



Ameren Missouri
ENERGY STAR New Homes
Impact and Process Evaluation:
Program Year 2014

May 15, 2015

Ameren Missouri
1901 Chouteau Avenue
St. Louis, MO 63103



The Cadmus Group, Inc.

An Employee-Owned Company • www.cadmusgroup.com

This page left blank.

Prepared by:
Wyley Hodgson
Andrew Dionne
Salil Gogte
Nexant Planning & Evaluation

Doug Bruchs
M. Sami Khawaja, Ph.D.
Cadmus

This page left blank.

Table of Contents

Executive Summary.....	1
Program Description.....	1
Key Impact Evaluation Findings.....	1
Key Process Evaluation Findings.....	3
Key Conclusions and Recommendations.....	4
Introduction	5
Program Description.....	5
Program Activity	6
Evaluation Methodology.....	7
Data Tracking Review	7
Program Manager Interviews.....	7
Cost-Effectiveness Analysis	7
CSR Impact Evaluation Requirements	8
Process Evaluation Findings.....	10
Program Design and Delivery	10
PY14 Program Activity and Termination	11
Program Termination.....	11
CSR Summary	12
Gross Impact Evaluation Results.....	14
TRM Review Findings.....	14
Gross Energy Savings.....	14
Summary.....	16
Net Impact Evaluation Results	17
Summary.....	17
Benchmarking	18
Cost-Effectiveness Results	20
Appendix A. <i>Ex Post</i> Demand Reductions.....	22
Appendix B. Bibliography	23
Appendix C. Program Manager Interview Guide	24

This page left blank.

Executive Summary

Ameren Missouri engaged Cadmus and Nexant (the Cadmus team) to perform annual process and impact evaluations of the ENERGY STAR New Homes (ESNH) program for a three-year period from 2013 through 2015. This annual report covers the impact and process evaluation findings for Program Year 2014 (PY14), the period from January 1, 2014, through December 31, 2014.

Program Description

Ameren Missouri added the ESNH program to its residential Act On Energy® portfolio in 2013. In PY14, Ameren Missouri changed the name of the program from ConstructionSavers (used in PY13) to the ENERGY STAR New Homes program. The program, implemented by ICF International (ICF), promoted energy-efficient new home construction. Targeting builders, the program offered a package of training, technical assistance, marketing assistance, and incentives for constructing ENERGY STAR homes. The program's design sought to increase consumer awareness of and demand for ENERGY STAR version 3.0 single-family homes, while increasing the building industry's willingness and ability to construct ENERGY STAR homes. To verify energy savings and program compliance, the ESNH program used independent, third-party, Home Energy Rating System (HERS) raters.

All homebuilders constructing new homes or conducting major renovations of existing single-family homes (or townhouses) in Ameren Missouri's service territory were eligible to participate in the ESNH program. The program provided two tiers for building options:

- Tier I homes were eligible for a \$500 rebate and had to meet the previous version (version 2.5) of ENERGY STAR guidelines.
- Tier II homes were eligible for an \$800 dollar rebate and had to meet current ENERGY STAR guidelines.

Due to limited participation, as well as the Program Year 2013 (PY13) evaluation results, which showed low gross savings realization rates, high free ridership levels, and non cost-effectiveness, a tariff was approved in June, 2014 to discontinue the ESNH program effective December 31, 2014. Ameren Missouri honored the applications for builders who had applied to build homes under the program prior to the program's cancellation. As a result, a small number of homes (31 total: one Tier 1 and 30 Tier 2) were constructed by participating builders during PY14.

Key Impact Evaluation Findings

As Ameren Missouri cancelled the program in early PY14, the Cadmus team limited the evaluation resources allocated to the ESNH program this year, reduced the total number of evaluation tasks, and heavily leveraged the PY13 evaluation findings. Specifically, we applied the results from the PY13 evaluation, which relied on REM/Rate analysis, to estimate PY14 gross and net savings.

In PY14, ESNH completed 31 qualifying homes through five unique participating builders (with three of these builders participating in PY13). As shown in Table 1, evaluated savings (*ex post*) were less than the

planning estimate (*ex ante*), based on Ameren Missouri’s Technical Resource Manual (TRM). Specifically, the Cadmus team found the TRM-based *ex ante* savings overstated the program’s *ex post* gross savings, and the program actually realized 67.3% of its claimed savings. The represents a moderate increase in the program’s gross realization rate, relative to PY13 (54.8%), due to the greater percentage of Tier 2 homes in PY14.

Table 1: Gross Energy Savings (kWh/Year)

Tier Level	Homes Constructed	Ex Ante (kWh/yr) ¹	Ex Post (kWh/yr)	Realization Rate
Tier I – High Performance Home	1	6,449	3,285	50.9%
Tier II – ENERGY STAR Home	30	401,341	271,292	67.6%
Overall	31	407,790	274,577	67.3%

¹*Ex ante* savings value update provided by Ameren Missouri.

To estimate the program’s net-to-gross (NTG) ratios for PY14, the Cadmus team used the following formula:

$$NTG = 1.0 - \text{Free Ridership} + \text{Participant Spillover} + \text{Nonparticipant Spillover} + \text{Market Effects}$$

We determined nonparticipant spillover (e.g., energy-efficiency actions by Ameren Missouri residential customers, motivated by Ameren Missouri marketing) did not prove relevant for the ESNH program as program marketing exclusively focused on builders and not on the general public. We also determined the nascent program, with limited participation, likely would not generate market effects; consequently, the evaluation deemed these at 0% for PY14—a rate similar to PY13.

To determine NTG, the Cadmus team used findings from the PY13 program builder surveys and program home REM/Rate analyses. In conducting last year’s evaluation, we calculated the following:

- Free ridership as the difference in energy consumption between a program home and a non-program home constructed by a participant builder; and
- Spillover as the energy savings derived from the following: (1) any building practices introduced by the program and employed in a non-program home; and (2) any measures installed in a program home that were neither rebated by the program nor typically installed in participant builders’ non-program homes.

The Cadmus team discovered that, typically, participating builders already built energy-efficient homes and low-income homes meeting current high-efficiency standards. This commonly occurs for start-up new construction programs, as such builders display the greatest interest in efficient construction and look to associate, market, and differentiate themselves as part of a utility-sponsored program.

As a result, however, the program experienced a high free ridership rate (77.6% for Tier I and 60.0% for Tier II homes), which drastically reduced the program’s net savings. We also found limited participant spillover—only 3.2% for Tier II homes and 0.0% for Tier 1 homes. Because the same builders made up

the PY14 population as those in PY13 (in addition to two new low-income builders required to build to ENERGY STAR standards outside of the program), we found these free ridership and spillover findings applicable to PY14 program performance.

Table 2 lists the NTG findings and applies the results to total *ex post* gross energy savings.

Table 2: Program Gross and Net *Ex Post* Savings (kWh/yr)

Measure	Total <i>Ex Post</i> Gross Energy Savings (kWh/yr)	Free Ridership	Participant Spillover	NTG Ratio	Net Savings (kWh/yr)
Tier I – High Performance Home	3,285	77.6%	0.0%	22.4%	736
Tier II – ENERGY STAR Home	271,292	60.0%	3.2%	43.2%	117,183
Overall	274,577	60.2%	3.1%	42.9%	117,919

The Missouri Public Service Commission (MPSC) approved annual energy and demand savings targets for each program year. As shown in Table 3, the ESNH program realized only 8% of its proposed net energy savings target (1,440 MWh) and 17% of its demand savings target (272 kW) for PY14.

Table 3: ESNH Savings Comparison

Metric	MPSC-Approved Target ¹	<i>Ex Ante</i> Gross Savings Utility Reported (Prior to Evaluation) ²	<i>Ex Post</i> Gross Savings Determined by EM&V ³	<i>Ex Post</i> Net Savings Determined by EM&V ⁴	Percent of Goal Achieved ⁵
Energy (MWh)	1,440	408	275	118	8%
Demand (kW)	272	61	107	46	17%

¹ <http://www.ameren.com/-/media/missouri-site/Files/Rates/UECSheet191EEResidential.pdf>

² Calculated by applying tracked program activity to TRM savings values.

³ Calculated by applying tracked program activity to Cadmus' evaluated savings values.

⁴ Calculated by multiplying the Cadmus team's evaluated gross savings and NTG ratio, which accounts for free ridership, participant spillover, nonparticipant spillover, and market effects.

⁵ Compares MPSC approved target and *ex post* net savings determined by EM&V.

Key Process Evaluation Findings

During PY14, the ESNH program participation rate in the continued to be very low. The Cadmus team determined the continuing trend in low market response resulted from the following:

- A fragmented local new construction market;
- Regional macroeconomic factors driving builders to focus more heavily on profit margins; and
- Energy efficiency not being a priority for many Missouri new construction builders.

Ameren Missouri's internal analyses of the ESNH program determined its initial deemed savings (codified in the TRM) were inflated, and the program could not operate cost-effectively. Given these factors and the PY13 evaluation results, Ameren Missouri filed a tariff to terminate the program as of December 31, 2014. The tariff was approved in June, 2014 and effectively stopped program enrollment at that time. .

Key Conclusions and Recommendations

Based on the impact and process evaluation findings reported above, the Cadmus team offers the following conclusions and recommendations for future new construction programs, should Ameren Missouri consider reoffering such a program.

Conclusion 1. The program suffered from low builder participation and a high free ridership rate.

Similarly to PY13, energy-efficient builders or low-income builders (required to build to high-efficiency standards outside of the program) comprised this year's participating builders. Recently established new construction programs often attract these builder types, as the builders have prior knowledge and experience with high-efficiency homes.

Recommendation 1a. For future new construction programs, avoid free ridership by targeting builders not currently constructing to high-energy efficiency building standards. Program outreach should include networking with builders, HERS raters, realtors, local Home Builders Associations, and other stakeholders to encourage program acceptance, spread awareness of program benefits among the builder community, and capture a wider range of builders.

Recommendation 1b. Reduce entry barriers as much as possible. Ameren Missouri should carefully evaluate program requirements to ensure they are not overly aggressive for Missouri builders.

Conclusion 2. Missouri may lack customer demand for high-efficiency housing, as indicated in the program manager interviews and the findings from the Shelton Group segmentation study.

Recommendation 2. Include the benefits of energy-efficient homes in future general public marketing campaigns to build awareness of and interest in high-efficiency new construction and to create demand for future program offerings. Builder reluctance partly results from insufficient customer awareness and demand; so providing customer education about the value of high-efficiency homes through Ameren Missouri's general marketing campaigns could positively affect the building market. This effort, combined with the implementer's work in educating the building community, could help bridge the gap between participating builders and future new home buyers.

Introduction

Ameren Missouri engaged Cadmus and Nexant (the Cadmus team) to perform a process and impact evaluation of the ENERGY STAR New Homes (ESNH) program for a three-year period. This annual report covers the impact and process evaluation findings for Program Year 2014 (PY14), the period from January 1, 2014, through December 31, 2014.

Program Description

In PY14, Ameren Missouri changed the name of the program from ConstructionSavers (used in PY13) to the ENERGY STAR New Homes program. The ESNH program promoted the building of new energy-efficient homes with the following high-efficiency features:

- Envelope (outer walls, windows, doors, skylights, roof, and insulation);
- HVAC system; ductwork; and
- Lighting.

Targeting builders, the program offered a package of training, technical assistance, marketing assistance, and incentives for constructing ENERGY STAR homes. The program sought to increase consumer awareness of and demand for ENERGY STAR version 3.0 single-family homes, while increasing the building industry's willingness and ability to construct ENERGY STAR homes. To verify energy savings and program compliance, the ESNH program used independent, third-party, Home Energy Rating System (HERS) raters.

All homebuilders constructing new homes or conducting a major renovation on existing single-family homes (or townhouses) within Ameren Missouri's service territory were eligible to participate in the ESNH program. The program provided two tiers of building options:

- Tier I homes were eligible for a \$500 rebate and had to meet the previous version (v2.5) of ENERGY STAR guidelines.
- Tier II homes were eligible for an \$800 rebate and had to meet current ENERGY STAR v. 3.0 certification guidelines.

Projects could qualify for the program through the following two paths:

- The prescriptive path allowed participants to choose their savings measures from the ENERGY STAR Reference Design Specifications. For this path, the construction methods had to hold true to measures selected when builders submitted the project application to the program.
- The performance path required calculation of savings for proposed measures using approved modeling software to determine a HERS score for a home. These measures could be adjusted during construction, provided the adjusted HERS score remained less than or equal to the original target.

The ESNH program used the following approaches to program promotion:

- Recruiting homebuilders;
- Providing builder training; and
- Supporting builders through use of the ENERGY STAR brand (with ENERGY STAR branding only applicable to Tier 2 homes).

ICF International (ICF) marketed and delivered the program, providing the following services:

- Providing ENERGY STAR flags, yard signs, and other materials for Tier 2 homes, and custom signage for Tier 1 homes;
- Performing outreach efforts, such as conducting recruitment meetings with builders and HERS raters; and
- Managing and maintaining an online portal that allowed builders to register with the program and to submit the required documentation.

Due to limited participation and the Program Year 2013 (PY13) evaluation results, which showed low gross savings realization rates and high free ridership levels, Ameren Missouri discontinued the ESNH program effective December 31, 2014 with a tariff approved in June 2014. Ameren Missouri’s internal analyses of the ESNH program determined that the program could not operate cost-effectively. A small number of builders had already applied for homes to be built as part of the program (31 total: one Tier 1 and 30 Tier 2) prior to the June, 2014 tariff approval to close the program.

Program Activity

As shown in Table 4, five builders completed a total of 31 homes under the ESNH program.

Table 4: Program Participation (PY14)

Tier	Homes Constructed
Tier I – High Performance Home	1
Tier II – ENERGY STAR Home	30
Total	31

Evaluation Methodology

Given the program’s cancellation, the Cadmus team identified the following, limited objectives for the PY14 evaluation:

- Leverage analysis findings from PY13 and apply these to PY14 performance to estimate savings;
- Assess the program’s achievements against goals;
- Estimate the program’s cost-effectiveness; and
- Understand and document the rationale for the program’s cancellation via discussions with key program stakeholders.

Table 5 lists evaluation activities and provides a brief explanation of each activity’s purpose. Overviews of each activity follow the table.

Table 5: PY14 Process and Impact Evaluation Activities and Rationale

Evaluation Activity	Process	Impact	Rationale
Review the Tracking Data	•	•	Providing ongoing support to ensure all necessary program data were tracked accurately; identifying gaps for EM&V purposes.
Interview Program Managers	•		Enhancing our understanding of the program to identify program successes and challenges.
Conduct a Cost-Effectiveness Analysis		•	Measuring the program’s cost-effectiveness through five standard perspectives: total resource cost (TRC), utility cost test (UCT), societal cost test (SCT), participant cost test (PART), and ratepayer impact test (RIM).

Data Tracking Review

Similarly to PY13, the Cadmus team reviewed the program tracking database (Vision) used by ICF. Specifically, we assessed whether ICF gathered the data necessary for an accurate evaluation and for use with algorithms detailed in the Ameren Missouri Technical Resource Manual (TRM).

Program Manager Interviews

For the ESNH PY14 evaluation, the Cadmus team interviewed two Ameren Missouri program managers in January 2015. We designed these interviews to enhance our understanding of program activities conducted during the year and the rationale for the program’s termination.

Cost-Effectiveness Analysis

Using final PY14 ESNH program participation data, implementation data, and *ex post* gross and net savings estimates presented in this report, Morgan Marketing Partners (MMP) determined the

program’s cost-effectiveness using DSMore.¹ MMP also calculated measure-specific cost-effectiveness. As shown in the Cost-Effectiveness Results section, the Cadmus team assessed cost-effectiveness using the five standard perspectives produced by DSMore:

- Total Resource Cost
- Utility Cost
- Societal Cost Test
- Participant Cost Test
- Ratepayer Impact Test

CSR Impact Evaluation Requirements

According to the Missouri Code of State Regulations (CSR), demand-side programs that are 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 6. The table provides a summary response for each specified CSR process requirement. In addition, the CSR requires that impact evaluations of demand-side program satisfy the requirements noted in Table 6. The table indicates the data used in this evaluation that satisfy the CSR impact data requirement.

Table 6: Summary Responses to CSR Impact Evaluation Requirements

CSR Requirement	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 post-adoption loads of program participants, corrected for the effects of weather and other intertemporal differences		
Comparisons between program participants’ loads and those of an appropriate control group over the same time period	X	The evaluation approach compares the building practices and techniques for both program participating builders as well as non-participating builders. These differences were applied to building simulations of program home.
Data: The evaluation must use one or more of the following types of data to assess program impact:		
Monthly billing data		

¹ A financial analysis tool designed to evaluate the costs, benefits, and risks of demand-side management (DSM) programs and services.

Hourly load data		
Load research data		
End-use load metered data		
Building and equipment simulation models	x	Use simulation modeling to determine energy impacts of the program.
Survey responses	x	Surveyed program participants and non-participants regarding building practices and spillover.
Audit and survey data on:		
Equipment type/size efficiency		
Household or business characteristics	x	Evaluation team verified program home characteristics via home models.
Energy-related building characteristics		

Process Evaluation Findings

This section presents the Cadmus team’s process evaluation findings for Ameren Missouri’s ESNH program in PY14. We limited process evaluation data collection to interviews with Ameren Missouri program managers due to the program’s termination in 2014. This section divides our findings into two parts: Program Design and Delivery and PY14 Program Activity and Termination. Please see the PY13 evaluation report for information about feedback from participating builders or the program’s marketing practices.

Program Design and Delivery

Ameren Missouri added the ESNH program to its portfolio in PY13. The program’s development and launch followed an opportunity recognized through Ameren Missouri’s potential studies. ICF’s role in promoting the program included recruitment, retention, and support of qualified homebuilders.

The program targeted builders through a package of training, technical assistance, marketing assistance, and incentives for constructing ENERGY STAR homes, and it sought to increase consumer awareness of and demand for ENERGY STAR version 3.0 single-family homes. The program’s design included education of those within Missouri’s building industry, increasing their knowledge about and willingness to construct ENERGY STAR homes.

ICF characterized ESNH as a market transformation program, as it sought to persuade builders to increase their investment levels in developing better-performing homes. Thus, ICF designed its marketing campaign to meet the following objectives:

- Increase participation by qualified home builders and meet energy-savings goals;
- Help participating home builders promote their energy-efficient homes; and
- Assist Ameren Missouri in increasing residential electric customer awareness of energy-efficient homes and participating builders.

All homebuilders constructing new single-family homes or conducting a major renovation of existing single-family homes (or townhouses) in Ameren Missouri’s service territory were eligible to participate in ESNH. As shown in Table 7, the program offered two options.

Table 7: Program Home Tiers and Rebates

Program Home Tiers	Rebate Amount
Tier I – High Performance Home: required to meet ENERGY STAR version 2.5 guidelines	\$500
Tier II – ENERGY STAR Home: required to meet current ENERGY STAR guidelines (i.e., version 3.0 guidelines).	\$800

PY14 Program Activity and Termination

ESNH solicited and enrolled builders into the program until April 2014, when it was determined that the program would not be cost-effective. At that time, Ameren Missouri instructed ICF to cease builder recruitment and subsequently filed a tariff to end the program effective December 31, 2014. The Ameren Missouri tariff was approved on June 21, 2014 to remove the program from the Act On Energy portfolio. After this date, the program permitted previously enrolled builders to complete their subscribed homes by the end of the year to receive a program rebate.

In September, 2013, ICF hired a local program manager to oversee both the ESNH and HVAC programs. The local program manager replaced the interim, part-time ESNH program manager who was based out of state and who primarily managed the program remotely. The new program manager operated the ESNH program in a manner similar to that used in PY13, regarding outreach and marketing, QA/QC, and technical training.

The program manager also identified and solicited builders that previously built ENERGY STAR homes (but had ceased to do so due to costs and requirements), intending to bring these builders into the ESNH program. ICF proved unsuccessful, however, in achieving this: PY13 participant builders made up the majority of PY14 participants, with only two low-income builders (already required to build to ENERGY STAR specifications as new participants).

During PY14, the ESNH program participation rate continued to be very low. The Cadmus team determined the continuing trend in low market response resulted from the following:

- A fragmented local new construction market;
- Regional macroeconomic factors driving builders to focus more heavily on profit margins; and
- Energy efficiency not being a priority for many Missouri new construction builders.

Program Termination

Ameren Missouri chose to end the ESNH program due to its inability to make the program cost-effective. At the beginning of PY14, Ameren Missouri worked with ICF to identify approaches for reducing program free ridership and increasing participation by focusing on recruitment of builders that had ceased ENERGY STAR building as well as production builders. Additionally, Ameren Missouri and ICF discussed redesigning the program to replace the tiered offerings with a performance-based design to provide greater flexibility in allowing builders to meet program requirements.

Ameren Missouri concluded, however, that even with significantly stronger program performance (i.e., increased participation and reduced free ridership), the ESNH program would not prove cost-effective. This conclusion largely drew upon an Ameren Missouri internal program analysis, using revised *ex ante* savings estimates based on the PY13 evaluation. Even with revised *ex ante* savings estimates and greater builder participation, Ameren Missouri found it unlikely ESNH program would still pass cost-effectiveness tests.

Ameren Missouri program managers reported builders in the program expressed disappointment upon learning the program would end. Builders also experienced some initial confusion regarding the program's status due to communication issues. These issues, however, were corrected, and ICF staff and Ameren Missouri maintained good relationships with builders. Ameren Missouri program managers expressed strong interests in continuing relationships with the building community through other Ameren Missouri programs.

Ultimately, Ameren Missouri felt the economy proved the greatest detriment to the program's success. In Missouri, the new home construction market remained very slow in 2014, especially for single-family homes. Ameren Missouri program managers also noted the initial program design probably was too aggressive for Missouri homebuilders and acknowledged lower initial requirements or implementing a performance-based design might have better enabled the program's successful launch.

CSR Summary

According to the Missouri Code of State Regulations (CSR),² demand-side programs that function as part of a utility's preferred resource plan are subject to ongoing process evaluations that address, at a minimum, the five questions listed in Table 8, below. Because the ESNH program was cancelled at the end of PY14, we provided only minor updates to the CSR summary listed below.

² <http://sos.mo.gov/adrules/csr/current/4csr/4c240-22.pdf>

Table 8: Summary Responses to CSR Process Evaluation Requirements

CSR Requirement Number	CSR Requirement Description	Summary Response
1	What are the primary market imperfections common to the target market segment?	The primary market imperfection common to the target market is inadequate information and/or knowledge regarding the benefits of high efficient new construction homes. The new construction market in Missouri is fragmented and energy efficiency is not a priority for Missouri home builders.
2	Is the target market segment appropriately defined, or should it be further subdivided or merged with other market segments?	The current target segment market would benefit from additional stratification to attract builders that do not typically build high efficient or “green” homes and/or are not low income multifamily builders who are required to build to higher efficiency standards.
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?	No. The program should include additional end-use technologies, including appliances.
4	Are the communication channels and delivery mechanisms appropriate for the target market segment?	Yes, current communication channels are appropriate.
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?	Additional networking with the target market segment to spread program awareness is needed.

Gross Impact Evaluation Results

This section details how the Cadmus team calculated gross savings and determined realization rates for participating Tier I and Tier II homes.

TRM Review Findings

ICF used the Ameren Missouri TRM measure-level savings to calculate program *ex ante* savings (the TRM did not provide whole-house savings). During the PY13 evaluation, the Cadmus team found this approach overestimated savings relative to evaluated *ex post* savings. We found lighting had the greatest impact, accounting for 56% of *ex ante* savings and three times greater than evaluated *ex post* lighting savings. Additionally, we found *ex ante* HVAC and shell measure savings, which accounted for 42% of *ex ante* savings, one and a half times greater than evaluated *ex post* savings. These discrepancies largely reflected TRM assumptions. Table 9, below, explains potential causes for these discrepancies.

Gross Energy Savings

The Cadmus team applied PY13 gross savings values (by tier) to calculate an *ex post* gross savings estimate for PY14. In PY13, we defined gross savings as the difference in energy consumption between an ESNH program home and that same home built to nonparticipant building standards, and we estimated consumption using REM/Rate models for a sample of participating homes. Please see the PY13 evaluation report for a detailed description of the gross energy methodology and findings.

Table 9: Ex Ante/Ex Post Savings Discrepancy Rationale

End-Use Energy Savings Category	Ex Ante/Ex Post Savings Discrepancy Rationale
<p>Lighting</p>	<p>The TRM savings assumed a baseline scenario in which a CFL bulb replaced an equivalent wattage incandescent bulb. However, field data and program REM/Rate models collected by the Cadmus team demonstrated that approximately 35% of lighting in baseline nonparticipant homes were CFLs or high-efficient lighting, and 8% of lighting in program homes were <i>not</i> high-efficient. <i>Ex ante</i> savings were derived from just one bulb type (13W CFL), therefore assuming no variations in bulbs for each home in the program. This assumed only one bulb type was used throughout a home.</p>
<p>HVAC/Shell</p>	<p>TRM baseline conditions were not well documented for these measures (e.g., the TRM did not stipulate insulation R-values, HVAC efficiencies). Moreover, the TRM did not provide specific new construction savings for measures such as central air conditioners, duct sealing, air sealing, and air-source heat pumps. Therefore, the Cadmus team could not assess how TRM savings assumptions varied from program REM/Rate models and field data.</p> <p>Windows accounted for 13% of <i>ex ante</i> program savings. Ameren Missouri provided details regarding the TRM’s window baseline assumptions. We found <i>ex ante</i> window savings were based on a mix of home vintages (with new construction only accounting for 10.4% of the vintage mix), various HVAC systems (with 20% of homes assumed to have electric furnaces, whereas 0% of program homes had electric furnaces), and an assumed installation rate of 350 square feet of windows per home (while the actual average installed window quantity was 171 square feet per program home). Based on program REM/Rate models, we found these baseline parameters not representative of program homes and overestimated savings by 277%.</p> <p>It remains unclear if TRM savings for HVAC and shell measures accounted for interactive effects. As the ESNH program was a whole house performance program, individual measure savings could have been overestimated if not accounting for other, high-efficient measures installed in the home (e.g., energy savings from a central air conditioner could be less when installing a unit in a newly constructed home with high insulation R-values and air sealing).</p> <p>Ground source heat pump TRM savings were 14,349 kWh/yr, though average annual energy consumption of an existing single-family home in Missouri was 12,721 kWh/yr.*</p>

*U.S. Energy Information Administration. *Residential Energy Consumption Survey*. 2012.

Summary

The Cadmus team calculated *ex post* gross savings for each home in the sample by tier level. Table 10 summarizes *ex post* and *ex ante* savings. We calculated *ex post* savings at 50.9% of the program’s *ex ante* savings for Tier I homes and 67.6% of the program’s *ex ante* savings for Tier II homes. These low realization rates largely resulted from overestimated *ex ante* savings, based on the Ameren Missouri TRM, as discussed.

Table 10: Program Realization Rates and Gross Savings

Tier	<i>Ex Ante</i> Program Savings (kWh/yr)	Realization Rate	<i>Ex Post</i> Program Savings (kWh/yr)	Precision at 90% Confidence
Tier I – High Performance Home	6,449	50.9%	3,285	8.5% ²
Tier II – ENERGY STAR Home	401,341	67.6%	271,292	Census
Overall	407,790	67.3%	274,577	0.1%

¹Precision calculated using t-score of 1.689; precision adjusted using a finite population correction factor. Precision results reflect PY13 analysis.

Net Impact Evaluation Results

Similarly to the gross savings analysis, the Cadmus team leveraged the PY13 evaluation to estimate PY14 net savings for Tier I and Tier II homes. Please see the PY13 evaluation report for a detailed description of the net energy methodology and findings.

Summary

The Cadmus team applied the PY13 net-to-gross (NTG) ratios, determined through REM/Rate model analyses, for each tier to the total population’s *ex post* gross kWh savings. Based on final NTG ratios, we calculated program net savings for each tier, as shown in Table 11.

Table 11: Program Net Savings

Tier	<i>Ex Post</i> Gross Program Savings (kWh/yr)	NTG	<i>Ex Post</i> Net Program Savings (kWh/yr)
Tier I – High Performance Home	3,285	22.4%	736
Tier II – ENERGY STAR Home	271,292	43.2%	117,183
Overall	274,577	42.9%	117,919

Benchmarking

The Cadmus team researched programs similar to the ESNH program and offered by other utilities. Table 12 lists participation levels (homes constructed), gross and net savings, and results for TRC Resource Cost-Effectiveness of those utilities and Ameren Missouri. These data indicate low participation often occurs in a new-construction program's first year. (For example, only two the five listed utilities completed more than 100 homes in its first year.)

Participation growth across this sample of new-construction programs also trends exponentially, with the number of homes constructed reaching into the thousands by a program's fourth year. This trend may indicate new construction programs require additional time before establishing credibility with the builder community.

The ESNH program saw an increase in total program net savings for its second operating year (an increase from 67.4 MWh/yr to 117.9 MWh/yr). The program remained considerably below typical savings seen in the second and third years of new construction programs; however, this is not unexpected as the program stopped accepting applications mid-year.

Table 12: ESNH Benchmarking Results

State or Utility	Program Launch Year/ Program Year	Homes Constructed	Range of Program Rebates	Ex Post Savings (MWh/yr)	NTG	Net Savings (MWh/yr)	TRC
Ameren Missouri	2013/2014	31	\$500 - \$800	275.0	0.43	117.9	0.52
Ameren Missouri	2013/2013	101	\$500 - \$800	238.0	0.28	67.4	0.27
DNREC ¹	2011/2011	201	\$3,000 - \$6,000	41.4	0.56	23.2	N/A
Georgia Power Company ²	2009/2011	736	\$150 - \$300	968.6	1.04	1007.3	2.47
Rocky Mountain Power ³	2005/2009	2093	\$200 - \$2,000	2,521.3	0.80	2,766.4	1.89
Salt River Project ⁴	2005/2009	3,248	\$450 - \$1,150	5,706.0	0.52	2,967.0	1.06
Ontario Power Authority	2006/2007	265	N/A	4,782.0	0.76	3,602.0	N/A
South Utility 1 ⁵	2012/2012	44	N/A	93.7	0.84	78.7	N/A
South Utility 2 ⁵	2009/2009	84	N/A	163.0	N/A	163.0	N/A
Midwest Utility ⁵	Unknown/ 2012	15	N/A	32.6	0.84	27.4	0.21
West Utility ⁵	Unknown/ 2011	2,396	N/A	3,942.0	0.65	2,979.0	1.60

¹Delaware Department of Natural Resources and Environmental Control. "SEU and State Energy Efficiency Program EM&V Report." Opinion Dynamics Corporation. July 2012.

²Impact Evaluation of Georgia Power Company's 2011 DSM Programs. Nexant, Inc. December 21, 2012.

³PacificCorp. "Rocky Mountain Power ENERGY STAR New Homes Impact Evaluation for 2009-2010." The Cadmus Group, Inc. April 27, 2012.

⁴Salt River Project. "SRP FY2010 Energy Efficiency Evaluation." The Cadmus Group, Inc. August 2010.

⁵Report is not publicly available.

Cost-Effectiveness Results

To analyze the cost-effectiveness of the PY14 ESNH program, MMP utilized DSMore, assessing cost-effectiveness using the following five tests, as defined by the California Standard Practice Manual:³

- TRC
- UCT
- RIM
- PART
- SCT

DSMore took hourly prices and hourly energy savings from specific measures installed through the ESNH program, and correlated prices and savings to 30 years of historic weather data. Using long-term weather ensured the model captured low-probability, high-consequence weather events and appropriately valued them. As a result, the model’s produced an accurate evaluation of a demand-side efficiency measure relative to other alternative supply options.

Table 13 lists key assumptions the Cadmus team used in the analysis, and the source of each assumption.

Table 13: Key Assumptions for Cost-effectiveness Analysis

Assumptions	Source
Discount Rate = 6.95%	Ameren Missouri 2012 MEEIA Filing (2013 – 2015 Energy Efficiency Plan)
Line Losses = 5.72%	
Summer Peak occurred during the 16th hour of a July day, on average.	
Avoided Electric T&D = \$31.01/kW	
Escalation rates for different costs occurred at the component level, with separate escalation rates for fuel, capacity, generation, transmission and distribution, and customer rates carried out over 25 years.	

In addition, MMP leveraged the “Batch Tools” (model inputs) used by Ameren Missouri in its original analysis as inputs into the *ex post* DSMore analysis. By starting with the original DSMore Batch Tool used by Ameren Missouri and only modifying it with new data from the evaluation (PY14-specific ESNH participation counts, per-unit gross savings, and NTG), consistency was assured. In particular, model assumptions were driven by measure load shapes, which told the model when to apply savings during the day. This assured the load shape for that end use matched the system peak impacts of the end use and provided the correct summer coincident savings. MMP used measure lifetime assumptions and

³ California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects. October 2001.

incremental costs, based on the program’s database, the Ameren Missouri TRM, or the original Batch Tool.

A key step in the analysis process involved acquiring PY14 Ameren Missouri program spending data: actual spending, broken down into implementation, incentives, and administration costs. MMP applied these numbers at the program level, not the measure level.

While applying incentives at the measure level proves useful for planning purposes, it is unnecessary for cost-effectiveness modeling, as results are based on the overall program.

Table 14 summarizes the cost-effectiveness findings by test. Any benefit/cost scores above 1.0 indicate the present values of a program’s benefits are greater than the present value of its costs. In addition, the table includes the present value (in dollars) of the UCT net lifetime benefits (net avoided costs minus program costs).

As determined through a consensus-building process with stakeholders, all cost-effectiveness results shown include the program’s share of portfolio-level or indirect costs. Each program’s share of these costs was determined using the present value of each program’s UCT lifetime benefits (i.e., the present value of avoided generation costs as well as deferral of capacity capital and transmission and distribution capital costs). The residential portfolio summary report discusses this in greater detail.

As shown, the ESNH program did not pass any of the tests and generated negative net lifetime benefits.

Table 14: Cost-Effectiveness Results (PY14)

	UCT	TRC	RIM	Societal	PART	UCT Net Lifetime Benefits
ESNH	0.56	0.52	0.38	0.65	2.63	(\$131,965)

Appendix A. Ex Post Demand Reductions

MMP determined *ex post* demand reductions using *ex post* energy savings estimated in this PY14 report and DSMore (using load shapes provided by Ameren Missouri), as shown in Table 15.

Table 15: PY14 Summary: Ex Post Program Demand Reductions

ENSH Home	Total Net <i>Ex Post</i> Savings (kW)
Overall	46

Appendix B. Bibliography

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

Delaware Department of Natural Resources and Environmental Control. "SEU and State Energy Efficiency Program EM&V Report." Opinion Dynamics Corporation. July 2012.

Impact Evaluation of Georgia Power Company's 2011 DSM Programs. Nexant, Inc. December 21, 2012.

Missouri Code of State Regulations. <http://sos.mo.gov/adrules/csr/current/4csr/4c240-22.pdf>

PacificCorp. "Rocky Mountain Power ENERGY STAR New Homes Impact Evaluation for 2009-2010." The Cadmus Group, Inc. April 27, 2012.

Salt River Project. "SRP FY2010 Energy Efficiency Evaluation." The Cadmus Group, Inc. August 2010.

U.S. Energy Information Administration. *Residential Energy Consumption Survey*. 2012.

Appendix C. Program Manager Interview Guide

Respondent name: _____

Respondent phone: _____

Interview date: _____ Interviewer initials: _____

The PY14 interviews are intended to provide feedback on program performance and management to better understand the current situation of the New Home Construction program. These interviews will focus on the program's performance in the last year and seek to understand how the proposed changes to program marketing and delivery approaches have or have not been implemented.

PY2014 Summary

1. Please explain the changes in the implementation team's management.
2. What activity took place in 2014?
 - a. Marketing/outreach:
 - b. Trainings:
 - c. Site QC efforts:
 - d. Other?
3. Confirm total number of homes completed in 2014 (30 ENERGY STAR and 1 High Performance)

Program Closure and Feedback

4. When was it decided to end the program?
5. What was ICF's role after the decision was made to close the program?
6. What were the reasons that led to the decision to end the program?
 - a. Was the program re-design that would allow builders to earn rebates for exceeding a given baseline considered? If yes, why was it not implemented?
7. What has been the response from builders and/or other stakeholders (realtors, HBA, etc.)?
8. Can you share your perspectives on why you feel the program was not successful?
 - a. Program design? Program Staffing? Missouri residential new construction market? Program incentives and requirements?
9. What would you say are the biggest lessons learned since the launch of ConstructionSavers?
10. Is there anything else you'd like us to know about your experience administrating/implementing the program so far this year?