6.5478 | -47.82 | <.0001 |
| yr2017_month_7 | -4.6056 | 0.1545 | -4.9084 | -4.3029 | -29.82 | <.0001 |
| yr2017_month_8 | -6.1264 | 0.1372 | -6.3953 | -5.8575 | -44.65 | <.0001 |
| yr2017_month_9 | -6.5088 | 0.1302 | -6.7640 | -6.2535 | -49.98 | <.0001 |
| yr2017_month_10 | -7.6750 | 0.1694 | -8.0071 | -7.3429 | -45.30 | <.0001 |
| yr2017_month_11 | -8.9478 | 0.1729 | -9.2867 | -8.609 | -51.75 | <.0001 |
| yr2017_month_12 | -15.6706 | 0.2002 | -16.063 | -15.2783 | -78.29 | <.0001 |
| yr2018_month_1 | -18.4069 | 0.2211 | -18.8403 | -17.9736 | -83.25 | <.0001 |
| yr2018_month_2 | -13.4042 | 0.2771 | -13.9474 | -12.8611 | -48.37 | <.0001 |
| preusage_yr2016_month_9 | 1.2538 | 0.0095 | 1.2353 | 1.2724 | 132.47 | <.0001 |
| preusage_yr2016_month_10 | 2.9762 | 0.0131 | 2.9506 | 3.0018 | 228.02 | <.0001 |
| preusage_yr2016_month_11 | 2.0884 | 0.0161 | 2.0567 | 2.1200 | 129.48 | <.0001 |
| preusage_yr2016_month_12 | -0.3078 | 0.0232 | -0.3534 | -0.2623 | -13.24 | <.0001 |
| preusage_yr2017_month_1 | -0.3163 | 0.0225 | -0.3604 | -0.2723 | -14.07 | <.0001 |
| preusage_yr2017_month_2 | 0.8709 | 0.0188 | 0.8342 | 0.9077 | 46.44 | <.0001 |
| preusage_yr2017_month_3 | 1.6786 | 0.0172 | 1.6448 | 1.7123 | 97.47 | <.0001 |
| preusage_yr2017_month_4 | 2.8715 | 0.0160 | 2.8403 | 2.9028 | 179.96 | <.0001 |
| preusage_yr2017_month_5 | 2.4216 | 0.0164 | 2.3893 | 2.4538 | 147.3 | <.0001 |
| preusage_yr2017_month_6 | 0.6558 | 0.0174 | 0.6216 | 0.6900 | 37.61 | <.0001 |
| preusage_yr2017_month_7 | -0.3529 | 0.0193 | -0.3906 | -0.3151 | -18.32 | <.0001 |
| preusage_yr2017_month_8 | 0.8337 | 0.0175 | 0.7995 | 0.8679 | 47.77 | <.0001 |
| preusage_yr2017_month_9 | 1.6136 | 0.0176 | 1.5791 | 1.6482 | 91.48 | <.0001 |
| preusage_yr2017_month_10 | 2.3552 | 0.0169 | 2.3220 | 2.3884 | 139.03 | <.0001 |
| preusage_yr2017_month_11 | 1.5370 | 0.0208 | 1.4961 | 1.5778 | 73.75 | <.0001 |
| preusage_yr2017_month_12 | -0.4181 | 0.0277 | -0.4723 | -0.3639 | -15.11 | <.0001 |
| preusage_yr2018_month_1 | -1.5567 | 0.0321 | -1.6196 | -1.4937 | -48.45 | <.0001 |
| preusage_yr2018_month_2 | -0.2048 | 0.0802 | -0.3619 | -0.0477 | -2.55 | 0.0106 |
| prewinter_yr2016_month_9 | -0.5098 | 0.0042 | -0.5181 | -0.5016 | -121.51 | <.0001 |
| prewinter_yr2016_month_10 | -1.1329 | 0.0058 | -1.1442 | -1.1215 | -194.99 | <.0001 |
| prewinter_yr2016_month_11 | -0.3195 | 0.0072 | -0.3336 | -0.3053 | -44.23 | <.0001 |
| prewinter_yr2016_month_12 | 1.3302 | 0.0105 | 1.3096 | 1.3508 | 126.48 | <.0001 |
| prewinter_yr2017_month_1 | 1.2945 | 0.0102 | 1.2746 | 1.3144 | 127.39 | <.0001 |
| prewinter_yr2017_month_2 | 0.4454 | 0.0084 | 0.4288 | 0.4619 | 52.78 | <.0001 |
| prewinter_yr2017_month_3 | -0.1105 | 0.0077 | -0.1257 | -0.0954 | -14.30 | <.0001 |
| prewinter_yr2017_month_4 | -0.9499 | 0.0071 | -0.9638 | -0.9360 | -133.85 | <.0001 |
| prewinter_yr2017_month_5 | -0.9226 | 0.0073 | -0.9370 | -0.9083 | -126.22 | <.0001 |
| prewinter_yr2017_month_6 | -0.2650 | 0.0078 | -0.2802 | -0.2498 | -34.16 | <.0001 |

| Variable | Estimate | Standard Error | 95% Confidence Limits | | z-statistic | Pr>\|z\| |
|---|---|---|---|---|---|---|
| | | | Lower | Upper | | |
| prewinter_yr2017_month_7 | 0.1589 | 0.0086 | 0.1422 | 0.1757 | 18.58 | <.0001 |
| prewinter_yr2017_month_8 | -0.3433 | 0.0078 | -0.3585 | -0.3281 | -44.27 | <.0001 |
| prewinter_yr2017_month_9 | -0.6555 | 0.0078 | -0.6709 | -0.6402 | -83.65 | <.0001 |
| prewinter_yr2017_month_10 | -0.7646 | 0.0075 | -0.7794 | -0.7498 | -101.35 | <.0001 |
| prewinter_yr2017_month_11 | -0.0017 | 0.0094 | -0.0200 | 0.0166 | -0.18 | 0.857 |
| prewinter_yr2017_month_12 | 1.3798 | 0.0126 | 1.3552 | 1.4044 | 109.92 | <.0001 |
| prewinter_yr2018_month_1 | 2.1340 | 0.0146 | 2.1053 | 2.1626 | 146.00 | <.0001 |
| prewinter_yr2018_month_2 | 1.2116 | 0.0365 | 1.1402 | 1.2831 | 33.22 | <.0001 |
| presummer_yr2016_month_9 | -0.7884 | 0.0045 | -0.7972 | -0.7796 | -175.03 | <.0001 |
| presummer_yr2016_month_10 | -1.9467 | 0.0061 | -1.9586 | -1.9348 | -321.35 | <.0001 |
| presummer_yr2016_month_11 | -1.8369 | 0.0075 | -1.8516 | -1.8223 | -245.48 | <.0001 |
| presummer_yr2016_month_12 | -0.9580 | 0.0107 | -0.9790 | -0.9369 | -89.18 | <.0001 |
| presummer_yr2017_month_1 | -0.9702 | 0.0104 | -0.9905 | -0.9499 | -93.53 | <.0001 |
| presummer_yr2017_month_2 | -1.4264 | 0.0087 | -1.4434 | -1.4095 | -164.68 | <.0001 |
| presummer_yr2017_month_3 | -1.7163 | 0.008 | -1.7319 | -1.7007 | -215.76 | <.0001 |
| presummer_yr2017_month_4 | -2.0462 | 0.0073 | -2.0606 | -2.0318 | -278.43 | <.0001 |
| presummer_yr2017_month_5 | -1.5553 | 0.0076 | -1.5702 | -1.5404 | -204.09 | <.0001 |
| presummer_yr2017_month_6 | -0.4361 | 0.0082 | -0.4521 | -0.4201 | -53.30 | <.0001 |
| presummer_yr2017_month_7 | 0.1427 | 0.0091 | 0.1249 | 0.1605 | 15.71 | <.0001 |
| presummer_yr2017_month_8 | -0.5541 | 0.0082 | -0.5702 | -0.5381 | -67.72 | <.0001 |
| presummer_yr2017_month_9 | -1.052 | 0.0082 | -1.0681 | -1.0358 | -127.82 | <.0001 |
| presummer_yr2017_month_10 | -1.7282 | 0.0078 | -1.7435 | -1.7129 | -220.94 | <.0001 |
| presummer_yr2017_month_11 | -1.6582 | 0.0096 | -1.6771 | -1.6393 | -172.08 | <.0001 |
| presummer_yr2017_month_12 | -0.9233 | 0.0128 | -0.9483 | -0.8983 | -72.39 | <.0001 |
| presummer_yr2018_month_1 | -0.5193 | 0.0148 | -0.5483 | -0.4903 | -35.12 | <.0001 |
| presummer_yr2018_month_2 | -1.0502 | 0.0357 | -1.1202 | -0.9802 | -29.42 | <.0001 |
| hdd_day | 0.829 | 0.0218 | 0.7863 | 0.8717 | 38.04 | <.0001 |
| cdd_day | 1.6068 | 0.0261 | 1.5557 | 1.6579 | 61.62 | <.0001 |
| hdd_day_sq | -0.0182 | 0.0011 | -0.0203 | -0.016 | -16.47 | <.0001 |
| cdd_day_sq | -0.1251 | 0.0023 | -0.1296 | -0.1206 | -54.41 | <.0001 |
| hdd_day_cub | 0.0003 | 0.0000 | 0.0002 | 0.0003 | 15.64 | <.0001 |
| cdd_day_cub | 0.0038 | 0.0001 | 0.0036 | 0.0039 | 54.90 | <.0001 |
| part_PY1 | -0.0406 | 0.0238 | -0.0873 | 0.0061 | -1.70 | 0.0883 |
| part_PY2 | -0.1240 | 0.0280 | -0.1789 | -0.0692 | -4.43 | <.0001 |

**Table 95. Regression Model Estimates (Wave 2)**

| Variable | Estimate | Standard Error | 95% Confidence Limits | | z-statistic | Pr>\|z\| |
|---|---|---|---|---|---|---|
| | | | Lower | Upper | | |
| pre_adc | 2.7361 | 0.0332 | 2.6710 | 2.8011 | 82.4 | <.0001 |
| pre_winter | -1.0350 | 0.0145 | -1.0635 | -1.0066 | -71.38 | <.0001 |
| pre_summer | -0.6863 | 0.0155 | -0.7168 | -0.6559 | -44.16 | <.0001 |
| yr2017_month_5 | -6.6330 | 0.3704 | -7.3590 | -5.9070 | -17.91 | <.0001 |
| yr2017_month_6 | -7.3231 | 0.3975 | -8.1023 | -6.5440 | -18.42 | <.0001 |
| yr2017_month_7 | -6.4309 | 0.4416 | -7.2965 | -5.5653 | -14.56 | <.0001 |
| yr2017_month_8 | -5.9669 | 0.3816 | -6.7149 | -5.2189 | -15.64 | <.0001 |
| yr2017_month_9 | -5.5984 | 0.3585 | -6.3010 | -4.8958 | -15.62 | <.0001 |
| yr2017_month_10 | -5.8398 | 0.4928 | -6.8056 | -4.8739 | -11.85 | <.0001 |
| yr2017_month_11 | -10.4302 | 0.5980 | -11.6024 | -9.2581 | -17.44 | <.0001 |
| yr2017_month_12 | -20.473 | 0.7814 | -22.0045 | -18.9416 | -26.20 | <.0001 |
| yr2018_month_1 | -23.2806 | 0.8344 | -24.916 | -21.6452 | -27.90 | <.0001 |
| yr2018_month_2 | -17.9126 | 0.9422 | -19.7592 | -16.066 | -19.01 | <.0001 |
| preusage_yr2017_month_6 | -1.6765 | 0.0308 | -1.737 | -1.616 | -54.35 | <.0001 |
| preusage_yr2017_month_7 | -2.7690 | 0.0470 | -2.8612 | -2.6768 | -58.86 | <.0001 |
| preusage_yr2017_month_8 | -1.6269 | 0.0415 | -1.7083 | -1.5455 | -39.16 | <.0001 |
| preusage_yr2017_month_9 | -0.9636 | 0.0401 | -1.0422 | -0.8851 | -24.05 | <.0001 |
| preusage_yr2017_month_10 | -0.3685 | 0.0429 | -0.4527 | -0.2844 | -8.58 | <.0001 |
| preusage_yr2017_month_11 | -1.3785 | 0.0674 | -1.5105 | -1.2465 | -20.46 | <.0001 |
| preusage_yr2017_month_12 | -3.1599 | 0.0799 | -3.3166 | -3.0032 | -39.53 | <.0001 |
| preusage_yr2018_month_1 | -4.2158 | 0.0871 | -4.3865 | -4.045 | -48.39 | <.0001 |
| preusage_yr2018_month_2 | -3.2447 | 0.1871 | -3.6115 | -2.8779 | -17.34 | <.0001 |
| prewinter_yr2017_month_6 | 0.6116 | 0.0135 | 0.5852 | 0.6379 | 45.46 | <.0001 |
| prewinter_yr2017_month_7 | 1.0698 | 0.0204 | 1.0297 | 1.1098 | 52.36 | <.0001 |
| prewinter_yr2017_month_8 | 0.5827 | 0.0181 | 0.5472 | 0.6181 | 32.20 | <.0001 |
| prewinter_yr2017_month_9 | 0.3228 | 0.0175 | 0.2886 | 0.3571 | 18.47 | <.0001 |
| prewinter_yr2017_month_10 | 0.2802 | 0.0188 | 0.2434 | 0.3171 | 14.91 | <.0001 |
| prewinter_yr2017_month_11 | 1.1384 | 0.0297 | 1.0802 | 1.1967 | 38.32 | <.0001 |
| prewinter_yr2017_month_12 | 2.4508 | 0.0358 | 2.3806 | 2.521 | 68.39 | <.0001 |
| prewinter_yr2018_month_1 | 3.154 | 0.0393 | 3.0771 | 3.231 | 80.31 | <.0001 |
| prewinter_yr2018_month_2 | 2.3679 | 0.0814 | 2.2083 | 2.5275 | 29.08 | <.0001 |
| presummer_yr2017_month_6 | 1.0846 | 0.0149 | 1.0554 | 1.1138 | 72.87 | <.0001 |
| presummer_yr2017_month_7 | 1.7131 | 0.0225 | 1.6689 | 1.7573 | 76.00 | <.0001 |
| presummer_yr2017_month_8 | 1.0201 | 0.0198 | 0.9812 | 1.0589 | 51.48 | <.0001 |
| presummer_yr2017_month_9 | 0.5761 | 0.0189 | 0.539 | 0.6131 | 30.45 | <.0001 |
| presummer_yr2017_month_10 | -0.0092 | 0.0199 | -0.0483 | 0.0298 | -0.46 | 0.643 |
| presummer_yr2017_month_11 | 0.1626 | 0.0310 | 0.1018 | 0.2234 | 5.24 | <.0001 |
| presummer_yr2017_month_12 | 0.8111 | 0.0368 | 0.739 | 0.8831 | 22.07 | <.0001 |
| presummer_yr2018_month_1 | 1.2005 | 0.0401 | 1.1218 | 1.2792 | 29.90 | <.0001 |
| presummer_yr2018_month_2 | 0.8625 | 0.0858 | 0.6943 | 1.0307 | 10.05 | <.0001 |
| hdd_day | 0.3272 | 0.0719 | 0.1862 | 0.4682 | 4.55 | <.0001 |
| cdd_day | 1.3413 | 0.0808 | 1.183 | 1.4996 | 16.61 | <.0001 |
| hdd_day_sq | 0.0249 | 0.0041 | 0.0170 | 0.0329 | 6.13 | <.0001 |
| cdd_day_sq | -0.0919 | 0.0084 | -0.1084 | -0.0754 | -10.92 | <.0001 |
| hdd_day_cub | -0.0004 | 0.0001 | -0.0005 | -0.0003 | -6.39 | <.0001 |

| Variable | Estimate | Standard Error | 95% Confidence Limits | | z-statistic | Pr>\|z\| |
|---|---|---|---|---|---|---|
| | | | Lower | Upper | | |
| cdd_day_cub | 0.0029 | 0.0003 | 0.0024 | 0.0034 | 10.93 | <.0001 |
| part_PY2 | 0.0177 | 0.0798 | -0.1388 | 0.1741 | 0.22 | 0.8250 |