

**Evaluation of Home Energy Score Deployment:
New Jersey Natural Gas & Wisconsin Focus on Energy**

Final Report

September 2018

Prepared By:

The E2e Project

Christopher Knittel, The E2e Project¹

Catherine Wolfram, The E2e Project²

Raina Gandhi, The E2e Project

Karen Notsund, The E2e Project

Prepared For:

U.S. Department of Energy

Office of Energy Efficiency and Renewable Energy

¹ Christopher Knittel is the George P. Shultz Professor in the Sloan School of Management at the Massachusetts Institute of Technology.

² Catherine Wolfram is the Cora Jane Flood Professor of Business Administration at the Haas School of Business at the University of California – Berkeley.

Acknowledgement

This material is based upon work supported by the Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE). The research project was initiated and directed by Jeff Dowd (DOE/EERE). Project management and technical oversight was provided by Yaw O. Agyeman, Program Manager at Lawrence Berkeley National Laboratory (LBNL) under intra-university transaction agreement number 7402609, entered into by the University of California, Lawrence Berkeley National Laboratory and University of California, Berkeley.

The E2e Project, led by Christopher Knittel, Catherine Wolfram, Raina Gandhi and Karen Notsund, provided the analysis and reporting, based on data collected by DOE partners in New Jersey and Wisconsin.

We are grateful to the technical advisors – Lori Lewis, Kim Longfield and Cheryl Oros – who provided an independent review of the report. Their critiques, insights, and interpretations greatly improved the work. Additional gratitude is extended to the DOE review team, comprised of Jeff Dowd, Ben King, Steve Capanna, and John R. Mayernik, who also reviewed the report.

We are grateful to the partners in New Jersey and Wisconsin who assisted DOE in the deployment efforts leading to the data that served as the basis for the current report. Finally, we extend special gratitude to Joan Glickman, Program Manager for the Home Energy Score Program, who has led the development and deployment of the Home Energy Score Rating Tool.

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Table of Contents

Executive Summary.....	i
A. New Jersey Natural Gas – Home Energy Score.....	ii
1. Evaluation Objectives	ii
2. Method	ii
3. Findings.....	ii
4. Conclusions.....	iii
B. Wisconsin Focus on Energy – Home Energy Score	iv
1. Evaluation Objectives	iv
2. Method	iv
3. Findings.....	v
4. Conclusion	v
I. Background	1
A. New Jersey Natural Gas – Home Energy Score.....	3
B. Wisconsin Focus on Energy – Home Energy Score	3
II. Literature Review	4
III. Methodology.....	5
A. NJNG - HES Study Design.....	5
1. Surveys.....	6
2. Metrics	7
3. Data Collection Protocol.....	8
4. Analysis.....	8
B. Wisconsin Focus on Energy – HES Study Design.....	9
1. Survey	10
2. Metrics	11
3. Data Collection Protocol.....	11
4. Analysis.....	11
IV. Results.....	11
A. New Jersey Natural Gas – Home Energy Score.....	11
1. Estimation Results	13

2. Survey Results	17
B. Wisconsin Focus on Energy – Home Energy Score	19
V. Discussion.....	23
A. New Jersey Natural Gas – Home Energy Score.....	23
1. Limitations	25
B. Wisconsin Focus on Energy – Home Energy Score	25
1. Limitations	26
VI. Conclusions	27
A. New Jersey Natural Gas – Home Energy Score.....	27
B. Wisconsin Focus on Energy – Home Energy Score	27
VII. Recommendations	28
References	29
Appendix I. New Jersey Natural Gas	30
1. Surveys	30
2. NJNG Release Form.....	32
Appendix II. Wisconsin Focus on Energy.....	33
1. Surveys	34

List of Tables

Table 1: Frequency of HESs	13
Table 2: Regressions of Release, Conversion, and Project Completion Rate on Treatment	14
Table 3: Regressions of Number Projects, Time for Projects, and Total Measure Cost on Treatment	14
Table 4: Logistic Regressions with Initial HES (excluding non-HPwES and independents).....	15
Table 5: Logistic Regressions with HES after Recommendations	15
Table 6: Logistic Regressions with Change in HES	16
Table 7: Regressions of Initial HES, Predicted HES, and Jump in HES on Conversion.....	16
Table 8: Logistic Regressions of Release, Conversion, and Project Completion Rates	17
Table 9: Rank-sum Test for Understanding of Home Energy Efficiency	17
Table 10: Rank-sum Test of Satisfaction	18
Table 11: Survey Results on Understanding of HES and Likelihood of Investing.....	19
Table 12: Frequency of Treatment Participants' Views of the HES Report	20
Table 13: Treatment Participants' Changes in Attitudes after Receiving HES	21
Table 14: Frequency of Treatment Participants' Ranking of the Best Part of the Appointment.....	22
Table 15: Treatment Participants' View of the Most Useful Section of the Home Energy Report.....	23

List of Figures

Figure 1: Logic Model for NJNG – HES	3
Figure 2: Timeline for NJNG - HES Survey Data Collection in the Study	7
Figure 3: Timeline for FoE-HES Survey Data Collection in the Study.....	10
Figure 4: Treatment Participants' View of the HES Report.....	20
Figure 5: Treatment Participants' Ranking of the Best Part of the Appointment.....	22

Executive Summary

Research indicates that consumers have historically underinvested in energy efficiency upgrades. This underinvestment may occur for a variety of reasons, one of which is that consumers are not adequately informed about the benefits of energy efficiency. To address this, in 2012, the U.S. Department of Energy (DOE) launched a tool called the Home Energy Score (HES) to act as a simple, low-cost means to provide clear information about a home's energy efficiency and motivate homeowners and homebuyers to invest in energy efficiency.

The HES rating tool – a web-based tool and method for providing an energy rating of existing single-family homes – is a key component of the DOE's HES Program for residential building energy labeling. It functions as a voluntary national asset rating method that employs a simplified and standardized energy assessment process. The tool-development component of the program was undertaken by scientists at the Lawrence Berkeley National Laboratory (LBNL) and was designed to support the energy audit marketplace by providing a substantially lower-cost, entry-level assessment method analogous to the fuel-economy ratings associated with vehicles.

In 2014, the Department of Energy partnered with New Jersey Natural Gas (NJNG) and the Wisconsin Focus on Energy (FoE) to deploy the HES. NJNG's deployment approach entailed offering the HES randomly to homeowners who had already taken advantage of utility incentives to replace gas water heaters or furnaces. In Wisconsin, Focus on Energy offered the HES to homeowners who participated in the organization's direct install program, which provides a homeowner with up to two light-emitting diode (LED) and ten compact fluorescent light (CFL) bulbs, unlimited high-efficiency showerheads, water-saving kitchen and bathroom aerators, and assistance with water heater setback.

Both NJNG and FoE had previously commissioned evaluations of their incentive programs, unrelated to the deployment of the HES.^{3 4} Separately, in 2014, the Department of Energy in partnership with NGNJ and FoE launched evaluations focusing on the deployment of the HES and its impact on residential energy efficiency investment and program participation. New Jersey Natural Gas and the Wisconsin Focus on Energy staff designed, implemented, and collected the data for the evaluations of their respective programs' HES offerings.⁵ In May 2015, the Department of Energy contracted the E2e Project (E2e) to analyze the data from the New Jersey and Wisconsin deployments of the HES and produce this report. This report summarizes the findings of the New Jersey Natural Gas and the Wisconsin Focus on Energy deployments of the HES, based on data collected between 2014 and 2015.

³ New Jersey Natural Gas 2015 SAVEGREEN Evaluation, Final Report, by APPRISE, December 2015.

⁴ Focus on Energy, Calendar Year 2015 Evaluation Report, by CADMUS, May 20, 2016.

⁵ EnergySavvy Inc. performed survey data collection for NJNG.

A. New Jersey Natural Gas – Home Energy Score

Participants in this New Jersey Natural Gas – Home Energy Score (NJNG-HES) were households that had either requested an audit, or received an audit as a condition of the NJNG SAVEGREEN incentive for a furnace, boiler or gas water heater replacement.

1. Evaluation Objectives

The NJNG-HES evaluation was designed with the intent to answer the following questions:

- i. Does the Home Energy Score affect whether homeowners make energy efficiency investments through the Home Performance with ENERGY STAR (HPwES) Program?
- ii. Does the Home Energy Score have an impact on how soon homeowners make these investments?
- iii. Does the Home Energy Score change the level of homeowner investment in energy efficiency?
- iv. How do the answers to the above questions change when homeowners are reminded of their Home Energy Score at least three months later?

This evaluation did not address the last question because, during the period of data collection covered – May 2014 to October 2015 – there was no follow-up reminder sent to homeowners about their HESs.

2. Method

Homes were randomly assigned to assessors, and each assessor alternated between conducting an audit of a home in the treatment group and a home in the control group. Treatment homes received their initial HES, as well as a predicted HES, which is an estimation of what their HES would be if the homeowner implemented all of the recommended energy efficiency improvements. All homes that had either requested an audit, or received an audit as a condition of the NJNG SAVEGREEN incentive, were scored, but only the treatment group received their HESs. Homes in the control group received a normal audit and a follow-up survey, while homes in the treatment group received the same audit, along with their HES and a slightly different survey. Survey data collection for this current NJNG-HES study began in May 2014 and ended in October 2015.

3. Findings

The short-term post-implementation period covered by the current NJNG-HES study affected the ability of this study to determine some key outcomes, namely the likelihood that treated homeowners would complete a greater number of energy projects, or spend more on these projects. These outcomes tend to require a longer time to effect than the one-year, post-implementation period covered under this study.

- The treatment group (participants who received the HES during their audit) was 14% more likely to sign a release form, allowing contractors to contact them about potential home improvement work.
- The HES report was not more likely to lead to an initiation or completion of a retrofit energy efficiency project.
- The lower the initial HES, the more likely the treatment group were to sign a release form, initiate an energy efficiency retrofit, and complete a project.
- A higher predicted jump in HES was associated with a greater likelihood of signing a release form initiate an energy efficiency retrofit, and completing a project.

These results, however, are not generalizable beyond the program participants because there were a number of methodological limitations to the evaluation.

- First, participants were a self-selected group with a proclivity towards energy efficiency – having already either applied for a rebate program through NJNG SAVEGREEN, or requested an independent audit – characteristics that distinguish them systematically from the general population of homeowners.
- Although all households in the treatment group were supposed to receive the HES according to the design of the program, survey results indicate that not everyone may have actually received it, an implementation flaw that emerged only during the analysis of the data.
- Survey responses were slightly skewed towards the control group. The completion rate for the treatment group was approximately 17%; for the control group it was 26%.

4. Conclusions

There is some evidence in the literature to suggest that it takes years for homeowners to make major investments in energy efficiency, especially when, as in the case of the NJNG-HES program, the homeowners had already made a capital outlay as part of their participation in a program.

Yet in spite of the short-term post-implementation period covered by this evaluation, there are indications that the HES might be a valuable tool to motivate desired behaviors. For one, participants who received a HES were more likely to sign a release form allowing contractors to contact them about potential home improvement work, which can be reasonably interpreted as an initial declaration of intent to invest in energy efficiency. In addition, low initial HESs were associated with a statistically significant likelihood to sign a release form, convert to HPwES to do a project, and complete a project. This reflects a desired outcome, given that the aims of the tool is to inspire homeowners with low HES to want to make investments to improve the energy efficiency of their homes.

Finally, there was a significant positive relationship between the predicted jump in HES and whether the homeowner signed a release form, converted to HPwES, and completed a project. The average predicted jump in HES across both groups (treated and untreated) who signed the release form, converted to begin a retrofit project, and completed a project was slightly over 2 points, suggesting that there may be a threshold of presumed energy efficiency improvement required for a homeowner to decide to make an energy efficiency investment. Although the control group did not see their HES, this result suggests that those with lower HES were also more likely to invest, perhaps because they were aware of efficiency opportunities in their homes. Those who converted into the HPwES program (to begin a retrofit project) and those who completed a project had even higher associated increases in HESs, implying that the threshold for homeowners to decide to make an investment is higher than the threshold to decide to learn about energy efficiency by engaging with contractors.

No conclusions can be drawn about whether additional reminders would alter homeowners' behaviors one way or the other because, in the period of data collection covered for this study, the homeowners did not receive a reminder of their HESs.

B. Wisconsin Focus on Energy – Home Energy Score

This Wisconsin Focus on Energy – Home Energy Score (FoE-HES) evaluation was implemented in two municipalities in Wisconsin.

1. Evaluation Objectives

The FoE-HES evaluation was designed with the intent to answer the following questions:

- i. How does the HES impact homeowners' willingness to invest?
- ii. Does the HES change customer satisfaction?
- iii. Does the HES affect homeowner participation in other Focus on Energy residential programs?
- iv. Does the HES change the time span between participation in other Focus on Energy residential programs?

Flaws in the evaluation implementation, however, meant that question 1 could not be answered. Additionally, in the period of data collection covered by this evaluation, it does not appear that an effort was made to elicit knowledge about the third and fourth questions.

2. Method

Homeowners received a letter inviting them to participate in Focus on Energy's Express Energy Efficiency program, and those who called Focus on Energy to set up an appointment were randomly assigned to the treatment or control group. HESs were calculated for both groups, but although both groups received the standard Express Energy Efficiency site visit and program

offerings, only the treatment group was informed of their HES. At the end of the visit, the installation technician asked the homeowner to complete a survey. Survey data collection for the current FoE-HES study began in September 2014 and ended in December 2015.

3. Findings

Unfortunately, the FoE-HES study does not offer useful information because it was found that the installation technicians encouraged the homeowners who received the HES more than they did the other homeowners, which yielded a large disparity in response rates to the survey. Survey responses varied widely between groups, with a response rate of 93% in the treatment group and a response rate of 24% in the control group. In addition to the significant discrepancy in response rate, the FoE-HES study suffered from significant internal validity weaknesses, notably experimenter bias, making it impossible to obtain definitive comparative analysis between the treatment and control groups.

However, the survey results do provide some useful information about how the homeowners in the treatment group perceived the HES.

By overwhelming margins, the treatment group offered positive impressions of the HES. Approximately 97% either agreed or strongly agreed that the score was easy to understand; accurate (95%); motivational (93%); and useful (96%). About 39% of participants reported that they were more likely to improve energy efficiency in the next 12 months, against 15% who were less likely to improve energy efficiency in the next 12 months.

When asked about the best part of the visit, treated participants ranked receiving free products first; the free HES assessment second; and learning about energy efficiency programs and incentives third. Asked which section of the HES was most useful, 52% of treated participants chose the recommendation; 34% chose the score itself; and 14% chose the home facts.

4. Conclusion

Due to the previously described study weaknesses, no definitive conclusions about the impact of HES can be established based on comparisons between the treatment and control groups. However, the results suggest that homeowners do value the HES and appreciate the additional information it offers.

This FoE-HES study highlights the importance of proper rigor in the implementation of a study, especially in the data collection procedures. The finding that the installation technicians persistently encouraged treatment homeowners more than they did comparison homeowners undermines the internal validity of any analyses between the two groups because it introduces, at a fundamental level, an insidious bias into the study. Valid evaluation studies require equal treatment across all involved groups to prevent or minimize biases introduced by differential engagement.

I. Background

The Home Energy Score (HES) rating tool – a web-based tool and method for providing an energy rating of existing single-family homes – is a key component of the U.S. Department of Energy’s (DOE) Home Energy Score Program for residential building energy labeling, a voluntary national asset rating method that employs a simplified and standardized energy assessment process. The tool-development component of the program was undertaken by scientists at the Lawrence Berkeley National Laboratory (LBNL), and was designed to support the energy audit marketplace by providing a substantially lower-cost, entry-level assessment method analogous to the fuel-economy ratings associated with vehicles.

In 2014, DOE launched evaluations in two states (in New Jersey and Wisconsin), focusing on the HES and its impact on residential energy efficiency investment. Each of these evaluations had slightly different focuses, but combined were meant to provide DOE with a fuller picture of how homeowners respond to the HES and how the score can be improved to better meet homeowner’s needs.

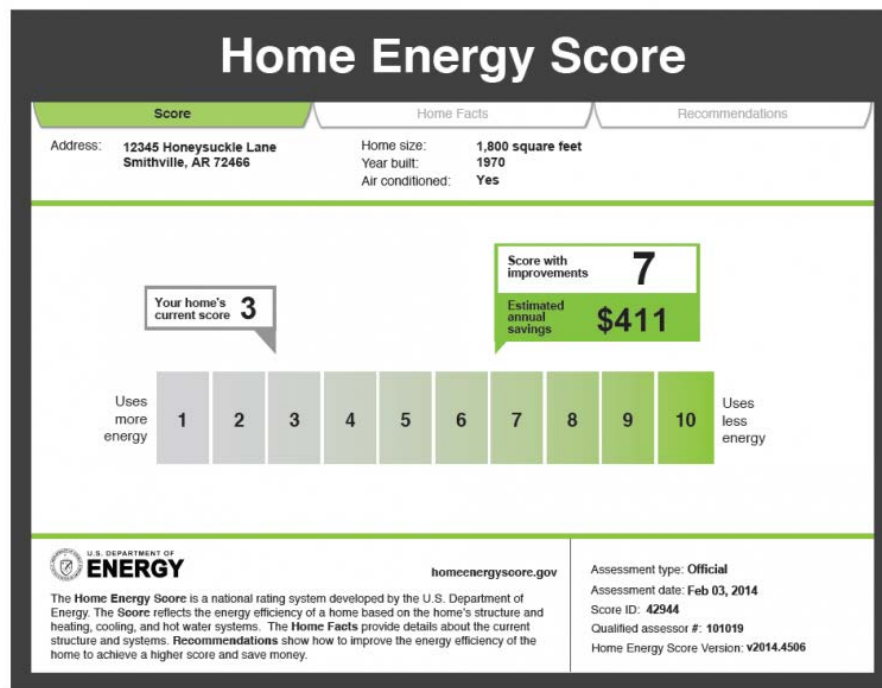
Overview of the Home Energy Score

In 2009, the White House Council on Environmental Quality and the Vice President instructed DOE to construct a system that allowed homeowners to compare easily and affordably their homes’ energy performance to that of others across the country. After a year of pilot studies, and in collaboration with the Lawrence Berkeley National Laboratory (LBNL) and the National Renewable Energy Laboratory (NREL), DOE created the Home Energy Score (HES). The HES was launched in 2012.⁶

Like a vehicle’s miles-per-gallon rating, the HES represents a standardized measure of a home’s energy efficiency. Homes are scored on a 10-point scale, where a score of “1” is given to the most inefficient homes and a score of “10” is given to the most efficient homes. A home’s estimated energy use is also converted into a score on a 10-point scale, where “1” indicates that a home is in the highest energy consumption bracket and “10” indicates that a home is in the lowest energy consumption bracket. The Score also includes facts about the home, including the data collected and the breakdown of energy use, and recommendations for how the home’s

⁶ “What’s the Score? Lessons Learned from the U.S. Department of Energy’s Home Energy Score,” by Joan Glickman (DOE), Patty Kappaz (SRI International), and Gannate Khowailed (SRA International), prepared for the ACEEE Summer Study on Energy Efficiency in Buildings, 2014.

energy efficiency and HES can be improved. Some examples of recommendations from an assessment might be:



- Increase attic floor insulation to at least R-38
- Add insulation around ducts in unconditioned spaces to at least R-6
- Add insulating sheathing underneath siding to R-5.

The HES uses standardized calculations, formulas, and scoring methods based on the LBNL's DOE-2 model that consider local climate and use standard assumptions about occupant behavior, enabling a fair comparison of homes across the nation.

To create an official, Department of Energy-recognized HES, a qualified energy assessor must collect a standard set of information about a home's energy-related characteristics, such as its envelope, heating, cooling and hot water systems, and enter this information into an approved software tool. Assessors must be industry-certified and pass a two-part proctored test that assesses their understanding of building science and how to create a HES.

Homeowners are presumed to currently lack insight into the energy efficiency of their home, and so the purpose of the HES is to address this gap and enable homeowners to make more efficient decisions regarding their energy usage.

A. New Jersey Natural Gas – Home Energy Score

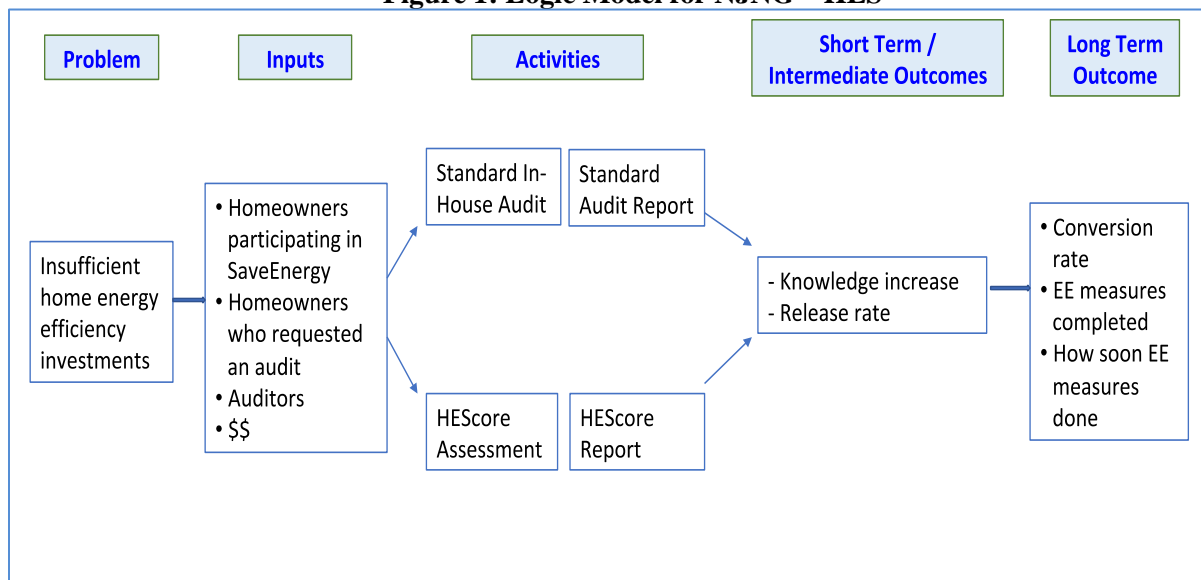
This study was conducted in partnership with New Jersey Natural Gas and EnergySavvy, beginning on May 1, 2014. This study is henceforth referred to as the New Jersey Natural Gas – Home Energy Score (NJNG-HES study). The study took place in New Jersey Natural Gas’s service territory, which covers more than 500,000 customers in Ocean, Monmouth, and part of Morris County in New Jersey. There were 4,851 participants total in the study, of which 2,242 were in the treatment and 2,609 were in the control.

This NJNG-HES evaluation was intended to answer four key questions among residential homeowners:

1. Does the HES affect whether homeowners make energy efficiency investments through the Home Performance with ENERGY STAR (HPwES) Program?
2. Does the HES have an impact on how soon homeowners make these investments?
3. Does the HES change the level of homeowner investment in energy efficiency?
4. How do the answers to the above questions change when homeowners are reminded of their HES at least three months later?

Figure 1 presents an overview of the underlying program logic.

Figure 1: Logic Model for NJNG – HES



* Conversion rate is the percentage of homeowners that began a retrofit project through the NJNG HPwES Program.

B. Wisconsin Focus on Energy – Home Energy Score

The Wisconsin study was conducted in partnership with Focus on Energy (FoE), beginning in September 2014 and ending in December 2015. This study is henceforth referred to as the Wisconsin Focus on Energy – Home Energy Score (FoE-HES study). Homeowners from four

towns who chose to participate in a direct install program randomly received the HES during their site visit. Homeowners were asked to complete a survey at the end of the visit, and their participation in Focus on Energy programs was tracked.

This FoE-HES study was intended to answer a few key questions among homeowners:

1. How does the HES impact homeowners' willingness to invest?
2. Does the HES change customer satisfaction?
3. Does the HES affect homeowner participation in other Focus on Energy residential programs?
4. Does the HES change the time span between participation in other Focus on Energy residential programs?

II. Literature Review

Energy efficiency investments are widely believed to offer the rare win-win opportunity. Detailed engineering projections, such as those summarized by the well-known McKinsey curves (McKinsey & Company, 2009), routinely project positive net present value investments based only on private returns. Moreover, by reducing the energy necessary to achieve a given level of energy services, these investments promise to decrease greenhouse gas (GHG) emissions in addition to other pollutants that compromise human health. However, there is a large and persistent difference between the levels of investment in energy efficiency that appear to be privately beneficial and the investments that private actors undertake. This disparity is known as the energy efficiency "gap."⁷

Policymakers have taken note of this tantalizing opportunity and virtually all plans to mitigate climate change have energy efficiency policies that aim to close the energy efficiency gap at their center. For example, energy efficiency accounts for 50% of the International Energy Agency's climate mitigation plan.⁸ In 2013, U.S. electric utilities budgeted nearly \$7 billion for efficiency programs; these expenditures are projected to double in the next decade (Barbose, et al., 2013).

Government interventions such as these are meant to improve welfare primarily through two mechanisms: by accounting for energy use externalities and by addressing investment inefficiencies. The existence of market failures drives a wedge between the private and social returns of investing in energy efficiency leading to too little investment from society's perspective. There exist investment inefficiencies that may cause consumers and firms to decide

⁷ Allcott and Greenstone, 2012.

⁸ International Energy Agency, "World Energy Outlook," 2011, and "World Energy Outlook," 2012.

not to invest in energy efficiency even though these investments are privately profitable. These forces include information asymmetries and misaligned incentives, imperfect information, and “behavioral” biases such as inattention to energy costs (Allcott and Greenstone 2012; Gillingham, Newell, and Palmer 2009).

This report focuses on information treatments. Providing relevant information is a simple and direct way to counter investment inefficiencies resulting from imperfect information and inattention, yet informational treatments have not substantially improved engagement among consumers. Providing customers with more accurate energy price information about appliances led to better allocations of energy efficiency. Consumers invest about the same amount overall in energy-efficiency, but the allocation is much better with more investment in high-usage high-price states and less investment in low-usage low-price states (Davis and Metcalf, 2014). Highlighting the cost and energy savings of energy efficient appliances does not dramatically change consumer purchase decisions, either: large shares of consumers still choose to buy incandescent light bulbs after being informed, online or in person, about the energy and cost savings of compact fluorescents (Allcott and Taubinsky, 2014).

Yet, consumers as a whole are heterogeneous, optimizing energy usage according to their unique needs, preferences, and constraints. While consumers overall value Energy Star certifications on appliances, they vary widely in how they use the information. Some consumers rely on the certification to make their decision, others rely on the information about energy costs provided, and others disregard the label entirely when deciding which appliance to buy (Houde, 2014). Households that have responded to information by investing more in energy efficiency tend to be the ones that face higher energy prices and usage, whereas households that responded to information by investing less in energy efficiency were the ones that had lower energy prices and usage (Davis and Metcalf, 2014). Thus, information treatments may not be a total panacea to the energy efficiency gap, but they may contribute to more efficient energy efficiency decisions. The HES is one such information treatment that may lead to more efficient residential energy improvements and eventually a more efficient real estate market.

III. Methodology

The initial concept for both the NJNG-HES and FoE-HES evaluations was to implement a randomized controlled trial (RCT) to measure the true causal impacts of the programs. RCTs are the gold standard for identifying the impact of a treatment, but have been used rarely in energy efficiency evaluations.

A. NJNG - HES Study Design

This study was designed and implemented as a randomized controlled trial. Participants came from two sources: those who had applied for a specific NJNG rebate, and those who had requested an independent audit. All households that replaced their furnace, boiler or gas water

heater with a qualifying higher-efficiency unit and applied for New Jersey Natural Gas SAVEGREEN incentives⁹ between May 2014 and October 2015 are part of the study. To receive the SAVEGREEN incentive, New Jersey Natural Gas requires homeowners to receive a comprehensive in-home audit. Additionally, homeowners who requested an independent audit from New Jersey Natural Gas between May 2014 and October 2015 are also part of the study.

New Jersey Natural Gas identified the sample, designed and implemented the randomization methodology, and processed all data before sending it to E2e for analysis and reporting. Homes were randomly assigned to assessors, and each assessor alternated between conducting an audit of a home in the treatment group and a home in the control group. Homes in the control group received a normal audit and a follow-up survey, while homes in the treatment group received the same audit but with their HES. Treatment homes received the same follow-up survey as the control homes, but with additional questions asking about their understanding of the score.

Each assessor had a tablet that they used for the audit that had an application developed by EnergySavvy and integrated with the Department of Energy's HES Application Programming Interface (API). During the audit, the assessors record information about the home in the app, and then the app produces the recommended energy-saving measures and generates the HES for the home. However, the app only shows the assessor the score report for homeowners that have been assigned to the treatment group. The assessor informs the homeowner of the audit recommendation and, if the homeowner is in the treatment group, their current HES and what their HES would be if they made the recommended improvements, i.e., the predicted HES.

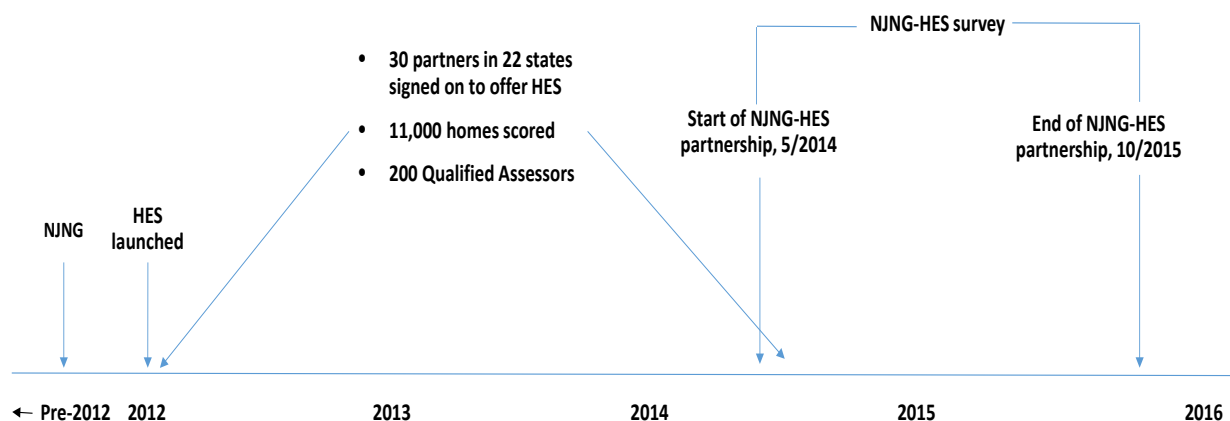
After the audit, homeowners received an audit report summarizing the results. Those that received the HES were provided with access to their score. Two weeks after the audit, participants were emailed a link to a follow-up survey. The control group survey consisted of four questions about the customers' understanding of New Jersey Natural Gas's available programs, their impression of the energy efficiency of their home, and their satisfaction with the overall audit experience. The treatment group survey had the same questions as the control group survey, with the addition of two questions about how well the customer understood the HES and whether the customer thought the score would encourage them to make additional energy efficiency investments.

1. Surveys

Survey data collection for this NJNG-HES study began in May 2014 and ended in October 2015. Figure 2 illustrates the timeline for survey data collection for the study.

⁹ Incentive for furnace and boiler is a \$500 rebate. Incentive for a water heater is a \$100 rebate. Customers installing both a qualifying furnace/boiler and water heater at the same time have the option of receiving the rebates or applying for a \$6,500 On Bill repayment program option.

Figure 2: Timeline for NJNG - HES Survey Data Collection in the Study



The post-audit surveys were sent to participants through an email and were administered by SurveyMonkey, Inc. Responding to the survey was voluntary and not tied to any New Jersey Natural Gas program or rebate.

The survey for the control group consisted of the following questions:

- I. Do you have a clear understanding of the rebates and incentives available from NJNG should you want to make additional energy efficiency upgrades?
- II. Do you have a clear understanding of how energy efficient your home currently is and its future potential?
- III. How satisfied are you with your overall home energy audit experience?
- IV. What other information would you like to receive as part of your home energy audit?

The survey for the treatment group consisted of the above questions preceded by two questions about the HES:

- I. Do you have a clear understanding of your Home Energy Score and what it means?
- II. How likely will the Home Energy Score encourage you to make additional investments in your home's energy efficiency?

See Appendix for the full surveys.

2. Metrics

The key metrics for the purpose of this study are:

- **Release rate:** the percentage of homeowners that signed a release form, which authorizes New Jersey Natural Gas to provide contractors with the customer's contact information to facilitate securing estimates for the implementation of further energy efficiency measures, including seal-up and insulation work. While customers are not

required to sign a release to participate in Home Performance with ENERGY STAR (HPwES), this is a strong indication of interest.

- Conversion rate: the percentage of homeowners that began a retrofit project through the HPwES Program.
- Energy efficiency measures completed by homeowner through New Jersey Natural Gas programs (by project).
- Time to move forward with projects: the number of days between submission of the HPwES application and the submission of the Promissory Note / Truth in Lending document, with which the homeowner agrees to the loan terms. This is also measured by the number of days between the submission of the Promissory Note / Truth in Lending document and the finalization of the On-Bill Repayment Program details.¹⁰
- Total project cost.

3. Data Collection Protocol

The assessor conducting the audit collected the data about the home in accordance with Building Performance Institute (BPI) standards. The information included inputs such as the total conditioned floor area, year the home was built, orientation of the home, heating fuel source, foundation type, and more. The assessor then input this information into the EnergySavvy tablet application, which was connected to the Department of Energy's HES API. The application then calculated the current and potential HESs for the home. EnergySavvy's server and the Department of Energy server thus had all of the home information and the HES reports.

New Jersey Natural Gas collected data about further program participation and energy efficiency investments. For those that did pursue future home performance work, New Jersey Natural Gas gathered data about what kind of project was done, the cost, and the start and end dates.

New Jersey Natural Gas emailed all participants with a link to the post-audit survey hosted on SurveyMonkey.

4. Analysis

Ordinary least square regressions were used to assess whether there were statistically significant differences in release rates, conversion rates, and project completion rates between those who received the HES and those who did not. Regressions were also used to determine whether the differences in the amount of time to move forward with projects, the number of projects, and total costs varied statistically significantly between the treatment and control groups.

Logistic regressions were used to identify how the initial HES, the HES after recommendations, and change in the HES affected the rates at which participants signed release forms, converted

¹⁰ The On-Bill Repayment Program provides on-bill financing over a specified period for customers who participate in the HPwES program.

into the HPwES program, and completed projects. Regressions were also done to consider the impact of the age and size (measured by conditioned floor area) of the home. Regressions and 2-proportion Z-tests were used to understand how release rates, conversion rates, and project completion rates were evolving over the course of the study.

The analysis was run multiple times: to evaluate the entire sample, to assess differences between those who entered the program through a non-HPwES program and those who did not, and to check for differences between those who requested an audit and those who received an audit because of a program.

Responses to the surveys across groups were compared using Wilcoxon rank sum tests to evaluate whether the proportion of respondents who chose each answer differed. This was done to compare responses to the questions that were the same for the control group and the overall treatment group.

B. Wisconsin Focus on Energy – HES Study Design

Homeowners in the towns of Watertown, Whitewater, Beaver Dam, and Waupun in Wisconsin received a mailing inviting them to participate in the Express Energy Efficiency Program, which is Focus on Energy's direct install program. The first 600 participants in Watertown and Whitewater that called Focus on Energy to participate in Express Energy Efficiency became part of this study. The first 500 participants in Beaver Dam and Waupun were also intended to become part of the study. However, the Beaver Dam and Waupun communities joined the pilot program much later and their data were not used in the analysis for this current study. The Express Energy Efficiency program offers homeowners up to two Light Emitting Diode (LED) and ten Compact Fluorescent (CFL) light bulbs, as well as unlimited high-efficiency showerheads, water-saving kitchen and bathroom aerators, and assistance with water heaters.

In Watertown and Whitewater, tax assessor data were used to identify households to send the mailing. This study began as a pilot only taking place in Watertown and Whitewater. After several months of conducting the pilot, it was extended to include Beaver Dam and Waupun. In Beaver Dam and Waupun, utility customer information was used. However, as previously mentioned, the Beaver Dam and Waupun data came later and was not included in the analysis for this current report. Only residential customers with three or fewer housing units received the mailing, excluding any mortgage company, or bank-owned properties and properties owned by people who live out of state or out of city.

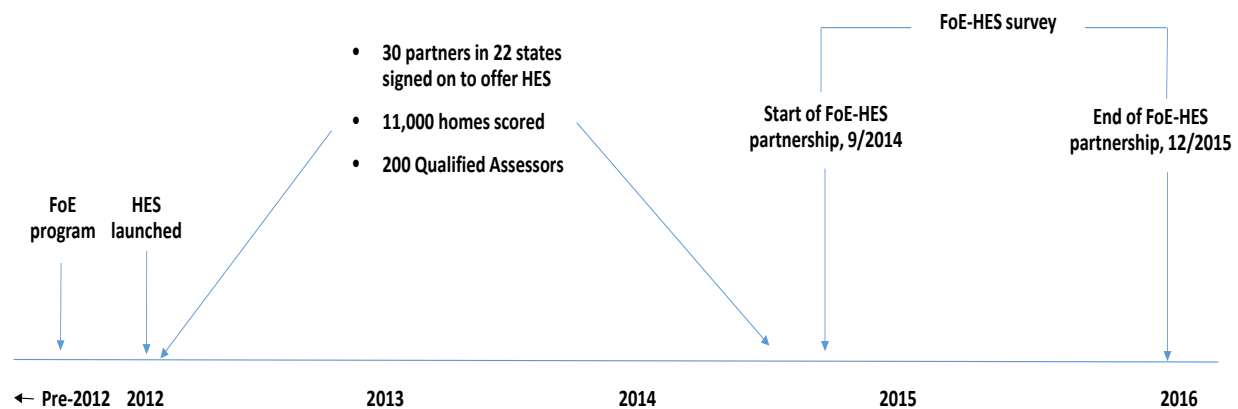
Homeowners were assigned to the control group or the treatment group based on their requested appointment time and date. Three installation technicians were assigned to a city on a specific day, and each technician conducted both HES site visits and standard site visits. For each day, HES visits were scheduled first until filled, and then the standard site visits were scheduled.

For both groups, an installation technician visited the home and conducted the standard Express Energy Efficiency Program site visit. Only the treatment group was told their HES during the visit. During the site visit, the technician asked participants to complete a survey asking about energy efficiency investments, their satisfaction with the visit and program, and their understanding of the HES.

1. Survey

Survey data collection for the FoE-HES study began in September 2014 and ended in December 2015. Figure 3 illustrates the timeline for data collection for the FoE-HES study.

Figure 3: Timeline for FoE-HES Survey Data Collection in the Study



Technicians brought paper surveys to the site visits and requested that participants complete them. Once completed, the participant would hand the technician the finished survey. Responding to the survey was voluntary and not tied to any Focus on Energy or Wisconsin state program or rebate.

Both the control group and the treatment group received questions asking them to rate Focus on Energy on their quality of service, website ease of use, ease of participation, variety of services offered, and overall satisfaction. There were 5 responses ranging from “Very Satisfied” to “Very Dissatisfied” in addition to a “Not Applicable” option. The survey also asked if the homeowner wanted to improve the efficiency of their home, if they had a good idea of how to do so, and if they intended to make an efficiency improvement in the next 12 months.

The treatment group received additional questions asking them whether they found the HES to be accurate, easy to understand, motivational, and useful. They were asked what section of the score report they found the most useful, and whether they felt that they were more or less likely to improve their home in the next 12 months or before selling.

2. Metrics

The key metrics for the purpose of this study are:

- Customer satisfaction: measured by the follow-up survey.
- Customer willingness to invest: measured by the follow-up survey.
- Energy efficiency measures completed by homeowner (by project): the specific investment(s) made by the homeowner and the efficiency (if applicable) of the measure.
- Project cost and incentive amount.

HESs were calculated for all homes in the sample in their current state.

3. Data Collection Protocol

Focus on Energy installers collected the data about the home. This information included inputs such as total conditioned floor area, year the home was built, orientation of the home, home's heating fuel source, foundation type, and more. The installer input this information into the DOE's HES application programming interface (API) to calculate the HESs for the home. The installer administered the survey and provided Focus on Energy with the survey results.

4. Analysis

Ordinary least square regressions was intended to be used to assess whether there were statistically significant differences in program participation rates between those who received the HES and those who did not in outcomes such as customer willingness to invest, and energy efficiency measures completed. However, due to fatal weaknesses in the implementation of the FoE-HES study, these results are not reported.

The FoE-HES study compared responses to the surveys across groups using Wilcoxon rank sum tests to evaluate whether the proportion of respondents who chose each answer differed.

IV. Results

A. New Jersey Natural Gas – Home Energy Score

There were 5,650 total participants in the NJNG-HES study. However, 434 of the participants received the study through NJNG programs not affiliated with the HPwES program and were excluded from the evaluation study. There was an additional group of 365 participants who requested an audit of their own volition.

The ordinary least square regression results reported here exclude the 365 participants who came into the program on their own. It focuses instead on the 4,851 participants who entered the project through the SaveGreen rebate program, with 2,242 in the treatment group and 2,609 in the control group.

An additional 171 participants began the study but were removed by NJNG and EnergySavvy for various reasons. Of these, 102 had been in the treatment group and 69 had been in the control group. The primary reasons for removal were that the customer had become unresponsive (26%), had ineligible equipment (7.6%), opted out (0.6%), or other (66%), which included reasons such as the application not being approved.

A predicted HES was calculated for every household participating in the HPwES program. The predicted HES is the score the household would have if it had implemented all of the energy efficiency recommendations from the technician. Table 1 below shows how many households (and the percentage of the total) had each HES initially (Column 1). Column 2 indicates how many households would be in each category under the predicted HES and Column 3 shows the number of households that had their HES increase by each level. For example, 1,313 households had an increase of 1 level when comparing the initial HES to the predicted HES. The initial HESs were fairly evenly distributed. If these households implemented the HES recommendations, about 66% of the households would see an increase of 1 to 2 points in their score.

Table 1: Frequency of HESs

	(1) Initial HES (Percent)	(2) Predicted HES (Percent)	(3) Jump in HES (Percent)
0	0 (0)	0 (0)	467 (11.11)
1	381 (8.15)	74 (1.58)	1,313 (31.22)
2	206 (4.41)	50 (1.07)	1,462 (34.77)
3	355 (7.59)	91 (1.95)	995 (23.66)
4	628 (13.43)	175 (3.75)	327 (7.78)
5	611 (13.07)	276 (5.91)	90 (2.14)
6	742 (15.87)	534 (11.43)	14 (0.33)
7	705 (15.08)	803 (17.19)	4 (0.10)
8	593 (12.68)	1,086 (23.24)	0 (0)
9	294 (6.29)	986 (21.10)	0 (0)
10	161 (3.44)	597 (12.78)	0 (0)
Total	4,676	4,672	4,672

Percentages in parentheses

1. Estimation Results

The following results are based on the sample excluding the non-HPwES participants. These results do not vary if homeowners participated in projects through the NJNG rebate program or through a request for an audit.

After receiving the HES during their audit, treated participants were 14% more likely to sign a release form allowing contractors to contact them about potential home improvement work. This result was statistically significant. However, this difference disappeared in the overall HPwES conversion rates and project completion rates during the time period evaluated. The treatment group was not statistically significantly more likely to complete a greater number of energy efficiency projects. (See Table 2.)

Table 2: Regressions of Release, Conversion, and Project Completion Rate on Treatment (HPwES only)

	(1) Release Rate	(2) HPwES Conversion	(3) Project Completion
Treatment	0.0241** (0.0110)	0.00211 (0.00445)	0.000346 (0.00382)
Z-statistic	2.214	0.475	0.0906
Constant	0.178*** (0.00741)	0.0250*** (0.00303)	0.0190*** (0.00260)
Observations	5,215	5,152	5,152
R-squared	0.001	0.000	0.000

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Of the 94 completed projects during the study, the treatment group tended to have longer delays - 22 days more - between submitting the HPwES application and returning the Promissory Note/Truth in Lending documents, but once this document was submitted, there was no statistically significant difference in how long it took homeowners to reach the final On-Bill Repayment Program stage. The total cost of measures was also not statistically significantly different for the treatment group. (See Table 3.)

Table 3: Regressions of Number Projects, Time for Projects, and Total Measure Cost on Treatment

	(1) Number Projects	(2) Days from HPwES Application and Promissory Note	(3) Days from Promissory Note to Final On-Bill Repayment	(4) Total Cost of Measures Installed
Treatment	-0.0210 (0.210)	22.513** (9.925)	1.434 (4.434)	841.234 (1,116)
t-statistic	-0.100	2.268	0.323	0.754
Constant	1.137*** (0.142)	37.510*** (6.71)	15.07*** (3.000)	10,633*** (755.1)
Observations	94	94	94	94
R-squared	0.000	0.001	0.001	0.006

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The following results are based on regressions on just the participants who entered the project through the SaveGreen rebate program¹¹. A lower initial HES has a small but negative relationship with whether a participant signs a release form, converts to HPwES, and completes an energy efficiency project, regardless of treatment vs. control group assignment. (See Table 4.)

Table 4: Logistic Regressions with Initial HES (excluding non-HPwES and independents)

	(1) Release Rate	(2) HPwES Conversion	(3) Project Completion
Initial HES	-0.0931*** (0.0150)	-0.116*** (0.0366)	-0.0963** (0.0426)
Constant	-0.877*** (0.0863)	-2.961*** (0.200)	-3.377*** (0.236)
Observations	4,822	4,768	4,768

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The predicted HES after energy efficiency improvements was slightly negatively correlated with release rates, but it was not correlated with conversion or project completion rates. (See Table 5.)

Table 5: Logistic Regressions with HES after Recommendations

	(1) Release Rate	(2) HPwES Conversion	(3) Project Completion
HES after Recommendations	-0.0503*** (0.0178)	0.0107 (0.0455)	0.0234 (0.0537)
Constant	-1.006*** (0.135)	-3.653*** (0.352)	-4.070*** (0.418)
Observations	4,818	4,764	4,764

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

However, there are statistically significant positive relationships between the *predicted* jump in HES and whether someone signs a release form, converts to HPwES, and completes a project. Treated households were 2.3% more likely to sign a release form, 4.4% more likely to begin a retrofit project and 4% more likely to complete a project. These results suggest that a greater

¹¹ The number of observations may vary slightly due to incomplete data on some variables.

increase in a participant's HES is more likely to motivate them to undertake an energy efficiency upgrade (Table 6).

Table 6: Logistic Regressions with Change in HES

	(1) Release Rate	(2) HPwES Conversion	(3) Project Completion
Change in HES	0.230*** (0.0298)	0.444*** (0.0686)	0.396*** (0.0800)
Constant	-1.846*** (0.0730)	-4.572*** (0.198)	-4.775*** (0.227)
Observations	4,818	4,764	4,764

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Similarly, those who did convert, i.e., began a retrofit project, had an average predicted jump in HES 38% higher than those who did not (an average of 2.6 for those who did convert and 1.9 for those who did not). Those who did convert also had a lower average initial HES (4.8 compared to 5.5), but their predicted HES after improvements were not statistically significantly different. (See Table 7.)

Table 7: Regressions of Initial HES, Predicted HES, and Jump in HES on Conversion

	(1) Initial HES	(2) Predicted HES	(3) Jump in HES
Project Conversion	-0.674*** (0.211)	0.0412 (0.176)	0.693*** (0.105)
t-statistic	-3.192	0.235	6.582
Constant	5.545*** (0.0350)	7.459*** (0.0290)	1.915*** (0.0174)
Observations	4,768	4,764	4,764
R-squared	0.002	0.000	0.009

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The age of the home or the conditioned floor area had little, if any, relationship with the signing of the release form, conversion to the HPwES program, and completion of projects (Table 8).

**Table 8: Logistic Regressions of Release, Conversion, and Project Completion Rates
on Home, Age, and Size**

	(1) Release Rate	(2) HPwES Conversion	(3) Project Completion
Home Age	-0.00226* (0.00135)	-0.00384 (0.00318)	-0.00379 (0.00368)
Home Size	2.49e-05 (2.68e-05)	-2.68e-05 (7.51e-05)	1.16e-05 (7.71e-05)
Constant	3.038 (2.663)	4.070 (6.253)	3.558 (7.238)
Observations	4,827	4,772	4,772

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

2. Survey Results

As of October 22, 2015, there were 383 survey responses from the treatment group and 680 from the control group for a response rate of 16.7% and 25.6%, respectively. The low response rates and the discrepancy between groups suggests that the survey results are likely subject to selection bias, but the results may still be of anecdotal interest. The Wilcoxon rank sum test was used to identify whether there were statistically significant differences between the responses of the treatment and control groups.

Table 9: Rank-sum Test for Understanding of Home Energy Efficiency

	(1) Observations	(2) Rank Sum	(3) Expected
Control	680	363931	361080
Treated	381	199460	202311
Combined	1061	563391	563391

Unadjusted variance: 22928580

Adjustment for ties: -6241348.3

Adjusted variance 16687231.7

$z = 0.698$

Prob > $|z| = 0.4852$

There were no statistically significant differences ¹² between groups in how well they reported understanding the energy efficiency and energy efficiency potential of their homes (Table 9). Nor was there a statistically significant difference between groups in their level of satisfaction with their overall experience. (Table 10.)

Table 10: Rank-sum Test of Satisfaction

	(1) Observations	(2) Rank Sum	(3) Expected
Control	677	364895.5	359148.5
Treated	383	197434.5	203181.5
Combined	1060	562330	562330
Unadjusted variance:	22925646		
Adjustment for ties:	-11072737		
Adjusted variance	11852909		

$$z = 1.669$$

$$\text{Prob} > |z| = 0.0951$$

When asked whether the HES encouraged them to make additional energy efficiency investments, 75% of respondents responded affirmatively. This enthusiasm, however, was not reflected in the participants' actions. (Table 11).

¹² Results are statistically significant if the probability of z is greater than .05.

Table 11: Survey Results on Understanding of HES and Likelihood of Investing

	(1)	(2)
	Understanding of HES (Percent)	Investing after HES (Percent)
Very Unclear / Unlikely	27 (7.07)	13 (3.39)
Somewhat Unclear / Unlikely	15 (3.92)	13 (3.39)
Neutral	23 (6.02)	68 (17.75)
Somewhat Clear / Likely	88 (23.04)	159 (41.51)
Very Clear / Likely	229 (59.95)	130 (33.94)
Total	382	383
<i>Percentages in parentheses</i>		

B. Wisconsin Focus on Energy – Home Energy Score

The following results are preliminary, focusing on the survey responses collected from the Waterton and Whitewater towns from September 2014 until December 2015. At the end of the implementation period, there were a total of 598 participants, of which 385 were in the control group and 213 in the treatment group.

Survey response rates skewed very heavily towards the treatment group, with a response rate of 93.4% compared to a rate of 23.6% in the control group. As a result, the FoE-HES study suffered from significant internal validity weaknesses, making it impossible to obtain definitive comparative analysis between the treatment and control groups.

However, the survey results do provide useful information about how the homeowners in the participant treatment group perceived the HES.

The participant treatment group was asked a few questions about their view of the HES. Respondents overwhelmingly found the HES easy to understand, accurate, motivational, and useful. (Figure 4 and Table 12.)

Figure 4: Treatment Participants' View of the HES Report

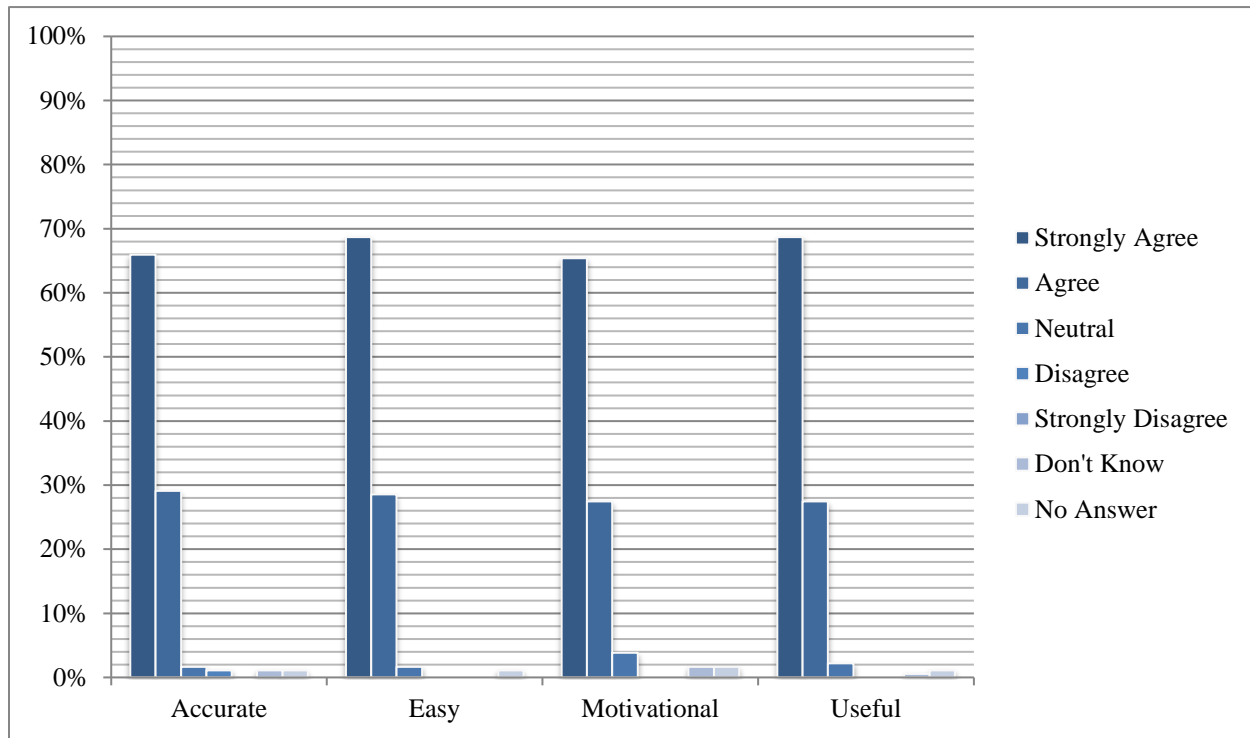


Table 12: Frequency of Treatment Participants' Views of the HES Report

	(1) Accurate	(2) Easy	(3) Motivational	(4) Useful
Strongly Agree	120 (65.93)	125 (68.68)	119 (65.38)	125 (68.68)
Agree	53 (29.12)	52 (28.57)	50 (27.47)	50 (27.47)
Neutral	3 (1.65)	3 (1.65)	7 (3.85)	4 (2.20)
Disagree	2 (1.10)	0 (0.00)	0 (0.00)	0 (0.00)
Strongly Disagree	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Don't Know	2 (1.10)	0 (0.00)	3 (1.65)	1 (0.55)
No Answer	2 (1.10)	2 (1.10)	3 (1.65)	2 (1.10)
Total	182	182	182	182

Note: Percentages in parentheses.

Thirty-nine percent (39.1%) of respondents reported that the HES made them more likely to make an energy efficiency investment within the next 12 months, while 14.5% said it made them less likely to do so. About twenty-one percent (20.7%) reported that the Score made them more likely to make an energy efficiency improvement before selling their home, while 40.2% of respondents said the HES did not change their interest in making energy improvements. (See Table 13.)

Table 13: Treatment Participants' Changes in Attitudes after Receiving HES

	(1) More Likely to Improve EE in Next 12 Months	(2) Less Likely to Improve EE in Next 12 Months	(3) More Likely to Improve EE Before Selling Home	(4) Unchanged Interest in Improving EE
Yes	70 (39.11)	26 (14.53)	37 (20.67)	72 (40.22)
No	109 (60.89)	153 (85.47)	142 (79.33)	107 (59.78)
Total	179	179	179	179

Note: Percentages in parentheses.

When asked what the best part of the visit was, treated respondents generally chose, in order of ranking: free products; the free assessment (HES); learning about energy efficiency programs and incentives; receiving other information or tips; and then taking action to be more energy efficient. (Figure 5 and Table 14.)

Figure 5: Treatment Participants' Ranking of the Best Part of the Appointment

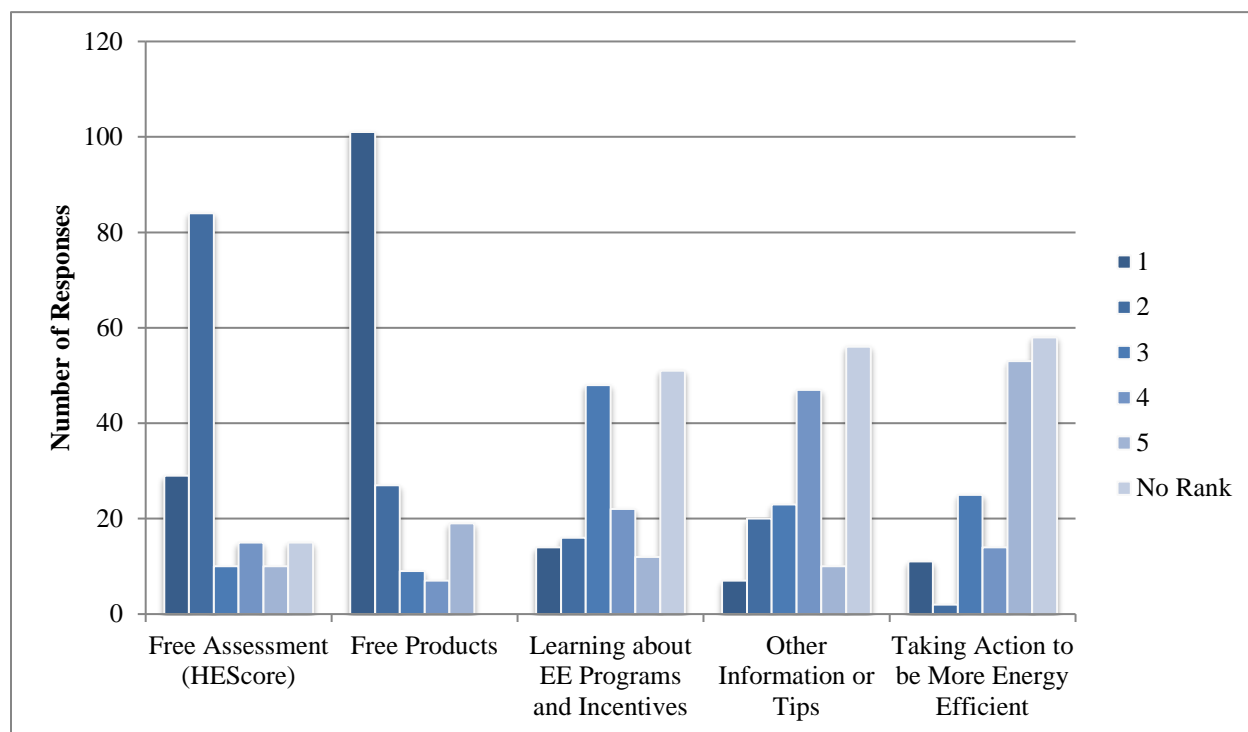


Table 14: Frequency of Treatment Participants' Ranking of the Best Part of the Appointment

	(1) Free Products	(2) Home Energy Score	(3) Learning about Programs and Incentives	(4) Other Information or Tips	(5) Taking Action
Not Ranked	0 (0)	15 (9.20)	51 (31.29)	56 (34.36)	58 (35.58)
1	101 (61.96)	29 (17.79)	14 (8.59)	7 (4.29)	11 (6.75)
2	27 (16.56)	84 (51.53)	16 (9.82)	20 (12.27)	2 (1.23)
3	9 (5.52)	10 (6.14)	48 (29.45)	23 (14.11)	25 (15.34)
4	7 (4.29)	15 (9.20)	22 (13.50)	47 (28.83)	14 (8.59)
5	19 (11.66)	10 (6.14)	12 (7.36)	10 (6.14)	53 (32.52)
Total	163	163	163	163	163

Note: Percentages in parentheses.

When asked which section of the HES report was the most useful, 52% chose the recommendations, 34% chose the score itself, and 14% chose the home facts. All but one of the survey respondents found the appointment time to be the right length. (See Table 15.)

Table 15: Treatment Participants' View of the Most Useful Section of the Home Energy Report

	Count
Home Facts	26 (14.61)
Recommendations	92 (51.69)
Score	60 (33.71)
Observations	178

Note: Percentages in parentheses.

V. Discussion

A. New Jersey Natural Gas – Home Energy Score

The NJNG-HES evaluation study was intended to address four questions aimed at understanding the impact of the HES on residential energy efficiency investment and program participation. The NJNG-HES participants who received the HES during their audit were 14% more likely to sign a release form allowing contractors to contact them about potential home improvement work. There were no statistically significant differences between groups in HPwES conversion rates and project completion rates overall. This suggests that the HES encouraged homeowners to think about moving forward on an investment, but the insignificant conversion and project completion rates indicate that they did not move forward on initiating a project. This may be because the evaluation period was not long enough to capture follow-through actions. The age of the home or the conditioned floor area had little, if any, relationship with the signing of the release form, conversion to the HPwES program, and completion of projects. The results also do not vary according to how participants entered the study.

These results indicate that the HES motivated homeowners to consider an energy efficiency investment but showed no impact on whether they actually did invest, how soon they might make an investment, nor whether it changed the level of their investment in energy efficiency. These were the first three questions of the evaluation study. The fourth question could not be

answered because it asked whether these findings changed if the homeowners were reminded of their scores three months later. The evaluation period did not include a follow-up reminder.

A lower initial Home Energy Score has a small but positive relationship with whether a participant signs a release form, converts to HPwES, and completes an energy efficiency project, regardless of group assignment. A higher predicted jump in HES is positively related to whether a participant signs a release form, converts to the HPwES program, and completes a project. This makes intuitive sense: if the HES is a measure of a home's efficiency, a greater potential for improvement in residential energy efficiency would likely lead to a greater willingness to invest in energy efficiency.

The average predicted jump in HES among all participants (treated and untreated) who signed the release form, converted, and completed a project was slightly over 2 points. This suggests that there may be a threshold of presumed energy efficiency improvement required for a homeowner to decide to make an energy efficiency investment. Additionally, those who converted and those who completed a project had associated increases in HESs of about 2.6, higher than the average increase in HES among those who signed the release form, implying that a certain threshold is necessary for homeowners to want to learn more but the threshold for them to decide to make an investment is higher.

Since the vast majority of the study participants received the audit because they had recently replaced their gas furnace, boiler, and/or water heater, the lack of an impact from an HES may be due to the short-term window evaluated in the study. Although they receive a \$500 rebate, the cost of the new equipment is still substantial, and so the majority of these homeowners are likely to be more unwilling to spend more on additional energy efficiency investments within the timeframe of this study. As a result, this study cannot show whether the HES makes homeowners more likely to invest in energy efficiency. Instead, it tells us primarily about people who have already made a capital outlay on energy efficiency, and whether the HES made them willing to undertake further energy efficiency investments in the future.

In terms of the survey, participants in both groups did not differ in how well they reported understanding the current and potential energy efficiency of their home.

Participants only learned of the HES once during their audit. There were no other points of delivery for the HES: contractors were not informed of homeowners' Scores and could not remind homeowners of their Score or answer any related questions. A homeowner could decide to make another energy improvement to their home immediately after the audit or over a year later, at which point they likely would have forgotten their HES.

1. Limitations

There are a number of methodological limitations to this NJNG-HES research that affect the internal validity of this study, and, as a further consequence, how generalizable the results are. Internally, flaws in implementation meant that not everyone in the treatment group received their HES.

Seventeen (17) of the 101 people who wrote comments on the survey mentioned that they never received their HES. By October 2014, the research and implementation team realized that some assessors were not satisfied with the HES and chose not to show it to the homeowner. This was usually because assessors felt that the potential HES, assuming the homeowner made all the suggested improvements to their home, was still too low or did not change enough (e.g., the home scored a 6 and still received a 6 after assuming the improvements were done) and that customers would be dissatisfied by a poor score. Though this was brought to the attention of NJNG, there is no way to know whether a home truly received the HES. However, most of the comments about not receiving a HES occurred before October 2014. The consequences of this flaw in implementation (a form of experimenter bias) could not be fully assessed.

Additionally, participation in the HPwES program was not random and suffered from self-selection bias which limits the generalization of the study. The study was also conducted over a relatively short period and so is likely unable to capture longer-run impacts.

Another important source of limitation was that if a homeowner chose to install a measure by themselves or with a contractor outside of the New Jersey Natural Gas programs, the data would not include this. The data only includes retrofit measures conducted through New Jersey Natural Gas.

Finally, the survey responses skewed towards the control group. The survey response rate for the treatment group was approximately 17%, while the survey response rate for the control group was approximately 26%.

B. Wisconsin Focus on Energy – Home Energy Score

This section solely focuses on the results of the FoE-HES survey. Survey responses skewed very heavily to the treatment group, with a response rate of 93% compared to a rate of 24% in the control group. As such, these results have limited generalizability even within the study population.

Based on the survey, there were no statistically significant differences in customer satisfaction between the two groups. The control group was more likely to say they had a good idea of how to improve the energy efficiency of their home and that they intended to make an energy efficiency improvement within the next year. However, they cited appliance upgrades as the most cost-effective measure, whereas the treatment group was statistically significantly more

likely to choose insulation, HVAC upgrades, and window treatments. Thirty-nine percent (39.1%) of the treatment group reported that receiving the HES made them more likely to make an energy efficiency investment within the next year, while only 14.5% said it made them less likely to do so.

Almost all of the survey respondents found it easy to understand, useful, accurate, and motivational. Participants who received the Score ranked it second to the free products received during the visit. People identified the recommendations as the most useful part of the report, but also valued the score itself. This suggests that homeowners value the HES Report overall.

1. Limitations

In considering the survey data, there are a number of limitations. The sample is self-selected, since it consists of the homeowners who were the first to respond to a mailing advertising Focus on Energy's Express Energy Efficiency program and agreed to complete the survey. The first people to respond may be those who are more environmentally conscious or interested in making energy efficiency improvements, and those who respond to a survey tend to be an even more selective group. Since randomization was based on when participants called, it is uncertain how random the process ended up being.

Of greater importance is the wide difference in survey response rates between the control group and the treatment group. This was flagged as an issue in early 2015. Upon investigation, it was discovered that the installation technicians, who provided all participants with the voluntary survey during the audit, were encouraging the treatment group to complete the survey much more than they were encouraging the control group. Technicians were told to encourage both groups equally to complete the survey, but the survey completion rates were still 24% for the control group and 93% for the treatment group. This severely limits the internal validity of the experiment and whether the results will be meaningful. The responses collected from the survey may not accurately reflect the views of the participants in the survey. Instead, those who did respond to the survey in the control group may have been driven to do so because they felt more strongly, whether positively or negatively, about their Express Energy Efficiency program experience. As such, no definitive conclusions based on comparisons of treatment vs. control participant groups can be drawn from this evaluation, so none findings and conclusions are not presented.

VI. Conclusions

A. New Jersey Natural Gas – Home Energy Score

This report evaluates the impact of providing homeowners with a HES during an audit, either because the audit was a requirement to be eligible for a NJNG rebate or because the homeowner requested an audit.

Participants who received the HES during their audit were more likely to sign a release form, indicating an interest in learning more about energy efficiency investments. Since most of the participants in the study had just spent thousands of dollars replacing HVAC equipment, this is a very positive suggestion that the HES helps homeowners become more interested in considering further investments in energy efficiency. Since there are no statistically significant differences in beginning or completing additional energy efficiency investments, however, this also implies that providing more information or a useful heuristic is not enough to induce greater adoption of energy efficiency measures. That the average increases in HES among those who converted and completed projects were higher than that among participants who signed a release form suggests that there is some threshold after which homeowners are interested in learning more about energy efficiency, but a higher barrier for them to decide to invest at that time.

A lower initial HES has a small but negative relationship with whether a participant signs a release form, converts to HPwES, and completes an energy efficiency project. This statistically significant finding suggests that homeowners who may have more to gain from an energy efficiency upgrade are more likely to undertake that investment. To achieve greater gains from the HES, it may be beneficial to target homeowners with lower initial HES.

The results of this study are positive, suggesting that the HES can be a useful tool in helping homeowners understand and make energy efficiency decisions. Homeowners only received the HES once, after the vast majority of participants had just replaced their gas furnaces, boilers, and/or water heaters, yet still were more likely to sign a release form. To further explore the impact of the HES, NJNG is exploring the possibility of adding an additional phase of the study, where homeowners in the treatment group are reminded of their HESs several months after their initial audit and capital outlay.

B. Wisconsin Focus on Energy – Home Energy Score

Due to the large disparity in response rates between the treatment and control groups and the resulting validity problems this created in implementing the study, the study cannot provide any definitive conclusions on the impact of HES on FoE participants. However, the results of the FoE-HES survey suggest that homeowners do value the HES and appreciate the additional information it offers. It does not seem to negatively impact satisfaction rates. Thus, the HES may

be a useful tool for homeowners to better understand their home's energy efficiency and what measures could be cost-effective.

This study shows the importance of data collection procedures and treating the control group and the treatment group exactly the same. In this case, this resulted in highly disparate survey response rates, severely limiting the internal validity of the study and the ability of the study to answer the research questions. The extra effort exerted by the installation technicians that led to higher survey completion rates in the treatment group may have otherwise impacted those participants: the technicians may have been more attentive, provided more information, spent more time helping participants understand the efficiency of their home, or otherwise acted in a fashion that could have positively affected a treatment participant's willingness to invest. Thus, the differences found between groups cannot be attributed to the HES.

VII. Recommendations

There are three recommendations, based on the lessons learned from the NJNG-HES and FoE-HES studies.

1. To conduct a rigorous evaluation of any program, including the HES program, requires adherence to careful research design methodology so that the results reflect the impact of the program. The evaluation methodology should be designed before the program is implemented and the data gathering requirements be made a crucial part of the implementation.
2. Future evaluations of the HES should be conducted from start to finish by an independent evaluator experienced in running randomized controlled trials. It should be the independent evaluator who determines the sample population and randomization method and oversees the collection of data, in addition to performing analysis and reporting. In these two studies, NJNG staff and FoE staff, respectively, performed the population sampling population and randomization and oversaw the collection of survey data. The data was delivered to E2e evaluators for analysis and reporting. This disjointed development and implementation of the RCT studies created challenges and problems for the studies. An experienced evaluator should be responsible for all aspects of an evaluation study, from design through to data collection, analysis, and reporting.
3. To truly understand the full impact of the HES, the evaluation must be done over a longer period, with surveys done at longer intervals to try and understand the long-term impacts of the HES.

References

- Allcott, Hunt and Michael Greenstone. 2012. “Is There an Energy Efficiency Gap?” *Journal of Economic Perspectives*, 26(1): 3-28.
- Allcott, Hunt and Dmitry Taubinsky. 2015. “Evaluating Behaviorally-Motivated Policy: Experimental Evidence from the Lightbulb Market.” *American Economic Review*, 105(8): 2501-2538.
- Allcott, Hunt, and Todd Rogers. 2014. “The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation.” *American Economic Review*, 104(10): 3003-37.
- Barbose, Galen L., Charles A. Goldman, Ian M. Hoffman, and Megan A. Billingsley. 2013. “The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025.” Lawrence Berkeley National Laboratory.
- Davis, Lucas, and Gilbert Metcalf. 2016. “Does Better Information Lead to Better Choices? Evidence from Energy-Efficiency Labels.” *Journal of the Association of Environmental and Resource Economists*, 3(3): 589-625.
- Gillingham, Kenneth, David Rapson, and Gernot Wagner. 2016. “The Rebound Effect and Energy Efficiency Policy.” *Review of Environmental Economics & Policy*, 10(1): 68-88.
- Gillingham, Kenneth, Richard Newell and Karen Palmer. 2009. “Energy Efficiency Economics and Policy.” *Annual Review of Resource Economics*, Annual Reviews 1(1): 597-620.
- Glickman, Joan, Patty Kappaz, and Gannate Khowailed, 2014, “What’s the Score? Lessons Learned from the U.S. Department of Energy’s Home Energy Score,” ACEEE Summer Study on Energy Efficiency in Buildings.
- Houde, Sébastien. 2018. “How Consumers Respond to Environmental Certification and the Value of Energy Information.” *The RAND Journal of Economics*, 49(2): 453-477.
- International Energy Agency. 2011. “World Energy Outlook.” (available at: https://www.iea.org/publications/freepublications/publication/WEO2011_WEB.pdf)
- International Energy Agency. 2012. “World Energy Outlook.” (available at: http://www.iea.org/publications/freepublications/publication/WEO2012_free.pdf)
- McKinsey & Company. 2009. “Unlocking Energy Efficiency in the U.S. Economy.” McKinsey & Company. (available at: http://www.mckinsey.com/~media/mckinsey/dotcom/client_service/epng/pdfs/unlocking%20energy%20efficiency/us_energy_efficiency_full_report.ashx)

Appendix I. New Jersey Natural Gas

1. Surveys

The follow-up survey for participants in the control group is below:



Homeowners Survey for NJNG In-Home Energy Audit

1. Do you have a clear understanding of the rebates and incentives available from NJNG should you want to make additional energy efficiency upgrades?

- ☐ Very clear ☐ Somewhat clear ☐ Neutral ☐ Somewhat unclear ☐ Very unclear

2. Do you have a clear understanding of how energy efficient your home currently is and its future potential?

- ☐ Very clear ☐ Somewhat clear ☐ Neutral ☐ Somewhat unclear ☐ Very unclear

3. How satisfied are you with your overall home energy audit experience?

- ☐ Very satisfied ☐ Somewhat satisfied ☐ Neutral ☐ Dissatisfied somewhat ☐ Very dissatisfied

4. What other information would you like to receive as part of your home energy audit?

Done

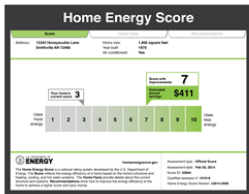
Powered by [SurveyMonkey](#)
Check out our [sample surveys](#) and create your own now!

The follow-up survey for participants in the treatment group is below:



Homeowners Survey for NJNG In-Home Energy Audit

Sample Home Energy Score



1. Do you have a clear understanding of your Home Energy Score and what it means?

- ☐ Very clear ☐ Somewhat clear ☐ Neutral ☐ Somewhat unclear ☐ Very unclear

2. How likely will the Home Energy Score encourage you to make additional investments in your home's energy efficiency?

- ☐ Very likely ☐ Somewhat likely ☐ Neutral ☐ Somewhat unlikely ☐ Very unlikely

3. Do you have a clear understanding of the rebates and incentives available from NJNG should you want to make additional energy efficiency upgrades?

- ☐ Very clear ☐ Somewhat clear ☐ Neutral ☐ Somewhat unclear ☐ Very unclear

4. Do you have a clear understanding of how energy efficient your home currently is and its future potential?

- ☐ Very clear ☐ Somewhat clear ☐ Neutral ☐ Somewhat unclear ☐ Very unclear

5. How satisfied are you with your overall home energy audit experience?

- ☐ Very satisfied ☐ Somewhat satisfied ☐ Neutral ☐ Dissatisfied somewhat ☐ Very dissatisfied

6. What other information would you like to receive as part of your home energy audit?

2. NJNG Release Form

The following is the release form used by New Jersey Natural Gas, which authorizes New Jersey Natural Gas to provide contractors with the customer's contact information.

Take the Next Step Toward Greater Energy Performance, Comfort and Savings!

Authorization for Release of Information

Customer authorization for New Jersey Natural Gas Company (NJNG) to release customer name, address, telephone number and e-mail address (e-mail address will be provided only if set forth below to Building Performance Institute (BPI) certified contractors.



I hereby request and authorize NJNG to release my name, address, telephone number, e-mail address (release of e-mail address is optional – it will be released only if I list my e-mail address below) and Home Energy Score* to BPI-certified contractors operating in my area solely for the purpose of contacting me about additional opportunities to save energy in my home through HPwES of New Jersey's Clean Energy Program™.

I certify that I am the owner of the premises listed below and fully authorized to execute this release. I also understand that I may cancel this authorization at any time by submitting a written request to NJNG. This authorization is valid until terminated by me in writing.

I understand and agree to the terms (listed above) of this authorization. I hereby release NJNG from all claims and liabilities arising from or connected with NJNG providing this information to the BPI-certified contractors.

Customer Signature _____

Customer Printed Name _____

Customer Address _____

City _____ Zip _____

Phone _____

E-mail (optional) _____

*The Home Energy Score is provided by the Department of Energy to help homeowners understand how much energy a home is expected to use and provides suggestions for improving its energy efficiency. It also allows homeowners to compare the energy performance of their homes to other homes nationwide.

Your Home Energy Score

Current score: _____ Score with proposed energy improvements: _____

Visit energy.gov/eere/buildings/home-energy-score for more information.

NJNG does not endorse or recommend any particular contractor. Contractors are not employees or agents of NJNG and will perform work according to their own means and methods of work, and are not subject to the control or supervision of NJNG. If you have any questions please contact The SAVEGREEN Project at 877-455-NJNG (6564).



877-455-NJNG (6564) www.savegreenproject.com

Appendix II. Wisconsin Focus on Energy

1. Surveys

Control Group Survey

Focus on Energy Customer Feedback						
1. Site ID: <input type="text"/>						
As a valued Focus on Energy participant, your opinion matters to us. Please take a moment to complete our survey. Thank you for your feedback!						
1. How did you hear about Focus on Energy						
<input type="radio"/> Direct Mail Letter						
<input type="radio"/> Internet						
<input type="radio"/> Newspaper						
<input type="radio"/> Community Association						
<input type="radio"/> Word of Mouth						
<input type="radio"/> Other						
Other (please specify) <input type="text"/>						
2. Please rate Focus on Energy on the following:						
	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	N/A
Overall satisfaction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Variety of services offered	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ease of participation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Website ease of use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I would like to improve the energy efficiency of my home:						
<input type="radio"/> Yes						
<input type="radio"/> No						
4. I have a good idea of how to improve the energy efficiency of my home:						
<input type="radio"/> Agree						
<input type="radio"/> Disagree						

Focus on Energy Customer Feedback

5. I intend to improve the energy efficiency of my home in the next 12 months:

- ☐ Agree
- ☐ Disagree

6. The most cost-effective way that I could improve the energy efficiency of my home is:

- ☐ Add insulation
- ☐ Replace windows
- ☐ HVAC upgrade
- ☐ Appliance upgrade

7. Additional comments

Focus on Energy Customer Feedback

1. Site ID:

As a valued Focus on Energy participant, your opinion matters to us. Please take a moment to complete our survey. Thank you for your feedback!

1. How did you hear about Focus on Energy

- ☐ Direct Mail Letter
- ☐ Internet
- ☐ Newspaper
- ☐ Community Association
- ☐ Word of Mouth
- ☐ Other

Other (please specify)

2. Please rate Focus on Energy on the following:

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied	N/A
Overall satisfaction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Variety of services offered	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ease of participation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Website ease of use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of service	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. I would like to improve the energy efficiency of my home:

- ☐ Yes
- ☐ No

4. I have a good idea of how to improve the energy efficiency of my home:

- ☐ Agree
- ☐ Disagree

Focus on Energy Customer Feedback

4. The best part of the appointment? (Please RANK in order of 1 - 5; where 1 is the best and 5 is your least favorite):

<input type="text"/>	Free assessment (Home Energy Score)
<input type="text"/>	Free energy saving products
<input type="text"/>	Learning about energy efficiency programs & incentives
<input type="text"/>	Other information or tips provided by the Focus on Energy representative
<input type="text"/>	Taking action to be more energy efficient

5. The appointment time was:

- ☐ Too long
- ☐ Just right
- ☐ Too short

6. Additional comments

DOE/EE Publication Number: 1864