

SOCIAL MARKETING FOR RESIDENTIAL ENERGY EFFICIENCY:  
MOTIVATIONS AND BARRIERS RELATING TO HOME IMPROVEMENTS  
IN THE PUGET SOUND REGION

by

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## ABSTRACT

### Social Marketing for Residential Energy Efficiency: Motivations and Barriers Relating to Home Improvements in the Puget Sound Region

Jana Fischback

Increasing residential energy efficiency through home energy audits and upgrades is a relatively easy and inexpensive way to reduce greenhouse gas emissions and reduce energy consumption. However, only a small percent of homeowners have audits and many of those don't result in homeowners investing in upgrades. Social marketing uses the tools of traditional marketing to foster behavior change that is good for both an individual and society as a whole. It has been identified as one method to encourage homeowners to increase their house's efficiency. This study surveyed nearly 300 homeowners in the Puget Sound region of Washington State who had home energy audits through a non-profit organization called Sustainable Works within the last three years. The goal of this research was to determine barriers and motivations for investing in energy efficiency upgrades. Identifying these barriers and motivations is an important step in a social marketing campaign. Multiple motivational factors for participants were identified as important, the most common being the desire to save money on energy bills, followed by reducing carbon footprint. No significant differences were found in demographic factors between those who invested in upgrades and those who did not. In addition to those who participated in the SustainableWorks and those who did not invest in upgrades, a third group of homeowners who implemented recommended upgrades but not through SustainableWorks was identified. In fact, over 50% of those previously identified as "non-participants" actually did implement upgrades outside of the program, either on their own as a do-it-yourself project or through an outside contractor. The most commonly reported barrier for all groups was concern about affording the initial payment or project. In addition, though none of the other 12 potential barriers were commonly reported as important for all three groups, some useful distinctions were found. In particular, both the non-participant group and the 'DIY/outside contractor group' were likely to agree that they did not want SustainableWorks as a contractor. Members of the DIY/outside contractor group were also likely to be concerned about the length of the payback period. These findings can inform future social marketing campaigns and highlight where more research needs to be done.



## Table of Contents

List of Figures.....	v
List of Tables.....	vi
Acknowledgements.....	vii
Chapter 1: Introduction.....	1
Chapter 2: Literature Review.....	9
Chapter 3: Methods.....	37
Chapter 4: Results & Discussion.....	47
Chapter 5: Conclusion.....	82
Appendices	
Appendix A: Participant Survey.....	84
Appendix B: Non-Participant Survey.....	94
Appendix C: Survey Respondent Demographic Information.....	95
Appendix D: Example of Energy Performance Score Report.....	96
Appendix E: Example of Quote from SustainableWorks.....	112
Bibliography.....	116

## List of Figures

Figure 1. End-use of energy consumption in Washington State.....	4
Figure 2. Achievable carbon emissions reduction from household actions.....	17
Figure 3. Example of Likert-type Barrier Question.....	42
Figure 4. Example of Likert-type Benefit Question.....	42
Figure 5. Example of Likert-type Conditions Question.....	42
Figure 6. How Participants Overcame Barriers Question.....	43
Figure 7. Participants' Barriers to Investing in Upgrades.....	54
Figure 8. DIY/Outside Contractors Group Barriers to Investing in Upgrades.....	56
Figure 9. Non-Participants' Barriers to Investing in Upgrades. ....	57
Figure 10. Ordination Graph of the Three Groups' Barriers.....	56
Figure 11. Barrier of Affordability of Project or Initial Payment.....	61
Figure 12. Barrier of concern about payback period.....	62
Figure 13. Barrier of concern about SustainableWorks' pricing being too expensive.....	63
Figure 14. Barrier of concern about return-on-investment.....	64
Figure 15. Barrier of concern about resale value.....	64
Figure 16. Barrier of not wanting SustainableWorks to act as the general contractor.....	65
Figure 17. Barrier of concern about inconvenience.....	66
Figure 18. Barrier of concern about disagreeing with recommendations.....	67
Figure 19. Barrier of concern about not being convinced of benefits.....	67
Figure 20. Barrier of the audit not being what the homeowner expected.....	68
Figure 21. Barrier of not being interested in deep upgrades.....	68
Figure 22. Barrier of believing that the auditor was not thorough.....	69
Figure 23. Barrier of concern about moving soon.....	70
Figure 24. Participants' Methods of Overcoming Barriers.....	71
Figure 25. Decreasing cost to encourage participation.....	72
Figure 26. More information about how to pay to encourage participation.....	73
Figure 27. More information about how ROI/Payback period.....	73

Figure 28. Conditions to Help DIY/Outside Contractor Group to Invest in Upgrades.....75  
Figure 29. Conditions to Help Non-Participants Invest in Upgrades.....76

**List of Tables**

Table 1. Participant’s Motivational Factors.....51  
Table 2. Comparison of Most Common Barriers Across the Three Groups.....59  
Table 3. Conditions to Encourage Non-Participant and DIY/Outside Contractor.....74

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## **Chapter One: Introduction**

Concern surrounding residential energy efficiency is not new. Research on how to improve the efficiency of homes began over four decades ago with the energy crisis of the 1970s. However, the dominant concern has shifted from a problem of supply, to the issue of climate change. The benefits of increasing energy efficiency, no matter what the motivator, have long been known. Now this research from the previous energy crisis must be re-framed into the current issues we face today.

Because the primary way to increase energy efficiency in homes is through homeowners investing in upgrades, there is a history of research focused on how to influence behavior change in this area. This behavior change is sometimes encouraged through concepts and tools from the area of social marketing, which is explained in the next chapter.

Improving energy efficiency in homes offers multiple benefits, both for the homeowner and society. For the individuals living in a home, improving weatherization, upgrading inefficient heating, ventilation and air conditioning (HVAC) systems or installing insulation often provides significant cost savings and increases the home's comfort. Reducing the amount of energy consumed also has societal and environmental benefits, no matter how that energy is produced. If the home is heated by natural gas, oil, or electricity produced from fossil fuels such as coal, there is the clear benefit of reducing greenhouse gas (GHG) emissions.

In Washington State, 53% of homes are heated with electricity and 33% are heated with natural gas (U.S. Department of Energy). This is inverted in comparison to residential heating for the whole country, in which 30% of homes are heated with

electricity and 51% are heated with natural gas (U.S. Department of Energy). Heating and cooling account for over half of an average home's energy use, with electricity for appliances and electronic devices accounting for about only 15% and lighting about 13% (U.S. Department of Energy; U.S. Energy Information Administration). This illustrates that improving HVAC efficiency and reducing loss of heat in a home through weatherization and insulation is a primary concern related to residential energy efficiency. From an emissions standpoint, because the electricity in Washington State comes primarily from clean hydropower, it makes sense to focus on improving the efficiency of HVAC systems that use natural gas or oil, and improving insulation to reduce the consumption of these fossil fuels.

However, even if the home is heated with electricity from a "clean" source such as hydropower, reducing energy consumption still provides benefits unrelated to carbon emissions. Increasing efficiency in homes will be important as the world's population grows and the demand for energy increases.

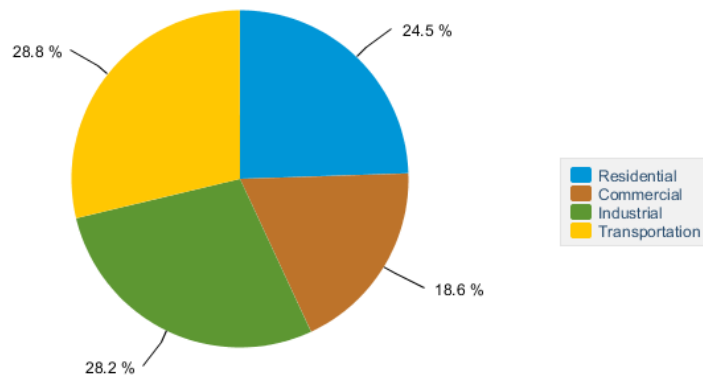
For example, reducing energy consumption of heating systems allows that energy to be used in other areas that are increasing in demand, such as the charging of electronic devices in the home or plug-in electric vehicles in the garage. The increase of electric and plug-in hybrid vehicles is expected to have serious implications for the electric grid, especially if many people charge during peak hours during the day (Hadley, 2006). Even though efficiency of traditional appliances has slightly improved, there has been major growth in various technological devices such as consumer electronics (International Energy Agency, 2009). An additional concern is that people are spending more time inside buildings than they used to, which causes

an increase in the need for lighting, heating or cooling, and use of appliances and electronics. Although new houses are much more energy efficient than older ones, the retrofitting of older houses is necessary to make an impact in the residential sector, as many houses last for 100 or more years.

### **Greenhouse Gas Emissions from the Residential Sector in Washington State**

Since the majority of Washington's electricity is produced by non-polluting hydropower, the emissions for the residential sector come primarily from those homes that burn natural gas for home and water heating. Even though energy consumption from the residential sector equals almost a quarter of total energy consumption in Washington (24.5%), the emissions from residential heating alone equal only 5% of Washington's GHG emissions at 5.2 million metric tons of carbon dioxide (MMtCO<sub>2</sub>e) (U.S. Energy Information Administration, 2011; Sandlin, 2010). However, GHGs from the residential sector are greater than Washington's waste management (3.8MMtCO<sub>2</sub>) and fossil fuel industry (0.7 MMtCO<sub>2</sub>) and nearly the same as emissions from agriculture (5.9 MMtCO<sub>2</sub>) and industrial processes (5.6 MMtCO<sub>2</sub>).

### Washington Energy Consumption by End-Use Sector, 2011



 Source: Energy Information Administration, State Energy Data System

Figure 1. End-use of energy consumption in Washington State. Source: EIA.

The reduction potential by increasing home energy efficiency is significant because the measures necessary to reduce these emissions are relatively inexpensive and easy to implement in comparison to the expensive cost of implementing energy efficiency measures in other sectors. For example, retrofitting older homes is more affordable than replacing Washington’s car fleet with electric vehicles. As climate change becomes an increasingly crucial global issue, governments, organizations and concerned citizens are examining all aspects of the production of anthropogenic greenhouse gas emissions in order to identify areas where we can quickly and easily reduce our impact on Earth’s climate.

### The Community Energy Efficiency Program (CEEP) in Washington State

In 2009, the Washington State University Energy Program was directed by the Washington State Legislature to create the Community Energy Efficiency Program (CEEP) to fund programs that would provide residential and commercial energy efficiency upgrades. This was funded through the American Recovery and



Reinvestment Act of 2009. Eight projects or organizations were selected, including the non-profit organization SustainableWorks. SustainableWorks has been performing home energy audits and acting as a general contractor to complete retrofit work since 2009. It currently operates in King, Pierce, Snohomish and Spokane Counties and is primarily funded through city, county, and state funding (L. Spencer, Personal Conversation, May 12<sup>th</sup>, 2014).

The organization uses a community-organizing model to encourage residents to have home energy audits conducted. These audits are heavily subsidized to encourage participation. After the audit, the homeowner receives a thorough consultation that includes a prioritized list of improvements that can be made to increase energy efficiency in the home (see Appendices D and E). To help with financing their suggested improvements, SustainableWorks offers homeowners added rebates in addition to the rebates and incentives that local utilities provide. Also, the organization has partnered with a local credit union to provide easy access to financing. The organization focuses on homeowners in the middle income bracket, based on the assumption that households with income less than this are able to qualify for a separate program outside of SustainableWorks, and that those with higher incomes are more likely to be able to afford energy efficiency upgrades with less financial assistance.

Despite the many incentives that they offer, approximately 70% of homeowners who have had energy audits fail to move forward with investing in improvements through SustainableWorks' program (Personal conversation with L. Spencer, April 24, 2014). However, one conclusion of this study is that SustainableWorks might

underestimate the amount of retrofit work that is done after their home energy audits. Of those who didn't use SustainableWorks as a contractor, my research found that 53% actually do invest in upgrades, whether through another contractor or doing it themselves. As of April 2014, 2955 audits had been conducted, resulting in 946 homes being retrofitted in the State of Washington through SustainableWorks (Personal conversation with L. Spencer, April 24, 2014).

## **Conclusion**

Improvements in efficiency by homeowners should be made in order to reduce GHGs and alleviate competing demand for energy. These improvements are often relatively easy and inexpensive compared to other methods of reducing emissions. Though emissions from homes are less than those from transportation, residential energy consumption creates significant enough emissions to have an impact. Along with emissions reductions, other benefits of residential energy reduction include accommodating a growing population and allowing more energy to be used for growing demand such as consumer electronics and plug-in electric vehicles.

The primary purpose of this research is to discover the specific motivations for and barriers to homeowners having retrofit work done in order to increase their home's energy efficiency. This is a crucial step in designing a community-based social marketing campaign, which may be implemented by SustainableWorks in the Tacoma-Pierce County area in the summer of 2014, following the results of this study. The field of social marketing uses traditional marketing principles to influence the behavior of a target audience, with the primary goal of benefiting not only the

individual through this behavior change, but also society as a whole. Social marketing campaigns attempt to do this by selecting a specific behavior to change, identifying barriers to and motivations for the behavior, and developing strategies to reduce barriers and increase benefits.

The only factor that was commonly rated as an important barrier was the affordability of the project or initial payment. There were no statistically significant differences found in the reported barriers among the three groups of respondents (those who invested in upgrades through SustainableWorks, those who took a do-it-yourself approach or used an outside contractor, and those who made no upgrades). SustainableWorks participants' methods of overcoming barriers were found to be in line with the barriers that were identified as most important. The most common method cited was qualifying for financial incentives.

The majority (78%) of the nine motivational factors provided for the respondents were most commonly rated as agree or strongly agree that they were motivational indeed. This variety of motivators illustrates the multiple angles that can be taken when encouraging homeowners to invest in upgrades. In addition, though financial aspects are a common concern when considering investing, they were also rated as highly motivational, such as in saving money on energy bills and upgrading energy efficiency as a good financial investment.

Another goal of this research was to identify any demographic factors that may influence whether or not a homeowner was likely to invest in energy efficiency upgrades through the SustainableWorks program. This study found that no factors

such as higher income, level of education, homeowner age or house size were shown to have a statistically significant influence.

As mentioned before, while a large portion of homeowners who have audits do not move forward with using SustainableWorks as the general contractor, a good portion of them do end up carrying out some of the recommended work.

The results can help researchers to better understand the complicated issues that homeowners face when considering improving the energy efficiency of their home, and the importance of increasing the benefits and removing the barriers.

### **Outline of this Report**

The report begins with a literature review of research relevant to homeowner's behaviors related to investing in energy efficiency and to the methods of social marketing to influence those behaviors. This is followed by a thorough description of the methods, including the survey procedures and statistical analysis, and the reasoning for the chosen methods of analysis. Finally, results are stated and discussed.

## **Chapter Two: Literature Review**

### **Introduction**

The following chapter will begin with a discussion of social marketing and the steps in a community-based social marketing campaign. I then provide a review of the relevant studies from fields including sociology, social- and environmental- psychology, behavior science and communication that examine behaviors specifically related to household energy consumption and efficiency. The section concludes with a review of a recent focus group designed to discover Washington State homeowners' attitudes about home energy efficiency upgrades.

### **Social Marketing**

Simply put, social marketing is the use of marketing for social good. The end goal of social marketing is not to change attitudes or raise awareness about an issue; the goal is to influence behavior. Towards this goal, it has proven to be more effective than traditional methods such as informational campaigns or financial incentives alone (McKenzie-Mohr, 2000). Social marketing does this through a systematic process that uses marketing principles by focusing on a specific target audience. Instead of using marketing to benefit an organization or company, however, the primary beneficiary of social marketing campaigns is society (Lee & Kotler, 2011; McKenzie-Mohr, 2000). According to Andreasen (2006), "greater social welfare comes about only through individual behaviors" and the power of marketing can be used to promote social good beyond just the marketplace.

The term “social marketing” was coined by Kotler and Zaltman (1971) in the early 1970s in the *Journal of Marketing* as a way to use traditional marketing methods, including the four P’s (product, price, place and promotion), as a way to “influence the acceptability of social ideas.” The field continued to grow and evolve throughout the next few decades. Andreasen (1994) formed an updated definition in 1994 that expanded to include the idea that the essence of social marketing was not focused on changing ideas but on influencing behavior.

In 1999, Doug McKenzie-Mohr provided an introduction into “community-based social marketing” (CBSM) that listed the steps to a pragmatic approach including: 1) selecting the behavior to be promoted, 2) identifying barriers and benefits that are associated with this behavior, 3) designing a strategy the uses behavior-change tools to minimize barriers and maximize benefits, 4) piloting the strategy and 5) evaluating its impact on the program once implemented broadly. The CBSM approach is based on research in social psychology, which has found that programs are often most effective at changing behavior when they are done at the community level and involve face-to-face contact with people (Lee & Kotler, 2011; McKenzie-Mohr, 2011).

## **Steps to a Community-based Social Marketing Campaign**

### 1. Selecting the desired behavior and target audience

When choosing what behavior needs to be changed, one should study an action that can significantly improve environmental quality (Steg & Vlek, 2009). As discussed in the previous section, residential energy efficiency is an area with many

opportunities to reduce greenhouse gas emissions and conserve energy for other uses and growing population.

According to Lee and Kotler (2011), since different groups of people will have different barriers and benefits, a campaign should focus on a target audience. They state that what interests one individual may not appeal to another. Dividing the market into segments allows the efforts and resources of the social marketing campaign to be concentrated on a group, so the tools can be uniquely designed to appeal to that group's benefits, barriers and competition. The target audience that is chosen includes those most likely to make the desired behavior change (Lee & Kotler, 2011).

In a study that attempted to predict the adoption of changes related to home energy use, Archer et al. (1987) conducted a survey of California households and identified primary variables that may predict a person's likelihood of investing in energy efficiency. These variables included people with higher disposable income, those who own their homes, and those who have home repair skills or knowledge. Also participants who sought information about energy conservation and thus were more knowledgeable about their options and those who believed the United States' energy crisis was worsening were more likely to invest in energy efficiency measures (Archer et al., 1987). Costanzo, Archer, Aronson and Pettigrew (1986) stated that by focusing efforts on households that meet these criteria, the success of the program will likely be increased. Similarly, in a study of nearly 500 Massachusetts electricity customers, Black, Stern and Elworth (1985) found that the strongest influence on the likelihood of major investments in energy efficiency was homeownership. Also

significant was the belief that the homeowner would have personal benefits from the increase in efficiency. Income was found to have only an indirect effect on investment, through the variable of homeownership (Black et al., 1985).

The characteristics of the actual home are important as well. Gamtessa (2012) found that homes that had more potential savings were more likely to be retrofitted in Canada. Potential energy savings are often related to the age of a home. In this study, homes built before 1991 had a higher probability of being retrofitted. This was also found to be true by Ferguson (1993), whose study found that in regards to installing insulation, the age of the home was a stronger predictor of participation than socio-demographic factors. Therefore, homeowners in older homes who anticipate large energy savings may be more likely to be motivated to have a home energy audit completed and possibly invest in efficiency measures (Gamtessa, 2012).

## 2. Identifying Barriers and Benefits

In order to encourage the desired behavior, practitioners must identify benefits that motivate homeowners to act, and barriers that are inhibiting the desired behavior. These can be identified using literature reviews, focus groups, and surveys.

According to Lee and Kotler (2011), “benefits” are what your target audience needs or wants. These are the potential values that the desired behavior will provide to the audience, and what motivates them to act. One of the goals of a social marketing campaign is to increase the benefits that matter to your audience in an attempt to move them to action (Lee & Kotler, 2011). It is crucial to ask the specific audience to identify the benefits, rather than making assumptions, because if the campaign focuses on motivational factors that are not relevant to the audience, it will



likely not be a success. For example, if reducing their carbon footprint motivates few homeowners, implementing a campaign that focuses on the positive environmental effects of reduced energy use would not encourage them to invest in home energy efficiency improvements.

Barriers to an action can be internal or external, and like benefits, they can vary for different audiences. In contrast to informational campaigns, social marketing campaigns attempt to reduce or remove as many barriers as possible. Because barriers are specific to certain behavior, a strategy for overcoming them can only be developed after they are revealed.

There are significant pressures to skip the important step of identifying barriers. These include planners believing that they already know the barriers, being short on time to research the barriers, and financial constraints (McKenzie-Mohr, 2000). However, identifying barriers is a critical step in creating a social marketing strategy. To identify benefits and barriers for a specific behavior, McKenzie-Mohr, Lee, Schultz and Kotler (2011) recommends taking these steps:

- 1) Perform a literature review on existing articles and reports
- 2) Gather qualitative data through methods such as interviews and focus groups
- 3) Survey a random sample within the target audience
- 4) Analyze using descriptive and multivariate statistics to identify who is doing the activity and who is not, what are the factors that distinguish the two groups and what is the relative importance of these factors

### 3. Developing Strategies

Multiple tools have been developed by social scientists to encourage behavior change. These include asking for a commitment to change, using the influence of social norms, using prompts to serve as reminders at the time the behavior takes place, and offering personalized feedback (Abrahamse, Steg, Vlek, Rothengatter, 2007; McKenzie-Mohr, 2011). Community-based social marketing uses the additional strategy of integrating the project into the community through community-based events and meetings, local media coverage and partnering with local organizations (Kennedy, Parker, Scott & Rowlands, 2000).

Combinations of appeals that include information, financial incentives, social norms, and increased convenience have been proven to have a greater effect on behavior compared to one or two interventions alone. This is true in part because different households have different barriers to taking action. There are also several separate barriers to any pro-environmental behavior (Dietz & Stern, 2002; Dietz, Gardner, Gilligan, Stern & Vandenberg, 2009; Gardner & Stern, 2002). By supplementing financial incentives with other benefits such as convenience and quality assurance, programs can reduce nonfinancial costs such as time, while at the same time reducing financial costs (Dietz et al. 2009).

The following section provides an explanation of the importance of behavior change in residential energy efficiency, and is followed by several methods that have been proven to be effective devices to influence behavior change, especially when used in combination. Tools related to curtailment behaviors, such as goal setting, commitment, and tailored feedback have been proven effective but are not listed here

because they do not directly relate to investing in energy efficiency upgrades (Abrahamse et al., 2007).

#### 4. – 5. Pilot, Implement & Evaluate the Campaign

Once strategies have been developed based on the specific audience and combination of barriers and benefits, it is important to pilot a program to identify any problems that might arise before a broad-scale program is put into action. Pilots should never include elements that are too expensive or difficult to include in the final program (McKenzie-Mohr, 2011).

After the program has been implemented, it is crucial to appropriately evaluate it. Most organizations only quickly summarize the program's success in the number of audits or retrofits completed, how much energy use was reduced, or the cost effectiveness of the program. In order to provide an opportunity for improvement for future studies, evaluations should also include the various social, behavioral and organizational variables in the program's design and implementation (Stern, 1992). This will offer other researchers and practitioners valuable information on how to design and conduct future programs.

#### **Importance of Behavior Change for Residential Energy Efficiency**

Attempting to influence household energy consumption behaviors has some advantages over the multiple proposed options for addressing climate change and energy independence. Changing household behavior is often less costly when compared to the price of developing new technologies to reduce greenhouse gas emissions (Allcott & Mullainathan, 2010). Dietz et al. (2009) also states that behavior

change is something that can take place almost immediately, rather than waiting for policies such as cap-and-trade programs to be implemented or for new technologies to be mass marketed. Another benefit of these short-term actions is the “demonstration effect” of individuals being able to see their impact and the impact of others. These individual actions also “buy time” while new energy-saving technologies and policies are being developed (Dietz et al., 2009).

With these advantages in mind, Dietz et al. (2009) produced a list of 17 actions that households can take now to reduce emissions at a relatively low cost with no loss of quality of life (see Figure 2). These include one-time investments related to weatherization, such as attic insulation or sealing drafts, and replacing inefficient HVAC equipment. From the authors’ calculations of “reasonably achievable emissions reduction,” if nearly all households in America took these steps to improve energy efficiency in their homes, almost 50 million metric tons of carbon per year would be saved within 10 years. Based on empirical studies of responses to interventions, the estimated percentage of homeowners that will adopt the actions when presented with the most effective interventions is approximately 80% according to Dietz et al. (2009). This is equivalent to avoiding the carbon dioxide emissions from approximately 37.4 million passenger vehicles annually (EPA, 2013). In addition, these emissions reductions can be quickly and rather inexpensively achieved.

Behavior change	Category*	Potential emissions reduction (MtC) <sup>†</sup>	Behavioral plasticity (%) <sup>‡</sup>	RAER (MtC) <sup>§</sup>	RAER (%/H) <sup>§</sup>
Weatherization	W	25.2	90	21.2	3.39
HVAC equipment	W	12.2	80	10.7	1.72
Low-flow showerheads	E	1.4	80	1.1	0.18
Efficient water heater	E	6.7	80	5.4	0.86
Appliances	E	14.7	80	11.7	1.87
Low rolling resistance tires	E	7.4	80	6.5	1.05
Fuel-efficient vehicle	E	56.3	50	31.4	5.02
Change HVAC air filters	M	8.7	30	3.7	0.59
Tune up AC	M	3.0	30	1.4	0.22
Routine auto maintenance	M	8.6	30	4.1	0.66
Laundry temperature	A	0.5	35	0.2	0.04
Water heater temperature	A	2.9	35	1.0	0.17
Standby electricity	D	9.2	35	3.2	0.52
Thermostat setbacks	D	10.1	35	4.5	0.71
Line drying	D	6.0	35	2.2	0.35
Driving behavior	D	24.1	25	7.7	1.23
Carpooling and trip-chaining	D	36.1	15	6.4	1.02
Totals		233		123	20

\*See text for definitions of categories W, E, M, A, and D.

<sup>†</sup>Effect of change from the current level of penetration to 100% penetration, corrected for double-counting. Measured in millions of metric tons of carbon (MtC).

<sup>‡</sup>Percentage of the relevant population that has not yet adopted an action that will adopt it by year 10 with the most effective interventions.

<sup>§</sup>Reduction in national CO<sub>2</sub> emissions at year 10 due to the behavioral change from plasticity, expressed in MtC/yr saved and as a percentage of total US individual/household sector emissions (%/H). Both estimates are corrected for double counting.

*Figure 2.* Achievable carbon emissions reduction from household actions. Categories relevant to this study are weatherization (W) and efficiency (E). Source: Dietz et al. (2009).

Pitt, Randolph, Jean and Chang (2012) also attempted to estimate the potential energy and GHG emission that can be saved from residential retrofit programs. They state that though it is easy to estimate energy and GHG savings in the retrofit of a single home, the wide variation in housing (size, home age, HVAC systems and type of home) make it difficult to estimate the nation's overall potential energy and GHG benefits from a large-scale retrofit program. They developed a four-step methodology to estimate savings. They first estimated the local amount of residential energy consumption and then created a baseline for heating demand in typical households. Next they estimated the amount of energy saved from retrofits. Finally, they extrapolated these savings to all single-family homes in the community. The authors found that in Blacksburg, Virginia, a basic retrofit with just a few upgrades such as replacing windows and adding minimal insulation reduced heat consumption by 17%. However, an "aggressive" retrofit using the best available technologies had the potential to reduce heating demand by over 80%. Therefore, actual energy savings

would fall somewhere between those two numbers, depending on the extent of the retrofit work completed (Pitt, et al., 2012).

With these potential energy savings, it is crucial to use interventions to increase benefits and remove any barriers that homeowners may have to adopting improved energy efficient home heating and cooling systems, appliances, and weatherization techniques. The term “intervention” is used here to mean any program, activity, appeal or event that intends to influence behavior (Wilson & Dowlatabadi, 2007). As important as upgrading to energy efficient technology can be, unless it is adopted by a significant number of households, its impact will not be significant (Costanzo et al., 1986).

Encouraging behavior change is also important because we cannot rely on emissions reductions from improved efficiency of new technology alone. In fact, increased consumption and population can often overtake any increase in efficiency that a new technology might provide (Midden, Meter, Weenig & Zieverink, 2007).

### **Influencing Behaviors**

The following section will provide an overview of various theories that explain how behavior change can be influenced. I begin by explaining the difference between curtailment and efficiency behaviors. I then discuss the problems associated with relying on rational thinking, affecting attitudes, or increasing knowledge to change behavior.

**Curtailment vs. Efficiency Behaviors.** There are two main categories of energy conservation decisions. Curtailment behaviors are frequently repeated actions that require regular attention, such as turning off lights when leaving a room or setting a thermostat. Efficiency behaviors, on the other hand, are one-time changes that often require the purchase of energy efficient equipment or a service, such as buying new insulation or having a home air-sealed (Stern & Gardner, 1981).

It is important to distinguish between curtailment and efficiency because the factors that may influence every day behavior are likely quite different from those that influence a large decision that is made only once (Stern & Gardner, 1981). A Canadian study found that curtailment behaviors were much more influenced by personal norms such as environmental attitudes than decisions to invest in energy efficiency, which were predicted by pragmatic factors such as a desire for a more comfortable home (Scott, Parker & Rowlands, 2001). Knowing these differences can help to focus marketing towards the appropriate motivators depending on the type of desired behavior change.

A home energy audit and retrofit work falls into the efficiency category, because they are one-time decisions that do not need to be revisited often (Abrahamse, Steg, Vlek, & Rothengatter, 2005). This is one advantage in encouraging this type of behavior change because action must be taken only one or two times, rather than trying to encourage actions that must be done repeatedly.

Another advantage of working to encourage investment in efficiency technology is that investment tends to have higher energy savings than curtailment behaviors do (Abrahamse et al., 2005; Gardner & Stern, 2008). For example, more

energy is likely saved by insulating a house once than by the homeowner turning down the thermostat every night (Stern & Gardner, 1981).

The two behaviors also vary greatly in other ways that may affect their adoption. Curtailment measures often mean sacrificing comfort, by having to sacrifice things such as a home that is a comfortable temperature. This feeling of having to go without something produces a very different psychological effect than the adoption of efficient technology, which often provides increased home comfort along with energy savings (Stern & Gardner, 1981). Therefore, very different methods must be used to encourage curtailment behavior as compared to investment in efficiency.

However, efficiency measures are usually more expensive than curtailment efforts, having a large initial cost. Usually there is no cost to performing curtailment actions. All of these points demonstrate that there are significant differences in the barriers that are present for improving energy efficiency compared to curtailment (Gardner & Stern, 2008).

**Rational Thinking vs. Action.** Home energy efficiency is a good example of how difficult it is to change behaviors or adopt new technology even when it benefits the homeowner financially over the long-term. This difficulty illustrates that though prices and technology are important, they are likely not the only barriers to better home energy efficiency (Allcott & Mullainathan, 2010). Improved technology has been available for decades, yet there is a persistent gap between potential savings through technology and actual behavior (Wilson & Dowlatabadi, 2007). This is known as the “energy efficiency gap” (Gardner & Stern, 2002; Jaffe & Stavins,



1994). For example, a homeowner might be informed, have positive attitudes about efficiency and weatherization measures, and have the resources, yet all of these factors may not result in action even when the outcome is obviously beneficial (Wilson & Dowlatabadi, 2007).

The rational-economic model relies on the idea that people will make the choice that is in their financial best interest (Coltrane, Archer & Aronson, 1986; Kurz, 2002). In order to influence behavior, the model suggests that homeowners only need to be informed of the financial advantages of their choices, and they will act accordingly. Unfortunately, many past interventions based on this model, including the Residential Conservation Service that was mandated in response to the energy crisis of the 1970s, have been unsuccessful (McKenzie-Mohr, 1994).

While substantial financial incentives are undoubtedly helpful in encouraging a home energy audit and retrofit work, there are often many other situational factors that override logic and inhibit their adoption of technology (Yates & Aronson, 1983). Factors include lack of knowledge about what incentives are available, difficulty in scheduling multiple contractors and difficult paperwork, plus long wait periods for rebates. Even when an investment in energy efficient equipment is expected to provide a good return over time, it can be hard to know exactly what that return will be (Dietz et al., 2009; Gardner & Stern, 2008). Also, no matter what the financial cost, all home improvements require the “cost” of people’s time and attention (Gardner & Stern, 2008).

For an example of how non-monetary factors can be just as important as financial incentives in changing consumer behavior, one study found that even when

the incentives for a home insulation program were identical for various utilities, average participation rates varied from 1% to 5%. This was the case even when 93% of the costs of the insulation were subsidized, almost eliminating the barrier of cost. This illustrates that other factors, including the way the subsidy was marketed, had large effect on the participation rates (Allcott & Mullainathan, 2010; Stern et al., 1986).

**Attitudes vs. Action.** Those attempting to change behavior often make the assumption that behaviors depend on attitudes. It seems intuitive that when a person has a positive attitude towards something, their actions would reflect that. However, this has been found to not always be true. According to Stern (2000), “Environmental intent is only one of the factors affecting behavior, and often, it is not one of the most important” (p. 415).

The theory of reasoned action provides insight into how to encourage behavioral change in regards to home energy use. Though many campaigns focus on changing people’s attitudes, attitudes alone have been found to be poor predictors of behavior (Ajzen & Fishbein, 1980). Even when a person has pro-environmental attitudes and motivation, they often do not result in the expected behavior. This is because behavior is the result of many different motivational and contextual factors (Costanzo et al., 1986; Steg & Vlek, 2009).

The contextual factors that surround the choices that a consumer has can often be more important than the consumer’s attitudes. For example, Black et al. (1985) found through a survey of Massachusetts’s electricity consumers that changes that are

relatively convenient or inexpensive were easily influenced by one's attitudes, whereas changes that are more difficult or expensive were less affected by beliefs and attitudes, because they have other important factors involved in the decision. This is especially relevant to increasing home energy efficiency, which is often a complex and sometimes expensive process. For example, according to their study, temperature settings of a home were more likely to be influenced by norms than difficult actions such as installing insulation.

If efforts are focused on increasing pro-environmental attitudes alone, behavior will likely not be affected. This is extremely important when designing messages because "behavior change is the only goal of consequence" with respect to energy conservation in homes (Costanzo et al., 1986, p. 521). Therefore, an important aspect of behavior change is removing the contextual factors that act as barriers (Steg & Vlek, 2009).

**Knowledge vs. Action.** Many programs designed to change behavior rely on information campaigns, typically by trying to increase public knowledge about an issue through advertising. Similar to campaigns attempting to change attitudes, providing information for homeowners, though likely to result in increased knowledge levels, does not always result in changed behavior (Abrahamse et al., 2005; McKenzie-Mohr, 2011). This may be because providing information only removes the barrier of lack of knowledge about a subject but does nothing to make the desired behavior any easier for the homeowner or make it any more financially attractive (Dietz et al., 2009).

Knowledge is still an important factor, however, because without accurate and accessible information, people who are already motivated to make changes could be prevented from taking this action due to lack of understanding (Gardner & Stern, 2008; Tabanico & Schultz, 2007). In a review of studies focused on household energy conservation, it was found that homeowners often seemed to emphasize savings from changes that are visible, such as turning off lights, frequently overestimating the amount of energy that they think can be saved by taking these actions. In one study the average homeowner believed that there was more potential energy savings in using curtailment than in adopting energy efficient technologies, even though experts have found that the most potential energy savings are almost always by taking efficiency measures (Abrahamse et al., 2005; Gardner & Stern, 2008).

McKenzie-Mohr (2011) cites several failed attempts of information-based campaigns. These included three hour-long workshops with educational materials that increased willingness to make changes but no actual change in behavior (Geller, 1981), and a study that provided general information about conserving home energy that was not effective in creating significant behavior change (Midden et al., 1983). These findings further illustrate the importance of identifying benefits and barriers that homeowners have to investing in energy efficient technologies, rather than only attempt to increase their knowledge.

## **Relevant Tools for Effective Behavior Change**

This section highlights a few social marketing techniques that can be used to encourage behavior change. A more detailed explanation of how these tools can be used in the situation of a home energy audit is provided in chapter 5.

**Tailored Information.** In trying to affect behavior, tailored information has an advantage over broad recommendations because the resident receives only relevant information to their situation. Home energy audits are a good example of this. Studies have found that audits can result in increased knowledge about home energy use, and more importantly, significant reductions of energy consumption (Abrahamse et al., 2007; Gardner & Stern, 2008; Gonzales, Aronson & Costanzo, 1988). Since savings can be predicted by measurements through a home audit, personalized information can give homeowners more confidence in making changes than general statements about potential savings could do (Costanzo et al., 1986).

**Social Diffusion.** Information that is passed on socially is likely a better influence on behavior change than non-personal sources of information such as mass media or direct mail (Costanzo et al., 1986). However, improvements in residential energy efficiency are not often obvious to those in one's social network compared to many other behaviors. In order to increase the visibility of these actions, SustainableWorks provides yard signs to clients who implement the recommended upgrades. They also provide case studies on their website with photos of clients in

front of their home with “before and after” information including costs of heating, energy use, and tons of carbon emitted.

In some cases informal social networks can be used to increase the credibility of home energy efficiency programs. Some homeowners may be motivated to consider a home energy audit because they have heard from people that they trust that the investment will pay off or because their neighbor was satisfied with the results of their audit (Stern & Aronson, 1984). In another study, homeowners who installed programmable thermostats were found to influence a portion of their network, including friends, family and coworkers. However, this action was not found to influence their neighbors (Darley, 1978).

**Increase Convenience.** Even if a person has the internal motivation to act, it will likely not happen if the behavior is inconvenient, unpleasant or too time-consuming (McKenzie-Mohr, 2011). Methods to increase convenience would be to act as a general contractor to provide one-stop shopping (Dietz et al., 2009; Gardner & Stern, 2008). Another way to increase convenience is to have small services available at the time of the audit, such as changing out old incandescent light bulbs to new CFLs or LEDs and installing a programmable thermostat. Though these things may not be expensive or difficult, the inconvenience of purchasing and installing the items may be a barrier for homeowners (McKenzie-Mohr, 2011).

This approach is one that SustainableWorks has recently implemented with their “Save Energy Today” program. For one fee, the homeowner receives a home energy assessment from a building scientist at the same time that a weatherization

technician provides minor changes that can be done in one day, including air sealing, installing new light bulbs, aerators, and shower heads, and insulating the hot water heater (R. Wells, personal communication, March 2014).

**Improving Credibility & Reducing Uncertainty.** By providing a list of approved sub-contractors plus an inspection of the completed work, organizations like SustainableWorks can increase their credibility. This helps homeowners feel more confident in having their homes retrofitted (Dietz et al., 2009; Gardner & Stern, 2008). Another strategy to overcome credibility issues is to create partnerships between organizations, such as pairing up a utility that offers audits with a local non-profit organization. Alternatively, an already existing neighborhood group could provide support in reaching out to the community to encourage home audits (Stern & Aronson, 1984). Stern (1992) provides an example where the same letter was sent randomly to invite homeowners to request free audits and insulation. One version was sent on a private company's letterhead, one version from the company that also mentioned the local county's role in the program, and finally one version on county letterhead. Of the households who received letters, requests for audits came from 6%, 11% and 31%, respectively, depending on the source of the letter (Stern, 1992). This illustrates how, at no additional cost, the effectiveness of campaign can be greatly altered depending on the audience's perceived credibility of the source.

**Framing.** The manner in which information is presented can also influence the decision. Through "framing" choices in a certain way, a person's preference can

be reversed even when actual outcome has not been changed (Wilson & Dowlatabadi, 2007). For example, because people experience loss aversion, they do not get the same amount of joy from gaining \$100 as the amount of sadness they have from losing \$100, even though the value is exactly the same (Gonzales et al., 1988). For example, an auditor explaining the importance of insulating a home may have more success explaining it in terms of energy or money lost, not saved.

### **Previous Campaigns Regarding Residential Energy Efficiency**

Though many social marketing campaigns have been focused on curtailment behaviors in homes, it was difficult to find many that used social marketing tools in the area of encouraging energy efficiency investments. The following case studies provide a review of residential energy efficiency campaigns, some of which used social marketing methods. However, due to the age of some of these studies, many of which took place in the 1970's and 1980's during different social and economic conditions, their findings may be limited to past circumstances and therefore less relevant to present-day homeowners.

**Home Energy Audits after the 1978 National Energy Act.** In 1978 the National Energy Act was passed, which required major utility companies to provide conservation services to residential customers (Hirst, Berry and Soderstrom, 1981). Through a review of evaluations performed by utilities, which were few and often informal, it was found that the average participation rate was less than 5% for most energy efficiency programs (Hirst et al., 1981).



This study also found that most participants were satisfied with their audit, their auditor's conduct and knowledge, and felt that the information from the auditor was easy to understand and helpful. Participants were found to take actions that required little investment and could be accomplished without a contractor, such as weather-stripping, programming a thermostat and adding water heater blankets (Hirst et al., 1981).

The review also looked at the demographic characteristics of the audit participants. The researchers found that homeowners who participated in the utility-sponsored audits had higher incomes and more education than what was average for their locations. Understandably, the homeowners were also found to have more interest or concern about energy conservation than the general population. In addition, audit participants' homes were more likely to be larger than the average home as well (Hirst et al., 1981).

In this review of 35 utilities, only three had published information about the amount of energy saved due to their programs. These utilities had varied results, with averages of 8.6% to 21% energy savings. However, one utility compared those who had audits, those who did a self-directed audit, and those who had no audit, and found no significant difference in energy consumption (Hirst et al., 1981).

**Wisconsin Power and Light Company Audits.** In another example of a program during that same time period, Wisconsin Power and Light Company offered free audits for gas customers, with over 19,000 homes audited in a little over two years (Hirst & Grady, 1982). Consumption and demographic data was collected, and

it was found that those who had participated and those who had not had audits were very similar. The audits did have a statistically significant influence on reducing annual gas consumption (Hirst & Grady, 1982).

### **Residential Energy Efficiency Project: the Waterloo Region of Canada.**

Kennedy et al. (2000) describes a Canadian home energy evaluation tool called EnerGuide for Houses (EGH) that was used by the Residential Energy Efficiency Project (REEP) in the Waterloo region of Ontario. This project used CBSM techniques to encourage citizens to schedule an EGH home energy audit. They first identified barriers from previous energy and environmental studies as 1) cost of the audit 2) time commitment 3) the idea the audit would not be useful and 4) lack of trust in the credibility of the organization conducting the audit. They then went on to address these barriers by keeping the cost down to \$25 (CDN) per audit, limiting the audits to two hours, relying on the credibility of the national EGH program, and partnering with a local university and non-profit organizations (Kennedy et al., 2000).

The REEP practitioners used community-based events and meetings to try to have as much direct personal contact as possible in an effort to use personal appeals to encourage homeowners to have audits. They also used direct and passive marketing, and local media to promote the program. The practitioners then evaluated how participants heard of the program after the audits were scheduled. They performed almost 900 audits in the first year and found that the largest portion were from referrals (36%), followed by media (28%) and then community-based events and meetings (18%). The practitioners concluded that the number of audits that came

from referrals signifies the importance of these kinds of energy efficiency projects to be recommended through someone whom people trust, like friends and neighbors (Kennedy et al., 2000). Scott, et al. (2001), who also analyzed this case study, emphasized the positive influence of social networks as an important finding of REEP, saying that these programs will have a synergistic effect.

Another study looked at the decade-long effects of the REEP program by analyzing thousands of evaluations made by REEP from 1999 to 2009 (Hoicka & Parker, 2011). They analyzed the rates of adopted measures that were recommended during audits. This study found that in general, achieved energy savings were less than what was predicted from the audit. Also, those homeowners that had the most energy savings were more likely to have treated the home as a system, making multiple changes as once. In addition, they found that the improvements that were implemented by homeowners were less extensive than what was recommended during the audit (Hoicka & Parker, 2011).

In conclusion, despite some valuable information discovered from these campaigns, there are gaps and weaknesses in these studies that my research attempts to address. Discovering differences in those who participate in programs, especially those homeowners who invest in recommended upgrades, can inform future campaigns. In addition, identifying barriers and benefits from the actual homeowners is an important step in these campaigns.

## **Focus Group Findings on Community Energy Efficiency Programs (CEEP)**

Though a focus group was not conducted for my research, the Washington State University Energy Extension Program (WSU Energy Program, 2013), recently administered a focus group to discover homeowners' attitudes related to home energy efficiency and the importance of home energy upgrades. The participants were in two groups: those who have participated in WSU's Community Energy Efficiency Program (CEEP) and had a home energy audit done and those who had not (some of the participants who had audits continued to work with CEEP to invest in upgrades). The results showed that homeowners who were participants felt educated, well supported in their efforts to improve their home's efficiency, and aware of the resources available to them. Non-participants, however, felt frustrated with the results of their efforts to improve efficiency and did not know where to get reliable information (WSU Energy Program, 2013).

Several themes were highlighted through the participants' comments during the focus groups. Benefits of working with CEEP included a comprehensive and prioritized list of recommended improvements and a clear idea of what the cost effectiveness would be for those improvements. Motivations to work with CEEP included hearing about the program through word-of-mouth, having a specific problem with their home, or wanting to reduce their energy use, in terms of both cost savings and energy savings. Other motivations included environmental concerns and the low cost of home audits (WSU Energy Program, 2013).

Finally, barriers were discussed in the focus groups. The most common two barriers were difficulty in scheduling/cost of the audit and implementation of the

recommendations. Other concerns included that the improvements would not be worth the investment, that they would not learn any new information from the audit, and that the recommendations would be cost-prohibitive. There were also concerns about the quality of work done by the subcontractors. Lastly, communication difficulties and the complexity of the project were identified as barriers (WSU Energy Program, 2013).

Though qualitative focus groups were not a method used for this thesis research, the focus groups conducted by the WSU Energy Program included a very similar demographic of homeowners in Washington State, including several who had worked with SustainableWorks. Their findings provide insights into the motivations and barriers of homeowners that are similar to those of my target audience of homeowners in Pierce County and the greater Puget Sound region.

### **In-Depth Interviews of SustainableWorks Clients**

In 2011, SustainableWorks hired a consultant to do a qualitative assessment of clients who had an audit but failed to move forward with home upgrades through the program (Schulte, 2012). Forty-one in-depth interviews were conducted in Shoreline and Spokane, WA.

The author found that 70% homeowners were satisfied with the audit process, but had barriers that kept them from investing in the recommendations provided. The most prevalent barrier was related to affordability, with 63% of respondents mentioning factors related to affordability as a reason for not pursuing upgrades. These included the initial costs being too high, not being able to afford the upgrades,

concern of limited return-on-investment, and concern that the payback period (the amount of time it takes to recover the cost of the investment) was too long.

Other barriers were related to a “do-it-yourself mindset” including the homeowner preferring to do it on his/her own or having a “do-it-yourself” perspective going into the audit (22% of respondents). Equally mentioned was the problem that the homeowner was looking for different information, including short-term, easy upgrades (22% of respondents). Very few respondents (5%) mentioned concern because they were moving soon (Schulte, 2012).

Respondents also reported on whether they implemented upgrades to their home and in many cases the upgrades were confirmed as the same as those recommended by SustainableWorks. Several mentioned that they were doing the upgrades themselves. At least six mentioned that they preferred to do the work with another contractor, or that they had a relationship already established with someone who could implement the upgrades for them (Schulte, 2012).

## **Conclusion**

Much has been learned about the variety of factors that can influence behavior. In order to encourage a homeowner to invest in energy efficiency, it is likely that more needs to be done than just attempting to increase knowledge or encourage pro-environmental attitudes. Social marketing is an emerging field that has proven successful in behavior change, and provides tools that have the potential to increase benefits and remove some barriers related to home energy efficiency.

There are few published studies that examine the specific benefits and barriers that homeowners have to investing in energy efficiency. Because social marketing campaigns focus on changing behavior, the campaigns that have been used in this area are more likely to influence curtailment behaviors rather than investing in efficient technologies, so there is a lack of evaluated campaigns that use social marketing techniques to encourage homeowners to retrofit their homes.

In addition, the majority of literature on the subject of social psychology as it relates to behaviors in household energy consumption and efficiency was published during the 1980s, following the energy crisis. Comparatively very little has been published since energy prices decreased in the 1990s and financial incentive to conserve diminished with high energy prices. Therefore, there may be some limitations to the previous review of studies because their findings may be limited to the specific social and economic conditions of that time.

For example, current motivations to conserve energy may be very different than in the 1970's and 1980s, if one motivation is to reduce one's carbon footprint. On the other hand, if their perceived benefit is an increase in comfort and saving money on energy bills, the necessary approach might be very similar to what it was 30-40 years ago. There are likely a variety of motivations that influence each homeowner including more recently developed motivations such as reducing carbon footprints since these the time of these studies.

There has been some resurgence in residential energy efficiency research since the turn of the century, as the threat of climate change and peak oil has become increasingly important global issues. Much of that research, however, has been

studies from outside the United States, including Canada and the Netherlands. More research is needed at regional and local levels to determine the benefits that motivate homeowners to invest in home energy efficiency upgrades and the unique barriers that they face in doing so.

These issues highlight the necessity for further research to discover the motivations and barriers that homeowners have to increasing their homes' efficiency through audits and home energy upgrades, under current conditions, at a local level. My research attempts to meet this need by identifying the importance of multiple factors in the decisions of homeowners in the Puget Sound area of Washington State.



### Chapter Three: Methods

This chapter will describe the design of the study. This study used a survey of homeowners who had a home energy audit conducted by SustainableWorks in the Puget Sound area of Washington State within the last three years. It was designed to determine the primary motivations for and barriers to investing in recommended energy efficiency upgrades for the respondent's home. To identify these factors, I am following the steps that McKenzie-Mohr et al. (2011) recommends, including:

- 1) Performing a literature review on existing articles and studies.
  - See the previous chapter.
- 2) Gathering qualitative data through methods such as focus groups.
  - See the previous chapter for information on a recent focus group that was conducted by the WSU Energy Extension. Open-ended questions in the survey provide some qualitative data. Each question included an open ended section for respondents to add additional information if they wished. There was also an option at the end of the survey to include anything else about their experience with SustainableWorks.
- 3) Surveying a random sample within the target audience.
  - I conducted a survey of over 1,110 homeowners who have had a home energy audit through SustainableWorks. Because my population was relatively small, I was able to make my survey available to the entire population rather than choosing randomly from within the population.

- 4) Analyze using descriptive and multivariate statistics to identify who is doing the activity and who is not, what are the factors that distinguish the two groups and what is the relative importance of these factors.
- Using data from the surveys, I was able to determine the primary barriers that were identified for each group of respondents. In addition, I look for differences among the groups, and relationships between demographic variables and group. I also was able to identify primary motivational factors for those who invested and possible conditions that could be changed to encourage those who did not invest to do so.

The participants of the study are described, the study's various measures are explained, procedures are covered and statistical analysis is described.

### **Survey Participants**

Two slightly different surveys were conducted in January 2014 by emailing SustainableWorks clients a survey to complete online. Email addresses were collected from the organization's database. Only those with working email addresses were surveyed. All clients living within the Puget Sound region of the state were included. Clients from Spokane, WA were excluded from the study because of the different climate and demographics in that area of Washington. Because only about 3.5% of SustainableWorks' audits are conducted for renters, the assumption was made that all clients in the database were homeowners and no attempt was made to exclude renters (L. Spencer, personal communication, April 28, 2014).

**“Participants.”** The first survey was sent to 404 homeowners who implemented some or all of the recommended upgrades through SustainableWorks. Clients who had audits and work completed since January 2011 were included in the survey sample. Of the 404 emails sent, 150 respondents, or 37.1%, completed the survey.

**“Non-Participants and DIY/Outside Contractors.”** The second survey collected data by emailing 743 homeowners who had an audit with SustainableWorks but have failed to implement any of the recommended retrofit work through the organization. This survey included clients who had an audit from January 2011 to July 15<sup>th</sup> of 2013, approximately six months before the survey, in order to exclude recent clients who may still be considering moving forward with the program. Of the 743 emails sent, 143 respondents, or 20.3%, completed the survey. Of this group, 68 reported investing in no upgrades. For this study they will be referred to as “Non-Participants.”

This study was initially divided into only two groups: those who chose to have energy efficiency upgrades through SustainableWorks and those who did not. However, after seeing that the remaining 75 respondents reported that they did implement changes after their audit, but not through SustainableWorks, a third category was created to differentiate those who were considered “Non-Participants” but who implemented changes, whether through another contractor or on their own.<sup>1</sup>

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<sup>1</sup> There are benefits to having a non-profit organization like SustainableWorks act as a general contractor after performing an audit themselves. First of all, the organization is subsidized by state money, so more incentives are available than

Investing in recommended upgrades, no matter who completes the work, is a desirable effect of an audit because it still works towards increasing the energy efficiency of a home. For this study, this third group of respondents will be referred to as “DIY/Outside Contractors,” in reference to the fact that they either completed the upgrades themselves or used a contractor outside of the SustainableWorks program. The total number of this type of completed surveys equaled 75, which is 53% of those who did not participate in the SustainableWorks retrofit program.

## **Measures**

The surveys included up to 18 questions of various types. They included multiple-choice questions to collect demographic information such as age range, education level, and income level. They also included questions about the respondents’ home, such as year built and square footage. All of the upgrades that SustainableWorks offers were listed and the respondent was asked to choose either what upgrades were recommended to them (for Non-Participants) or what upgrades they invested in (for Participants and DIY/Outside contractors).

**Likert-Type Rating Scales.** To measure the importance of various factors relating to investing in energy efficiency upgrades, several of the questions were composed of Likert-type scale questions. These rating scales ask respondents to identify their level of agreement of a statement on a 5-point symmetric scale from

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if a homeowner when through another contractor or attempted to do the upgrades themselves. The work done by SustainableWorks’ approved subcontractors is checked for quality after the upgrades have been completed. Also, the homeowner is offered a limited amount of choices, therefore reducing the confusion of what to choose when making upgrades. Finally, having upgrades performed through organizations such as SustainableWorks is advantageous because it is verifiable for governments and organizations to see what kind of impact they were having on communities.

strongly disagree (1) to strongly agree (5), in order to determine their attitude toward the importance of a specific factor in their decision to invest in upgrades. This format is often used by marketing researchers to discover the intensity of agreement, feelings or attitudes about a statement (Burns & Bush, 2008). A recent study found that results are similar whether a 5-point scale or 7-point scale is used, so a 5-point scale was chosen to increase the ease of analysis (Dawes, 2008). A copy of each survey can be found in the appendix.

One issue that arose in this study was an oversight in implementing the surveys. The Participants were given an option of “not applicable” when choosing what factors were barriers for them, but this was not provided to either of the non-participating groups. Therefore, in order to more appropriately compare data, those items that were designated as “not applicable” for certain barriers were converted into “neutral,” which is not necessarily equivalent.

Similar Likert-type questions were used to measure how important certain barriers were for all respondents (Figure 3). For Participants only, a list of potential motivators was rated (Figure 4). For Non-Participants and DIY/Outside Contractors, a list of potential methods to overcome barriers was listed, and they were asked to rate how important these factors would be in increasing their likelihood to invest in upgrades (Figure 5).

**7. Were any of the following factors barriers to moving forward with home energy efficiency improvements? Please rate the following factors.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I was concerned about affording the project or initial payment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SustainableWorks' pricing was too expensive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I didn't believe there would be a good return on my investment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 3. Example of Likert-type Barrier Question. Respondents were provided 13 Likert-type items to rate from “Strongly disagree” to “Strongly agree” to measure the importance of various barriers to investing in home energy efficiency upgrades. All respondents were asked to rate barriers.

**Please rate the importance of the following factors in your decision to invest in home energy efficiency upgrades that were recommended after your audit from SustainableWorks.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
I wanted to save money on my energy bills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted to reduce my carbon footprint.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted to increase the value of my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 4. Example of Likert-type Benefit Question. Respondents were provided nine Likert-type items to rate from “Strongly disagree” to “Strongly agree” to measure the importance of various motivating factors in investing in home energy efficiency upgrades. Only participants were asked to rate motivations.

**Would any of the following conditions help you move forward with making home energy efficiency upgrades? Select all that apply.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
Decrease the cost of upgrades through increased incentives and rebate programs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide more information about how I could pay for the home energy efficiency improvements.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 5. Example of Likert-type Conditions Question. An example of the question for non-participants regarding what conditions may help them to invest in energy efficiency upgrades. The respondents were provided 9 Likert-type items to rate from “Strongly disagree” to “Strongly agree.” Only Non-participants and DIY/Outside Contractors were asked to respond to this question.

In an attempt to identify methods that participants used to overcome barriers, they were provided a list of potential methods that they might have used to overcome the previously stated barriers, and asked to choose all that applied (Figure 6).

**How did you overcome any of the barriers listed previously? Select all that apply.**

- I qualified for incentives to reduce the project cost.
  - I used the financing through SustainableWorks to help finance the project.
  - I financed the work separately from SustainableWorks' partner lender.
  - I asked my auditor for more information about the improvements and my options.
  - I found out more information by reading through my audit report.
  - I did my own research about the recommended improvements.
  - I was reassured by the quality assurance and warranty.
  - I know of others who have invested and been satisfied with their results.
  - I calculated the return-on-investment or payback time.
- Other (please specify)

*Figure 6.* How Participants Overcame Barriers Question. Participants were asked to identify all methods they may have used in order to overcome any barriers to investing in energy efficiency upgrades. They were asked to choose all that applied.

## Procedures

Both surveys were created using SurveyMonkey.com and were sent from the email address of SustainableWorks' Director of Marketing and Outreach so they would come from a recognizable source. The first round of emails were sent at 10:00 am on Thursday, January 16<sup>th</sup>. A reminder email was sent the following week at 2:00 pm on Wednesday, January 22<sup>nd</sup>. The survey was closed and no more responses were collected 12:00 pm on Monday, January 27<sup>th</sup>.

The surveys began with a letter from the Director of Marketing and Outreach, explaining that a graduate student was conducting this research. Following that letter, another letter explained the research in further detail. Finally, a consent form was required before moving ahead with taking the survey. See the appendices A and B for the letters and consent form, along with the actual surveys.

As an incentive to complete the survey, participants were able to enter a random drawing for one of three \$50 gift cards to a home improvement store of their choice (Home Depot, Lowe's or Ace Hardware). The survey participants were informed that the survey was completely optional and anonymous, and that it should take them approximately 10 minutes to complete.

### **Statistical Analysis**

Once the surveys were completed, the data was downloaded from SurveyMonkey.com into an Excel spreadsheet. Only adequately complete surveys were included in the data analysis. To be included in the analysis, the respondent had to have answered if they made any recommended updates after their audit, whether that was through SustainableWorks or not, and the majority of the Likert-type and demographic questions. Other measures were taken to ensure complete surveys were used. For example, if a respondent stated "yes" that they made improvements to their home outside of the SustainableWorks program, but didn't identify any of the upgrades, their responses were not included in the analysis because of their conflicting response.



The Likert-type data was coded for analysis. The ratings of “strongly disagree” were given a value of 1, “disagree” a value of 2, “neutral” a value of 3, “agree” a value of 4, and “strongly agree” a value of 5. The Likert-type rating scales that have been coded numerically provide ordinal data, since the categories chosen are intrinsically ordered but can not have true numeric properties because they are not necessarily evenly distanced (Weisberg, Krosnick & Bowen, 1996). Therefore, some researchers criticize performing certain statistical tests, such as calculating averages, on Likert-type rating scale. They propose that the mode - the answer that occurred the most often – is the most appropriate way to report results. However, both mean and mode are used in practice. For this reason, both approaches are adopted in this analysis.

Demographic data was coded for analysis as well. The demographic make-up of the respondents in each group was calculated to determine the most commonly reported age range, race, income and education levels, and whether or not children live in the home. Then the average homes ages and sizes were calculated. To examine any relationships between household characteristics such as age group or income level and group type, nonparametric Chi-Square tests of independence were performed in Excel.

**Motivations and Barriers - Descriptive Statistics.** Descriptive statistics were calculated to determine the primary barriers for each group, the primary motivational factors and methods to overcome barriers for the participants, and the conditions that could be changed to encourage non-participants to invest in upgrades.

Percentages, mode and the average rating were calculated for each Likert-type question.

**Comparing Barriers Among Groups - Multivariate Analysis.** Finally, the barriers of the groups were compared using multi-response permutation procedures (MRPP) in PC-ORD software. This determined if there were significant differences in importance of barriers among the three groups of respondents. Following MRPP, an ordination graph was created in order to visualize any differences among groups.

To see if there were significant differences between any two of the groups, I then ran a pair-wise comparison among the groups. I then did a Bonferonni correction to account for the extra error created when running multiple tests on the same data. This was followed with a species indicator analysis, to determine if any specific barrier was significantly different than the rest.

## **Chapter Four: Results & Discussion**

This section will provide an overview of the results of this study, through descriptive statistics and deeper statistical analysis. It also includes analysis of the results and recommendations for their use in future social marketing campaigns for SustainableWorks in the Puget Sound region of Washington State.

### **Household characteristics**

Participants were predominately white (89%), within the age range of 40-69 (76%), and had a variety of education levels with 4% holding an AA or technical degree, 32% with bachelor's degrees and 36% with master's degrees. Nearly half reported household yearly incomes between \$50,000 and \$99,000 (46%), with another 30% reporting an income between \$100,000 and \$149,000.

DIY/Outside Contractors reported similar demographic factors, with a few differences. These respondents were also predominately white (91%), within the age range of 40-69 (71%). Education levels were somewhat different than participants, with 13% with AA or technical degrees 26% holding bachelor's degrees, and 33% with master's degrees. Again, nearly half reported household yearly incomes between \$50,000 and \$99,000 (49%), with 25% reporting an income between \$100,000 and \$149,000.

Finally, Non-Participants reported as 89% white, with 82% within the age range of 40-69. Education levels were similar to the other two groups, with 8% holding an AA or technical degree, 23% with a bachelor's degree, and 37% with a

master's degree. Over 40% reported an income between \$50,000 and \$99,000 and 17% reported an income between \$100,000 and \$149,000.

The average age of all of the homes in the three groups was similar. The average year built for both Participants and Non-Participants was in 1948, and for the DIY/Outside Contractor group was in 1945. Because Participant's homes were not found to be considerably older, this study does not support Ferguson's (1993) or Gamtessa's (2013) previous findings that age of the home is one of the best variables used to distinguish those who invest in upgrades and those who don't.

All groups reported the same average home size, between 1,500 and 1,999 square feet. The majority of all groups reported having no children under the age of 18 living in the home: 67% for Participants, 71% for DIY/Outside Contractors, and 65% for Non-Participants. For complete demographic data for all respondents, see Appendix C.

Homeowners in older homes, with high levels of education and income may be more likely to have an audit done, as found in previous studies (Hirst et al., 1981). However, based on the results of this study, these variables do not appear to have an effect on whether or not a homeowner is more likely to have upgrades done.

**Relationships Between Household Characteristics and Group.** Using Chi-Square tests for independence, I was able to examine the relationships between certain characteristics and whether or not the homeowner invested in efficiency measures through SustainableWorks, had work completed outside of their organization, or didn't invest at all. The test was run for relationships with group type

(Participant, DIY/Outside Contractor, and Non-Participant) and income level, age range, education level, and house size.

The relationship between all of these variables was not significant. Income ranges were separated into two groups, those who earned under \$100,000 per year and those who earned \$100,000 and over  $X^2(2, N=252) = .09, p=.96$ . Homeowner's ages were divided into those under 50 years old and those 50 and over  $X^2(2, N=286) = .98, p=.61$ . Education levels were grouped into two categories, those with less than a Bachelor's degree (high school diploma or GED, associate's or technical degree, or some college) and those with a Bachelor's degree or higher (some graduate school, a graduate degree, a PhD or a professional degree)  $X^2(2, N=276) = .88, p=.64$ . Finally, house sizes were divided into two groups, with houses under 2,000 square feet in one group and those 2,000 square feet and over in another  $X^2(2, N=286) = 1.33, p=.33$ .

Therefore, no demographic factors such as higher income or level of education, age or house size were shown to have an influence on whether or not a homeowner was likely to be a participant in the SustainableWorks program. A strong difference in a demographic characteristic between Participants and the DIY/Outside Contractor group or the Non-Participant group would have illustrated that that characteristic would be important to focus on in marketing strategies, as those with that characteristic would be more likely to follow through with recommended upgrades through SustainableWorks. For example, it could be hypothesized that those with higher incomes have more disposable income and are more likely to overcome the barrier of cost. However, no such differences were found to be significant in this study.

Some may find the lack of significant differences in characteristics among groups counter-intuitive. However, just because a homeowner has certain characteristics doesn't necessarily mean they will or will not invest in home energy efficiency. For example, two homeowners with similar income, age and education might approach home energy efficiency differently if one does not have experience in home upgrades and is willing to trust SustainableWorks to act as general contractor. However, the other may be experienced in do-it-yourself projects or know someone who is professional in the field and could do it for them.

An interesting finding was that there was not a bigger difference among the three groups in income. However, income may be only one financial aspect to take into account when one considers making large investments in home upgrades. Other factors such as savings and other financial commitments such as loans may influence decisions as well. The finding that average income level was not reported as different among groups once again illustrates that there are multiple factors relating to investing in home energy efficiency, each with distinct barriers.

Archer et al. (1987) found that higher *disposable* income increased the likelihood of a homeowner investing in energy efficiency upgrades. This study, however, did not differentiate between income and disposable income, which may be an important distinction. Black et al. (1985), had more similar findings to this study, in that income was only indirectly related to the likelihood of investing in efficiency, through the factor of homeownership.

## Motivational Factors

In the survey, participants rated nine motivational factors that led them to the decision to invest in recommended upgrades. Over half were rated very highly, with a mode of “strongly agree,” including saving money, concern about carbon footprint, increasing comfort, supporting a non-profit program, and upgrades being a good financial investment. Of these motivational factors, saving money was rated highest, with an average rating of 4.70, followed closely by increasing comfort with an average of 4.65. Increasing the home’s value and supporting quality jobs followed, both with modes of “agree.” The lowest rated motivation was having a friend or family member recommend the upgrades, rated at 2.61 with the most common response being “not applicable.”

Please rate the importance of the following factors in your decision to invest in home energy efficiency upgrades that were recommended after your audit from SustainableWorks.	Most Common Response (mode)	Average (out of 5)
I wanted to save money on my energy bills.	Strongly Agree	4.70
I wanted to reduce my carbon footprint.	Strongly Agree	4.46
I wanted to increase the value of my home.	Agree	3.95
I wanted my home to be more comfortable.	Strongly Agree	4.65
I wanted my home to be safer.	Neutral	3.26
I wanted to support quality jobs.	Agree	3.37
I wanted to support a local, non-profit program.	Strongly Agree	3.90
I felt it was a good financial investment.	Strongly Agree	4.38
A friend or family member recommended increasing my home’s energy efficiency.	Not Applicable	2.61

Table 1. Participants’ Motivational Factors.

The multiple recognized benefits of investing in home energy upgrades were illustrated through the fact that the importance of five out of nine motivational factors were most commonly rated by Participants as “strongly agree,” and none were commonly rated “disagree” or “strongly disagree.”

Though financial aspects are a common concern when considering investing in home energy efficiency upgrades, they were also rated as highly motivational, such as in saving money on energy bills and upgrading energy efficiency as a good financial investment. Knowing that financial benefits are strong motivational factors for those who followed through with recommendations through the SustainableWorks program, they should be highlighted in promotional materials and mentioned by SustainableWorks staff often.

For other factors that were rated slightly lower, there could be improvement in highlighting their importance and possibly providing some education about their benefits.

For example, increasing the resale value of the home was rated most often as “agree,” so auditors and staff could mention this to those who say they may be interested in moving somewhat soon. There could also be more emphasis on job creation that the SustainableWorks program provides, since wanting to support quality jobs was commonly rated as “agree” as well. While these factors may not be primary motivators, highlighting them as additional benefits may be of value to a campaign.

Finally, the most common response for the importance of a family member or friend recommending investing in home energy efficiency was “not applicable,” illustrating that it was not a important factor in the decision to move forward with



upgrades. Spreading awareness through word-of-mouth may increase the amount of audits, as found by Kennedy et al. (2000), but based on these findings it may have less of an affect in the decision to actually invest in the recommendations.

### **Barriers to Investing in Home Energy Efficiency**

In the survey I provided 13 factors that were potential barriers for investing in upgrades. In the following section, I identify responses from each individual group and then compare barriers among the three groups.

The differences in groups is best described with central tendency and summary statistics such as median and mode, but there are times when it is useful to look at the variation of responses within groups as well. Good example of this are the barriers of moving soon, believing SustainableWorks' pricing is too expensive, and not wanting SustainableWorks to act at the general contractor (see Figures 23, 13 and 16, respectively). In order to visualize the variation, all raw data is included in horizontal bar graphs (see Figures 7, 8 and 9) with additional graphs of individual barriers (see Figures 11 through 23).

**Participants.** For participants, the barrier that had the highest average rating (mode of "agree," mean of 3.56 out of 5) with over 50% of the respondents either agreeing or strongly agreeing, was about affording the project or initial payment. The two next highly rated barriers were also both related to finances, including being concerned about the payback period (mean of 2.66) and the return on investment (mean of 2.41). However, the most common response for these two barriers and the

majority of others was “disagree.” In fact, almost 60% of respondents disagreed or strongly disagreed about concern of return on investment being an important barrier, and almost 50% disagreed or strongly disagreed that concern about the payback period being an important barrier. Somewhat surprisingly, even though financial concerns were rated the highest among the other barriers, over 25% of respondents chose strongly disagree that SustainableWorks’ pricing was too expensive, with just over 10% agreeing or strongly agreeing.

The only two barriers that were most commonly rated as “strongly disagree” were moving soon (mean of 1.61) and the auditor not being thorough enough (mean of 1.67).

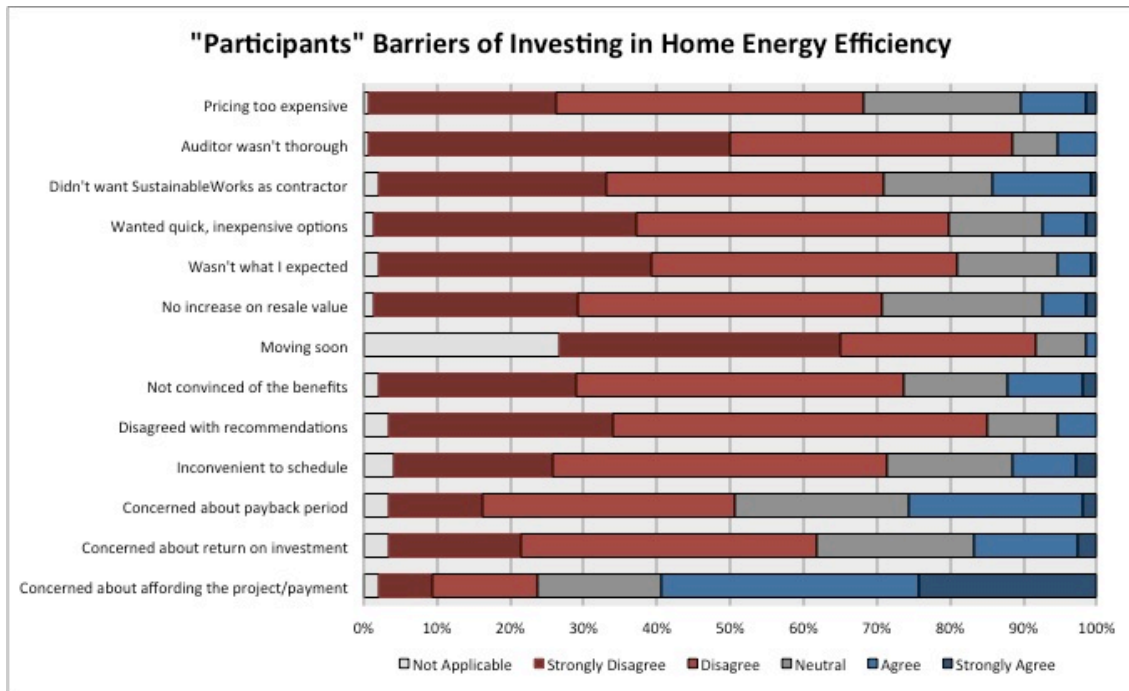


Figure 7. Participants’ Barriers to Investing in Upgrades. Participants responses when asked, “Were any of the following factors barriers to moving forward with home energy efficiency improvements? Please rate the following factors.”

**DIY/Outside Contractors.** For those who chose to have upgrades done outside of SustainableWorks, the barrier ranked the highest was also concern about affording the project/initial payment, with the most common response being “agree” and almost 74% saying they agreed or strongly agreed (average rating was 3.85 out of 5). There were two other barriers that also had the most common response of “agree,” that the homeowner didn’t want SustainableWorks to act as the general contractor, with over 66% stating they agreed or strongly agreed (mean of 3.58), and concern about the payback period, with 45% stating that they agreed or strongly agreed (mean of 3.11). The third highly rated concern was that SustainableWorks’ pricing was too expensive (mean of 3.45), though the most common response was “neutral.”

Both Participants and DIY/Outside contractors rated the same two barriers as the least concerning, both with a mode of “strongly disagree”: planning on moving soon was the lowest (mean of 1.86), followed by the auditor not being thorough enough (mean of 2.08). The rest of the barriers had the most common response of “disagree.”

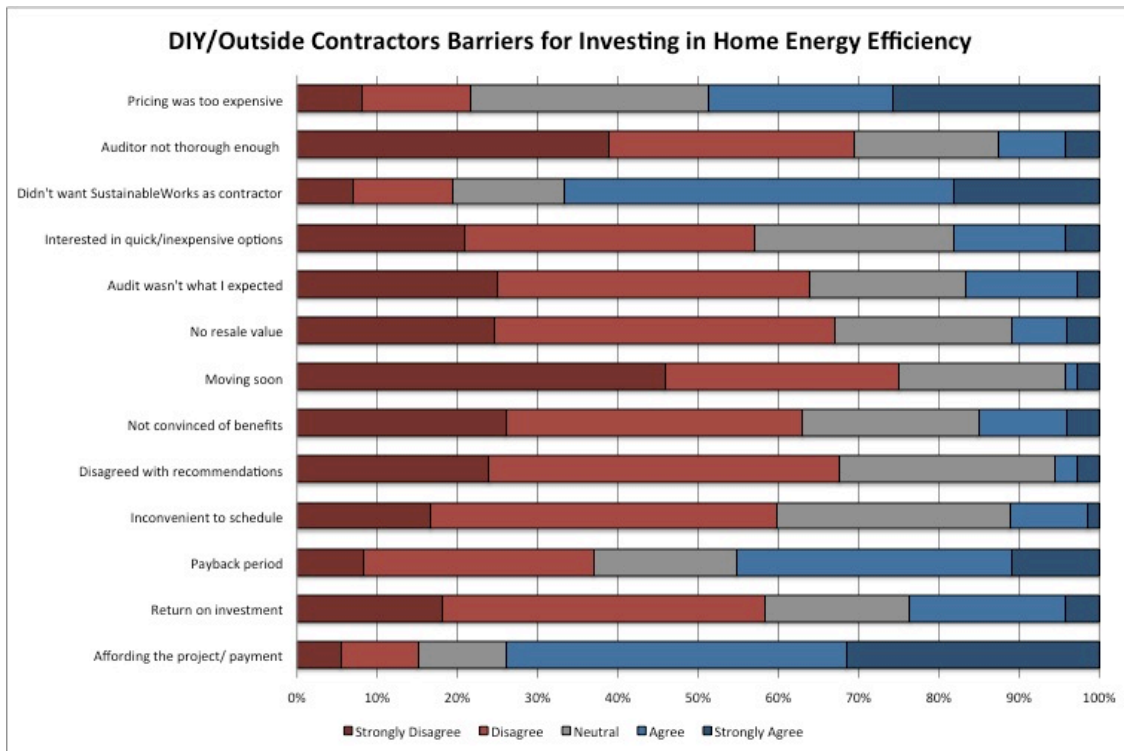


Figure 8. DIY/Outside Contractors Group Barriers to Investing in Upgrades. DIY/Outside Contractor group’s responses when asked, “Were any of the following factors barriers to moving forward with home energy efficiency improvements? Please rate the following factors.”

**Non-Participants.** As with the other two groups, Non-Participants rated concern about affording the project/initial the payment as the highest barrier, with over 80% agreeing or strongly agreeing. The next two barriers that followed were concerns were also about finances, including concern about the payback period and SustainableWorks’ pricing, both with an average rating of 3.21. However, the most common for both of these barriers was “neutral.”

Again, the majority of responses to the rest of the barriers were “disagree.” The only barrier that was rated as relatively low for the Non-Participant group was moving soon, with the most common response being “strongly disagree” (mean of 1.95).

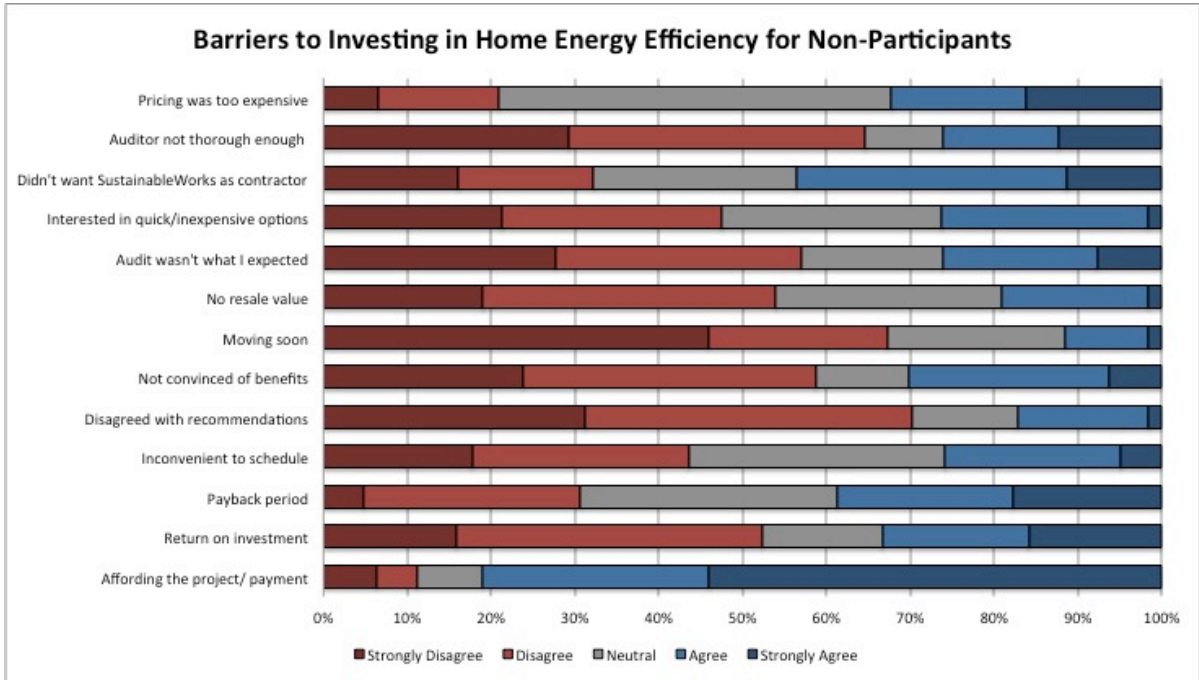
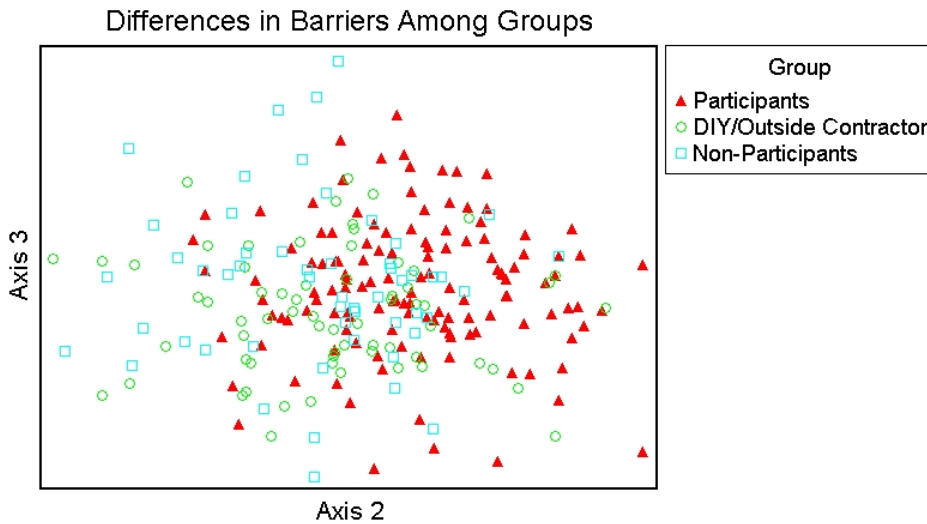


Figure 9. Non-Participants' Barriers to Investing in Upgrades. Non-Participants responses when asked, "Were any of the following factors barriers to moving forward with home energy efficiency improvements? Please rate the following factors."

### Comparison of Barriers Among Groups

Only slight difference in ratings of all barriers between the three groups was found using MRPP ( $A=0.03$ ,  $p=0.00$ ). A Bonferroni correction reduced the necessary p-value to  $p=0.016$ , which is irrelevant since the p-value equaled near zero. No difference would be illustrated with an agreement statistic "A" of zero, and a very significant difference would be close to 0.1. The A statistic of 0.03 illustrates that the three groups identified barriers as a whole very similarly.

The small, but not statistically significant difference in barriers between groups is represented in the ordination graph in Figure 10. If differences in the three groups' ratings of barriers were significantly different from each other, distinct clusters of points would be visible on the graph, rather than overlapping with only a small amount of clustering by shape/color.



*Figure 10.* Ordination Graph of the Three Groups' Barriers. An ordination graph visually displays the slight difference in barriers for Participants.

Through pairwise comparisons, individual groups' barriers are compared to one another. There was also a slight difference between Participants and DIY/Outside groups' barriers and Participants' and Non-Participants' barriers ( $A=0.03$ ,  $p=0.00$  and  $A=0.028$ ,  $p=0.00$  respectively). However, no significant difference in ratings of all barriers was found when comparing DIY/Outside and Non-Participants ( $A= 0.0022$ ,  $p=0.147$ ).

Were any of the following factors barriers to moving forward with home energy efficiency improvements? Please rate the following factors.	Participants Most Common Response (mode)	DIY/Outside Contractors Most Common Response (mode)	Non-Participants Most Common Response (mode)
Affording the project/payment	Agree	Agree	Strongly Agree
Return on investment	Disagree	Disagree	Disagree
Payback period	Disagree	Agree	Neutral
Inconvenient to schedule	Disagree	Disagree	Neutral
Disagreed with recommendations	Disagree	Disagree	Disagree
Not convinced of the benefits	Disagree	Disagree	Disagree
Moving soon	Strongly Disagree	Strongly Disagree	Strongly Disagree
No resale value	Disagree	Disagree	Disagree
Wasn't what I expected	Disagree	Disagree	Disagree
More into quick, inexpensive options.	Disagree	Disagree	Disagree
Didn't want SustainableWorks as contractor	Disagree	Agree	Agree
Auditor wasn't thorough	Strongly Disagree	Strongly Disagree	Disagree
Pricing too expensive	Disagree	Neutral	Neutral

Table 2. Comparison of Most Common Barriers Across the Three Groups. Most common responses (mode) from all three groups when asked what factors were barriers to investing in energy efficiency improvements.

The clear barrier across the three groups is affordability, with both Participants and the DIY/Outside Contractor group most commonly responding “agreed” that it was a barrier and Non-Participants responding “strongly agreed.” This finding is in line with the findings of Leiserowitz, Maibach and Roser-Renouf’s 2009 study that surveyed over 2,000 American adults, and found that the most frequent reason for not purchasing a variety of energy efficiency upgrades was “I can’t afford it.” As that report also states, this illustrates the importance of incentives and rebates are in reducing barriers for homeowners to upgrade their homes. It also

has implications for how SustainableWorks approaches homeowners for whom cost is a significant barrier: even if they have no other barriers at all, or if the program is able to help overcome other barriers, this may be significant enough to keep them from being able to invest in upgrades.

It is easy to understand why many people agreed that affording the project or initial payment was a barrier. Besides not wanting SustainableWorks as a contractor, financial barriers were the only other barriers that did not have common responses of “disagree.” Concern about return on investment, payback period, and pricing being too expensive all had common responses of “neutral” and “agree.”

An interesting finding from this study was that for all three groups, the most common response about the importance of a barrier was “disagree.” Out of 13 given barriers, the large majority of barriers were reported as not important, with the one exception of difficulty in affording the initial payment or project. Comparing across groups, the non-participants reported affordability as a more important barrier than the other two groups.

From the responses, it appears that many barriers are, in fact, not strong barriers at all. In all three of the groups, six out of the 13 factors were commonly rated as “disagree” that they were important barriers. These included concern about return on investment, disagreeing with recommendations, not being convinced of benefits, not believing it would add to resale value, the audit not being what the homeowner expected, and being interested in more quick, inexpensive options. One potential barrier, moving soon, was rated as “strongly disagree” by all three groups.



**Comparison of Individual Barriers.** With almost 54% of Non-Participants strongly agreeing about the concern of affording the project or initial payment, they were more than twice as likely to respond this way than Participants, at 24.3% (see Figure 11). The average rating of this barrier by Non-Participants was 4.17, larger than the other two groups’ averages at 3.56 and 3.85, respectively. It was the only barrier out of all three groups with the most commonly response of “strongly agree.”

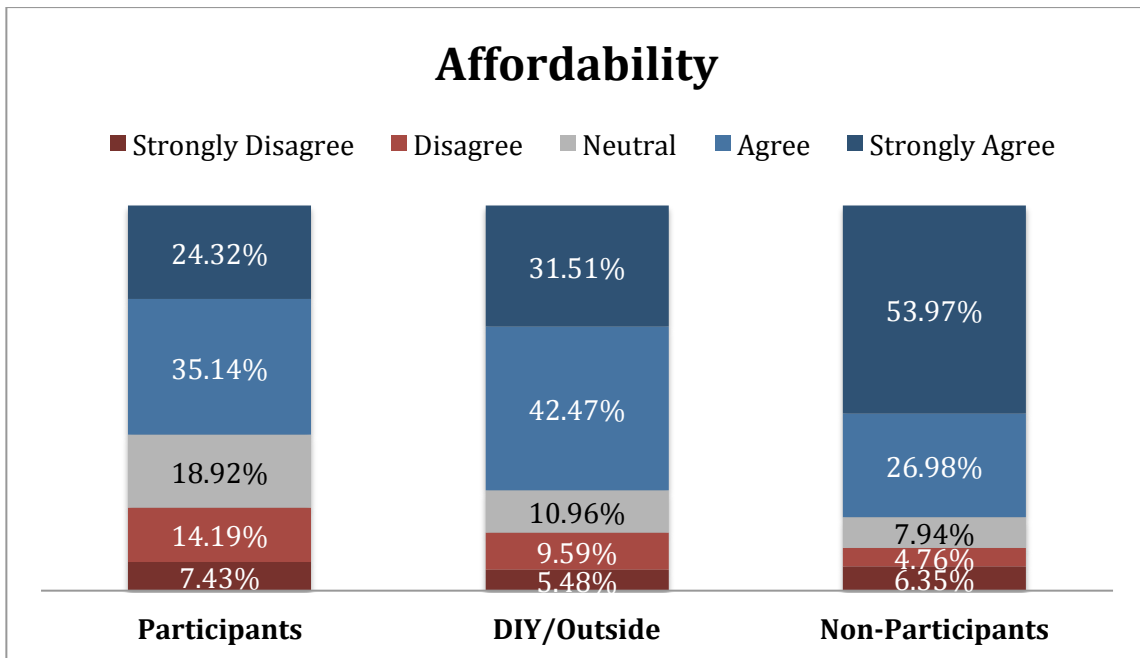


Figure 11. Barrier of Affordability of Project or Initial Payment. Responses when asked to rate how concerned the respondent was about affording the project or initial payment.

A few factors showed more disagreement between the groups. In regards to concern about payback period as an important barrier, participants’ most common response was disagree, the DIY/Outside Contractor group was agree, and non-participants was neutral. Figure 12 shows the distribution of the group’s responses regarding payback period.

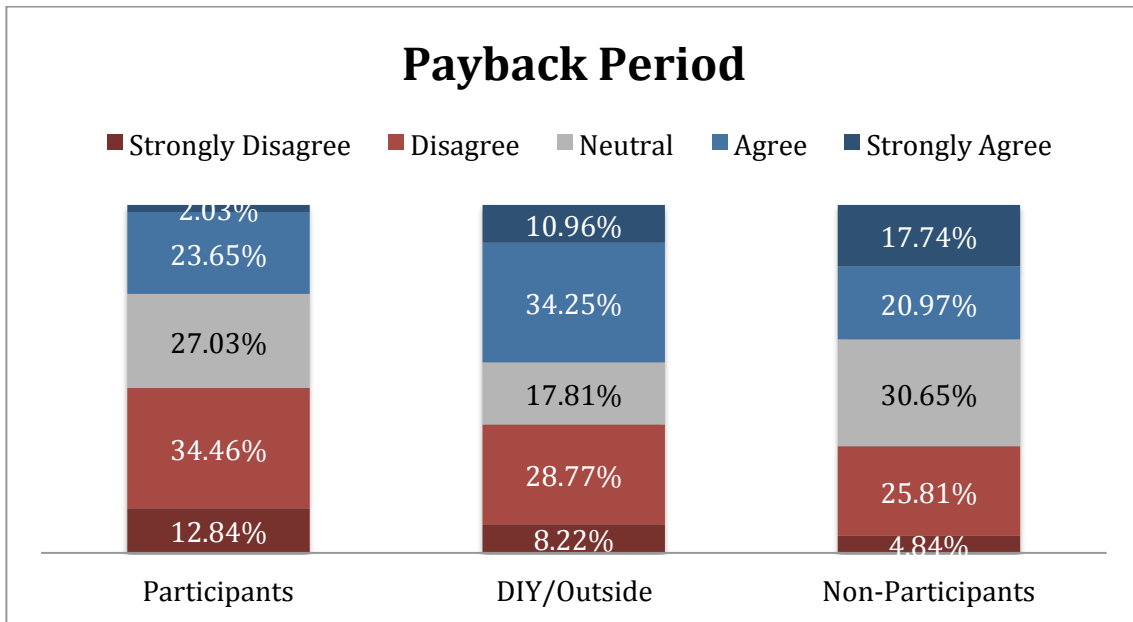


Figure 12. Barrier of concern about payback period. Responses when asked to rate how concerned the respondent was about the payback period.

The distribution of responses related to the prices of upgrades was even more varied, with much higher percentages of the DIY/Outside Contractor group strongly agreed or agreed to the statement “SustainableWorks’ pricing is too expensive” in comparison with the Participants. This may have been a primary reason why this group decided to invest in upgrades outside of the SustainableWorks’ program. Non-Participants, however, were most likely to respond as neutral and were less likely to agree or strongly agree than the DIY/Outside Contractor group (Figure 13).

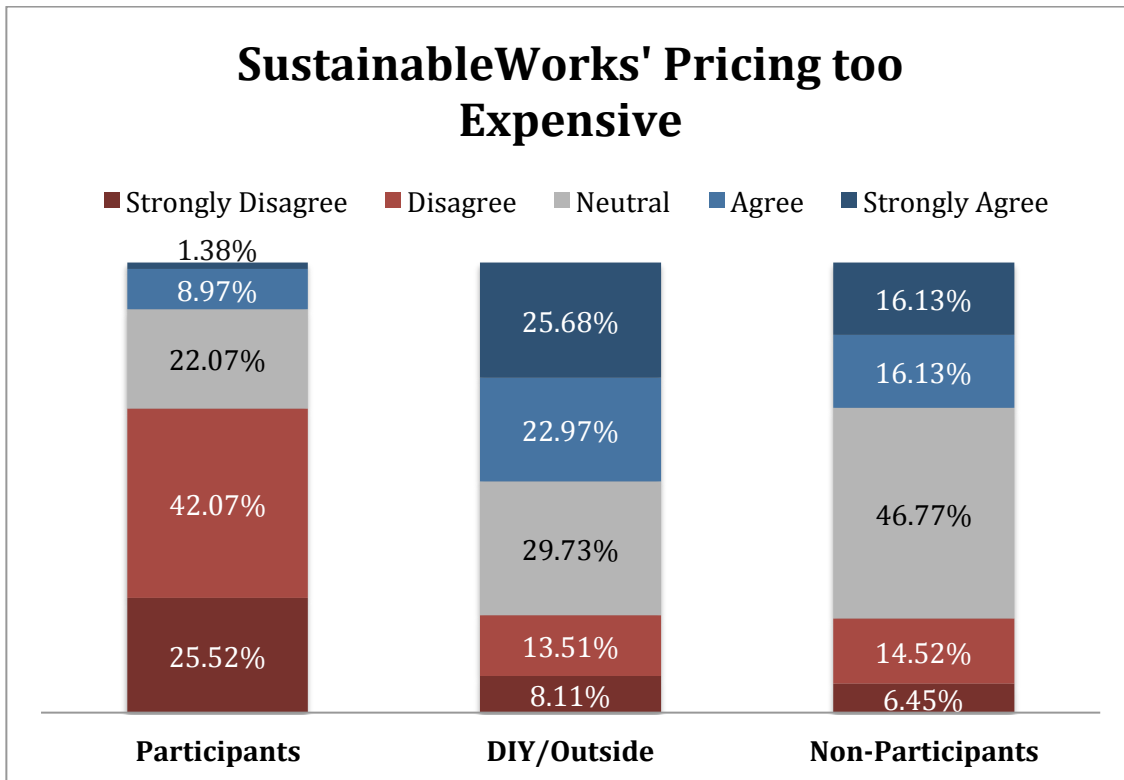


Figure 13. Barrier of concern about SustainableWorks' pricing being too expensive. Responses when asked about agreement for the statement, "SustainableWorks' pricing was too expensive."

The two other financially-related barriers were concern about return-on-investment, and concern about the investment increasing resale value of the home. The distributions of ratings were similar for these two factors (see Figures 14 and 15). Non-Participants were much more likely to strongly agree that they were concerned about the return on investment than the other groups (Figure 14). For concern about resale value, the DIY/Outside Contractor group was slightly more likely to strongly agree about their concern (Figure 15).

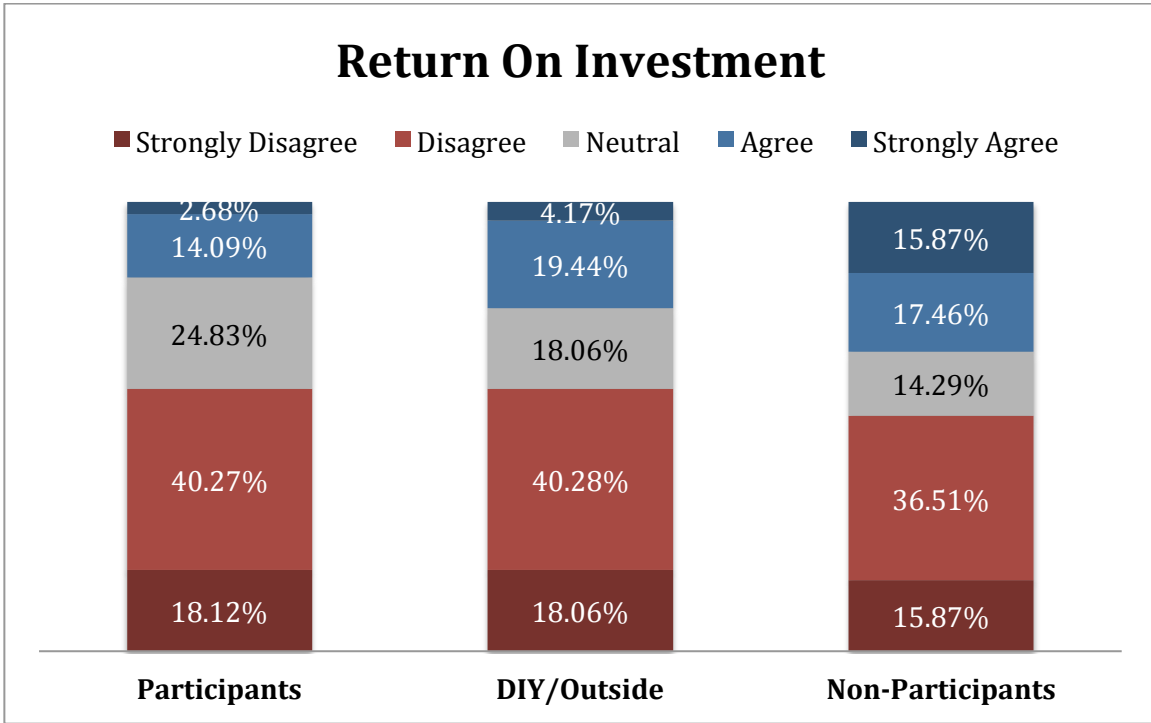


Figure 14. Barrier of concern about return-on-investment. Responses when the respondents were asked about agreement for the statement, “I didn’t believe there would be a good return on my investment.”

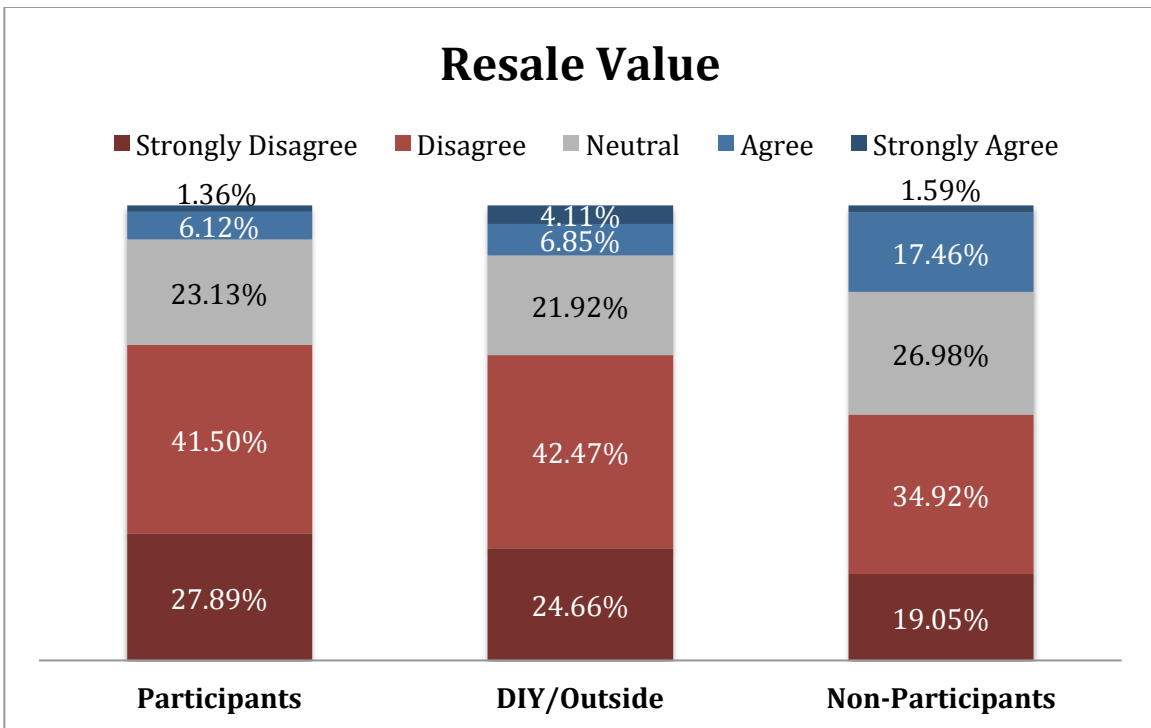


Figure 15. Barrier of concern about resale value. Responses when asked about agreement for the statement, “I did not feel that the upgrades would add resale value to my home.”

One highly rated factor that both Non-Participants and DIY/Outside group members often agreed about was the statement, “I did not want SustainableWorks as a General Contractor” (Figure 16). Though the primary goal of a home energy audit is that the homeowner will follow through with recommendations through their organization, it cannot be considered a failure if a portion of clients who participate in an audit end up having work completed outside of the program. However, if there are ways to encourage homeowners by increasing credibility such as testimonies from past clients, this could be one way to convert more audits to finished projects SustainableWorks’ projects.

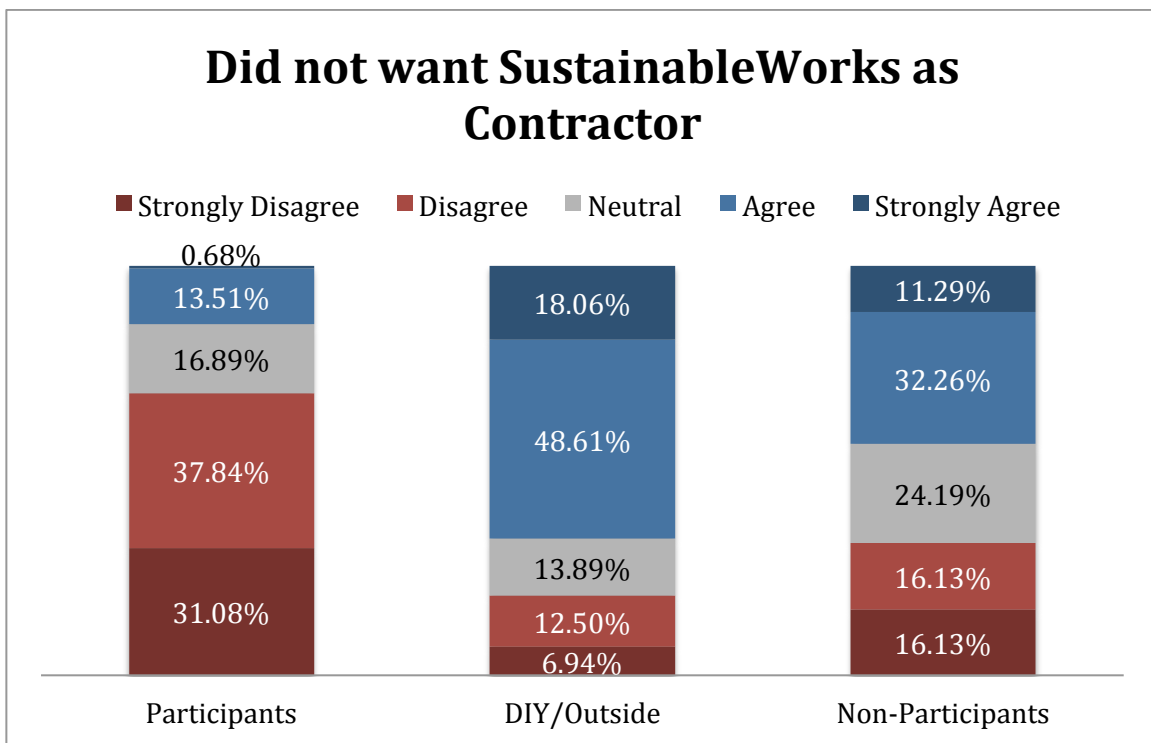


Figure 16. Barrier of not wanting SustainableWorks to act as the general contractor. Responses when asked about agreement with the statement, “I wanted the work done but I wasn’t sure I wanted to go through the SustainableWorks program to make the improvements.”

The next six factors were not related to finances. They include inconvenience of scheduling (Figure 17), disagreeing with the recommendations (Figure 18), not

being convinced of the benefits (Figure 19), the audit not being what the homeowner was expecting (Figure 20), being more interested in quick or inexpensive options (Figure 21) and finally, believing that the auditor was not thorough enough (Figure 22). This distribution of agreement for all of these factors was relatively similar, as can be seen in the following six figures.

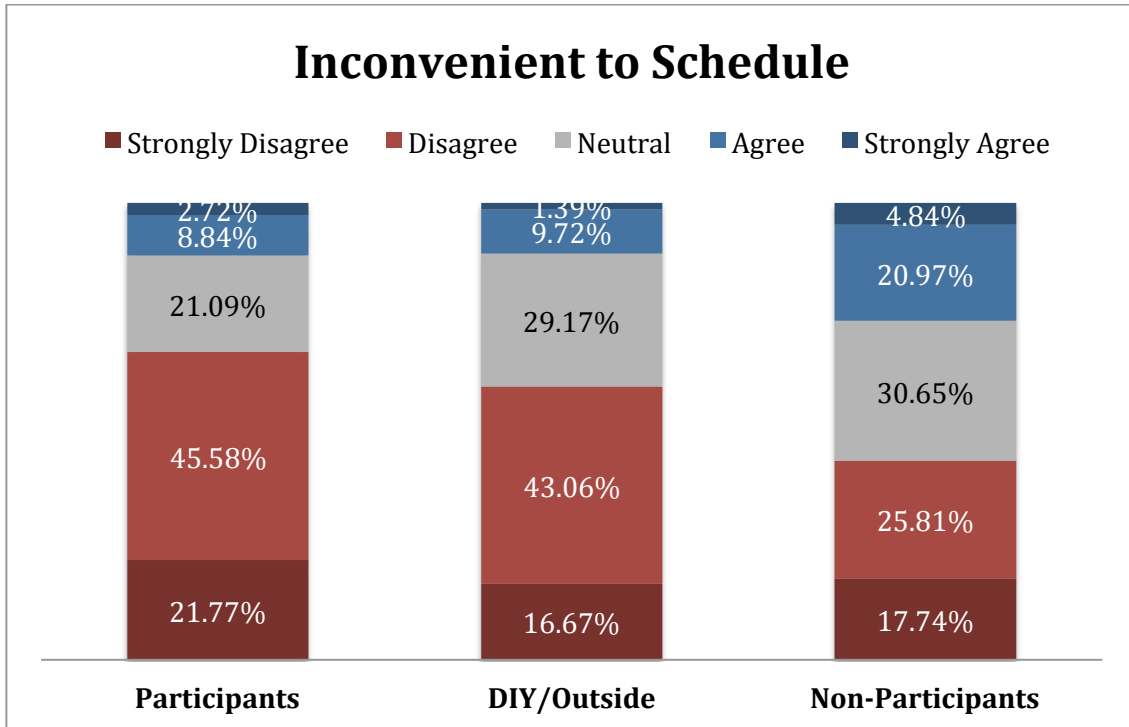


Figure 17. Barrier of concern about inconvenience. Responses when the respondents were asked about agreement for the statement, “It was inconvenient to schedule the work.”

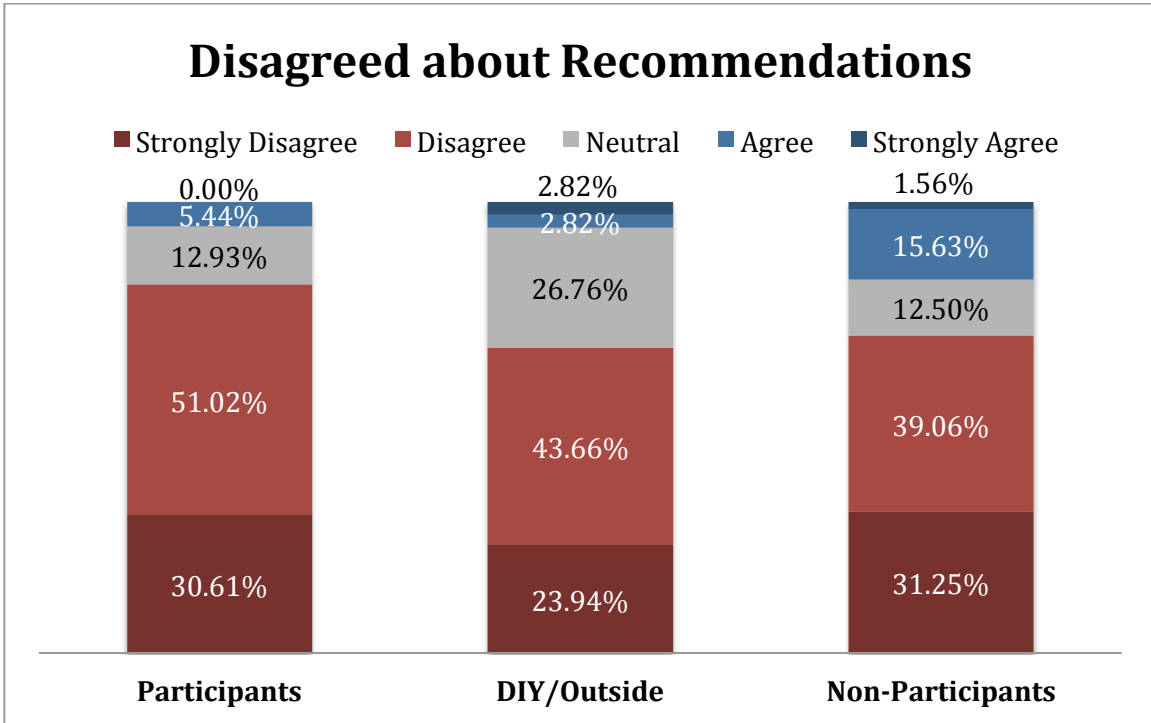


Figure 18. Barrier of concern about disagreeing with recommendations. Responses when the respondents were asked about agreement for the statement, “I disagreed with what was recommended to me.”

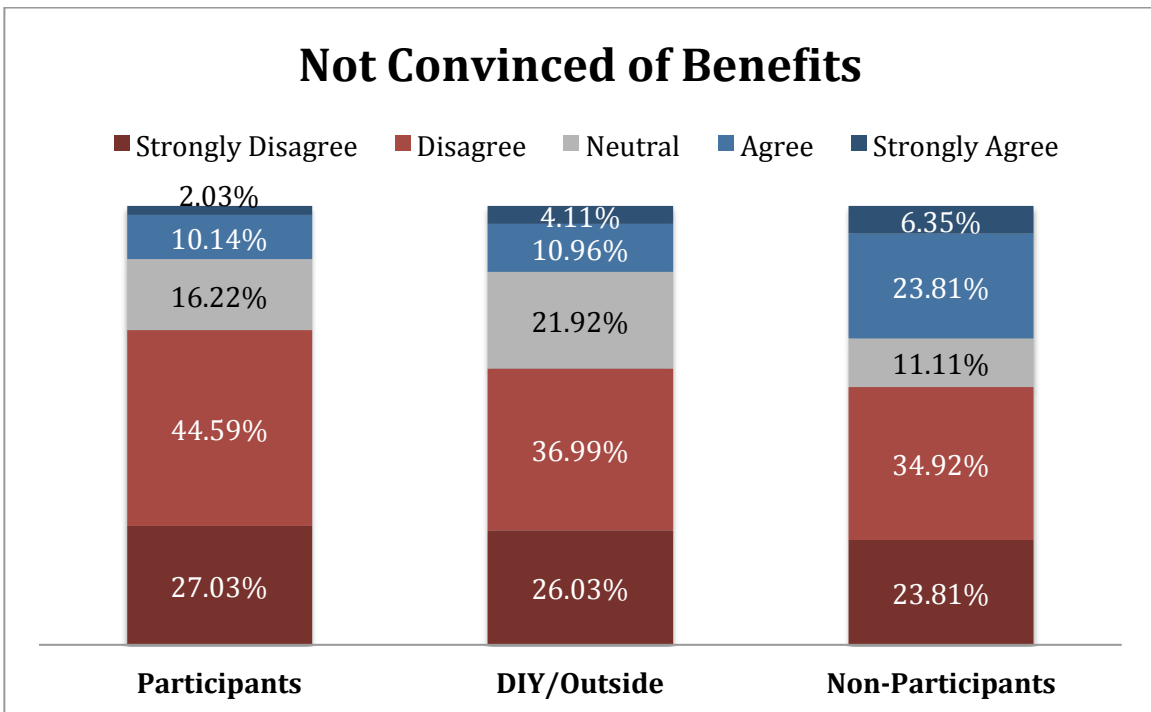


Figure 19. Barrier of concern about not being convinced of benefits. Responses when asked about agreement for the statement, “I was not fully convinced of the benefits of the recommended upgrades.”

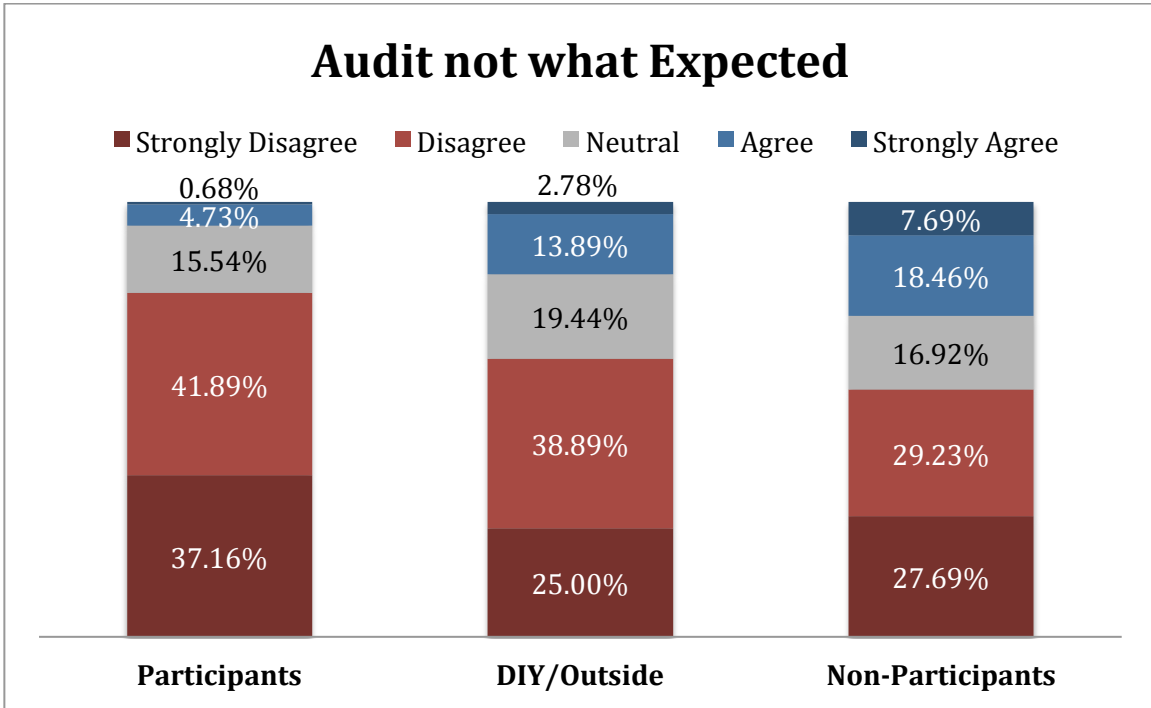


Figure 20. Barrier of the audit not being what the homeowner expected. Responses when asked about agreement for the statement, “The audit was not what I expected.”

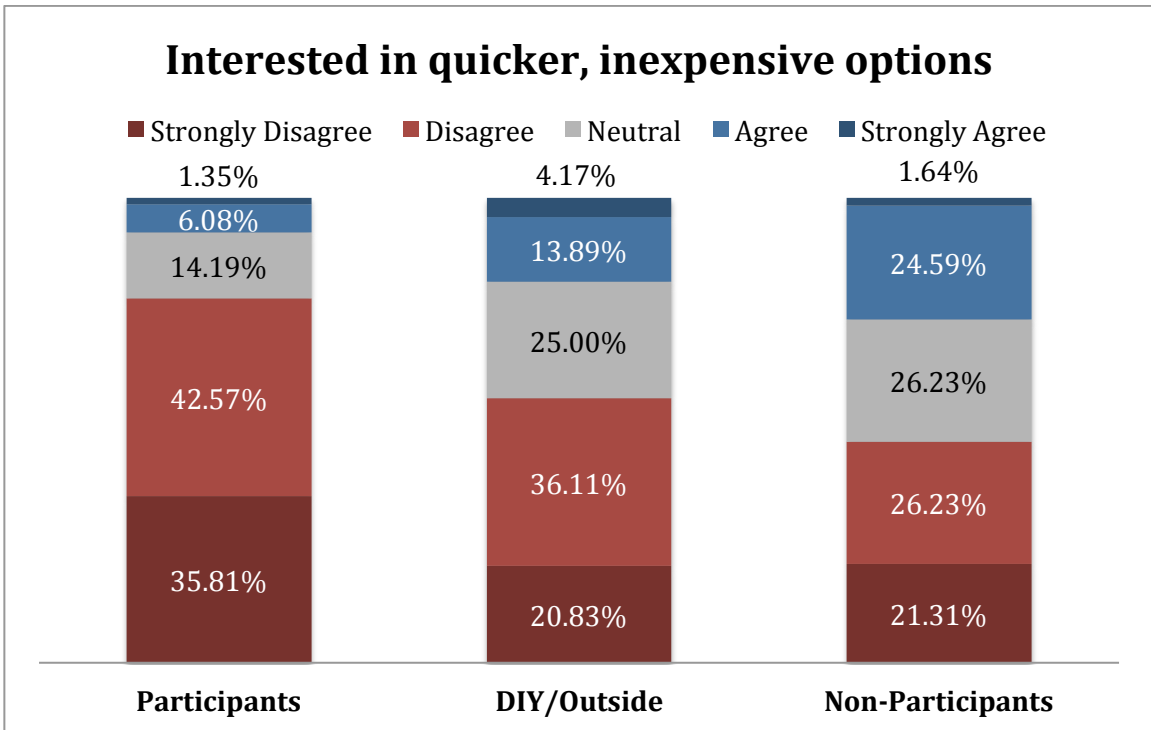


Figure 21. Barrier of not being interested in deep upgrades. Responses when asked about agreement for the statement, “I was more interested in quick, inexpensive options.”



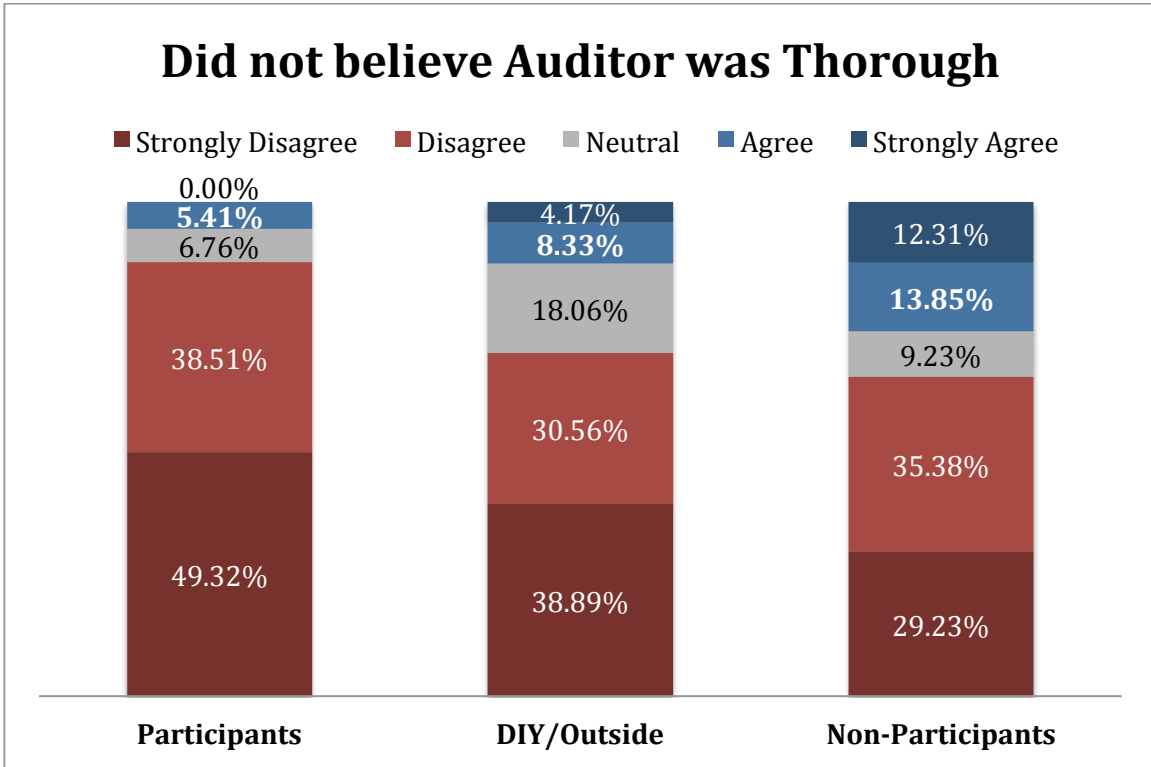


Figure 22. Barrier of believing that the auditor was not thorough. Responses when asked about agreement for the statement, “I didn’t feel that the auditor was thorough enough in assessing my home.”

Finally, the barrier of moving soon was rated low for all groups (Figure 23), and increasing the value of the home was rated in the bottom half of motivational factors, which also indicates that it is not something the homeowners are worried about. They appear to be more interested in the benefits that will affect them sooner, such as saving money on energy bills, reducing carbon footprint and increasing comfort, rather than benefits that they will get later on, such as having a home that is higher in value.

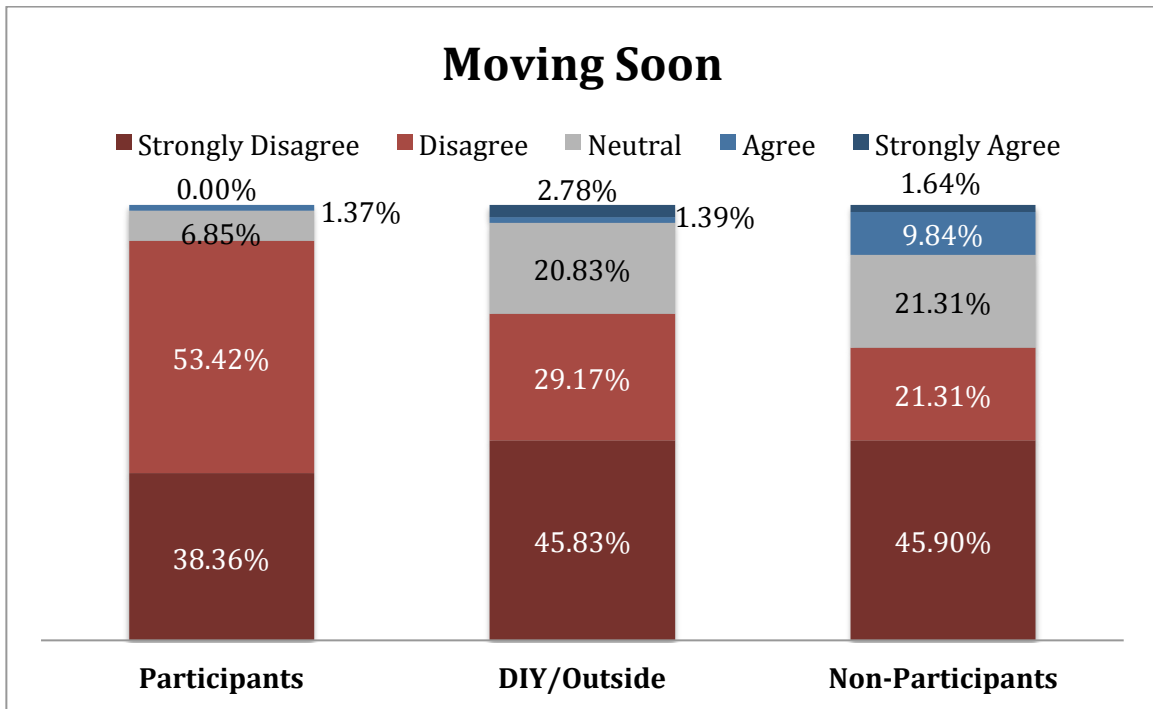


Figure 23. Barrier of concern about moving soon. Responses when asked to rate concern the homeowner had with investing because they were planning to move soon.

As is seen from the previous bar charts, though significant differences in barriers were not found in the three groups overall, comparing the distribution of agreement provides further insight into the variation of responses.

**Overcoming Barriers.** When Participants were asked what methods were used to overcome barriers, the highest response was qualifying for financial incentives (73%). Forty percent of respondents said they were reassured by the quality assurance and warranty. Nearly 40% reported doing their own research about the recommended improvements and 30% asked their auditor for more information. Financing through SustainableWorks’ partnership was reported by 39%, and financing through an outside institution was reported by 17%. See Figure 24 for the rest of the responses.

Participants’ methods of overcoming barriers are in line with the barriers that were identified as most important. The most common method was qualifying for

financial incentives, which helps to increase affordability. Many also reported financing through SustainableWorks partner credit union or an outside lender.

It is interesting that people rated concern about return on investment and payback period somewhat lowly, often as “neutral.” Also, participants didn’t often identify calculating those as a common way to overcome barriers. The concepts are more confusing than outright affordability, so they may not be well understood by homeowners. For example, Kempton, Gladhart and Keefe (1983) found that homeowners often failed to take into account future price increases and therefore underestimated potential savings when considering installing insulation in their homes.

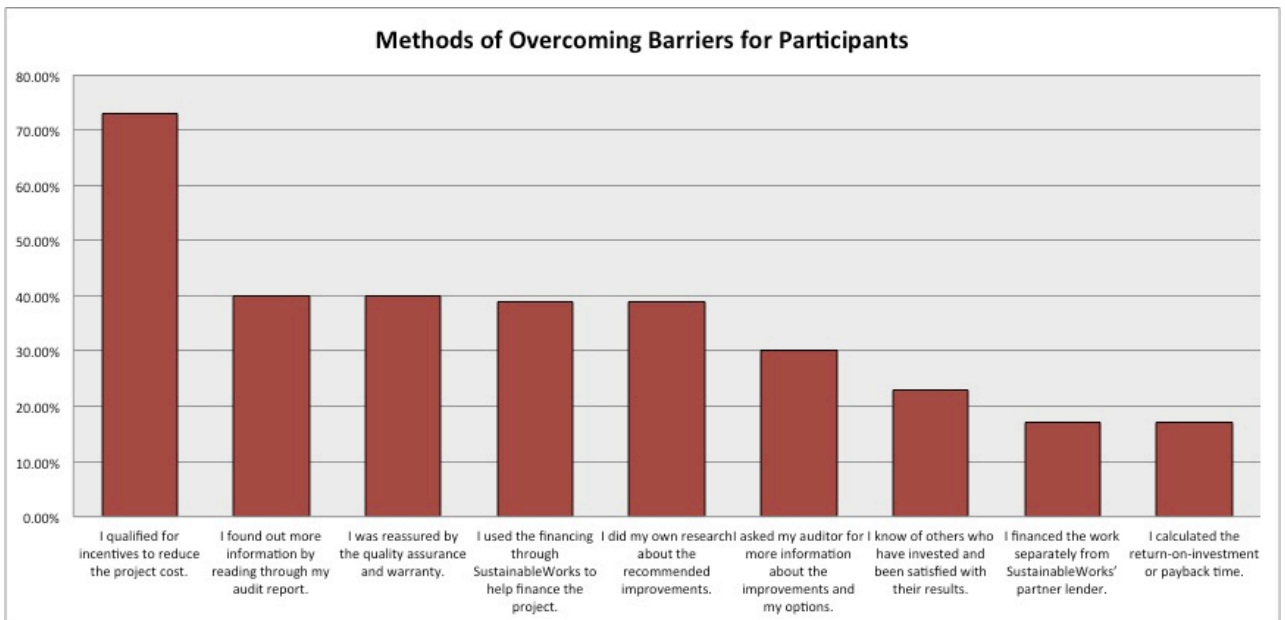


Figure 24. Participants’ Methods of Overcoming Barriers. Participants were asked to select all of the methods they used to overcome the previously listed barriers.

### Conditions that may help non-participants to move forward

Both Non-Participants and the DIY/Outside Contractor groups were asked to rate conditions that might help them move forward with making home energy

efficiency upgrades. The factor rated highest for both groups was decreasing the cost through incentives and rebates, with the DIY/Outside Contractor group most commonly answering agree and the non-participants strongly agreeing (Figure 25). The averages for that factor were very similar, however, with DIY/Outside Contractor group's average at 4.35 out of 5 and Non-Participants with an average of 4.30.

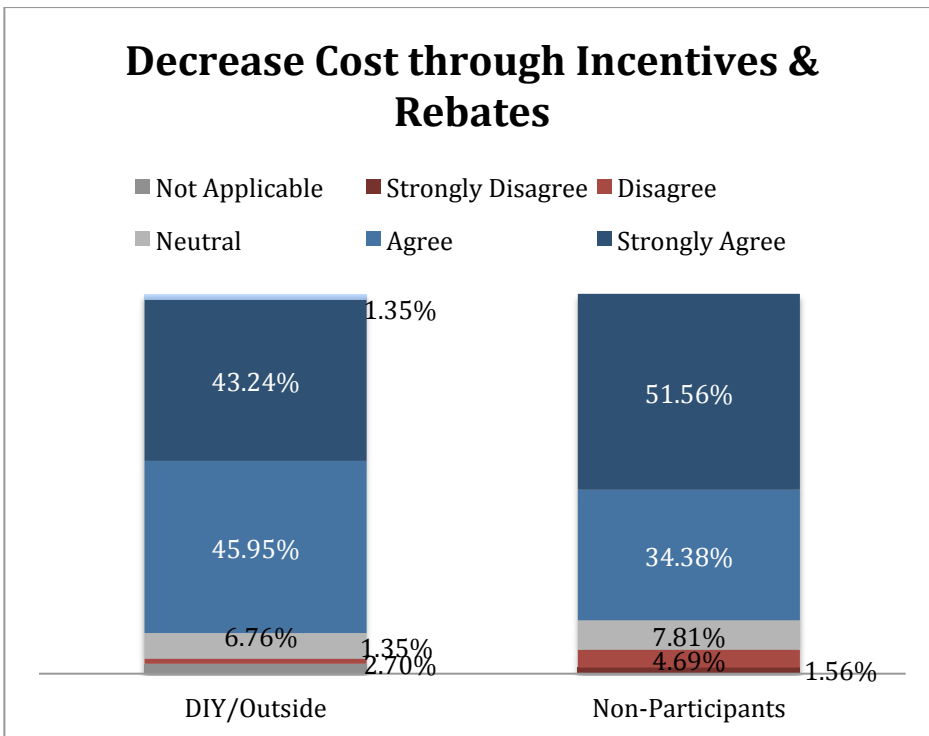


Figure 25. Decreasing cost to encourage participation. DIY/Outside Contractor and Non-Participants responses when asked to rate if decreasing the cost through incentives and rebates could help them move forward in making upgrades. .

Non-Participants also agreed that more information about how to pay (Figure 26) and more information about the return on investment and/or payback period would help (Figure 27). These may be areas that could be improved to increase the number of SustainableWorks clients. Both groups most commonly responded with “neutral” or “disagree” for the rest of the given conditions.

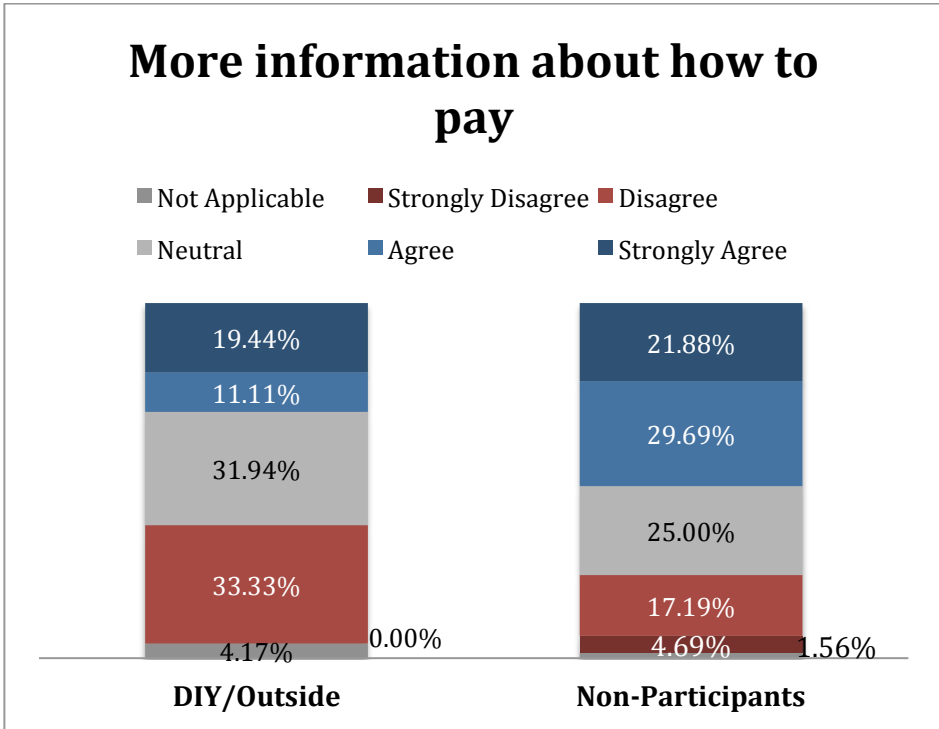


Figure 26. DIY/Outside Contractor and Non-Participants responses when asked to rate if having more information about how to pay might help them move forward in making upgrades.

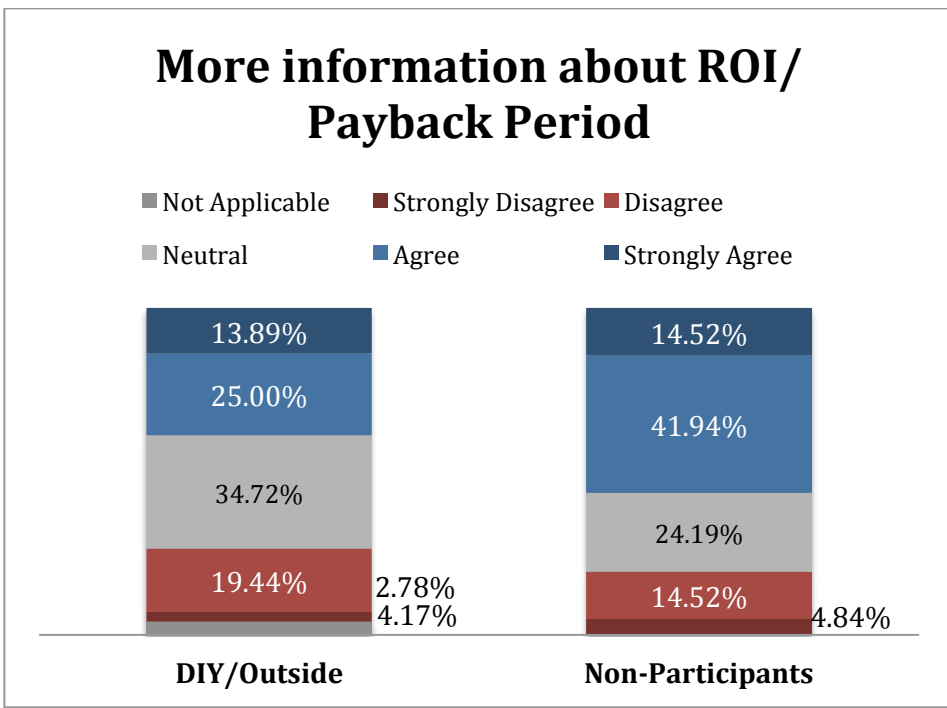


Figure 27. DIY/Outside Contractor and Non-Participants responses when asked to rate if having more information about return on investment or payback period might help them move forward in making upgrades.

The most common response for both groups was often “neutral,” which may indicate that most of the time, more information is not the solution to overcoming their barriers. Again, financial issues were highlighted with “decrease the cost with incentives and rebates” being the most agreed upon factor in both groups. The two groups did not agree on other statements, such as, “provide more information about how I could pay for the improvements;” the DIY/Outside Contractor group was most likely to disagree with that statement while the Non-Participants were more likely to agree.

<b>Would any of the following conditions help you move forward with making home energy efficiency upgrades?</b>	<b>DIY/Outside Contractor most common response</b>	<b>Non-Participants most common response</b>
Decrease the cost	Agree	Strongly Agree
More information about how to pay	Disagree	Agree
More information about the work	Neutral	Neutral
More information about ROI/payback period	Neutral	Agree
More convenient to schedule the work	Neutral	Neutral
Improve communication	Neutral	Disagree
Make the recommendations easier to understand	Neutral	Neutral
Help me better understand the value of making home energy efficiency improvements.	Neutral	Neutral
More info about the program/quality assurance	Disagree	Neutral

*Table 3.* Most Common Response Regarding Conditions to Encourage Non-Participant and DIY/Outside Contractor groups to Invest in Upgrades. Most common responses (mode) from DIY/Outside contractor and Non-Participant groups when asked what factors were barriers to investing in energy efficiency improvements.

The Non-Participants were also more likely to agree that they would like more information about the return on investment and/or payback period, while the DIY/Outside contractor group was neutral. These comparisons give a little more

insight into what barriers the groups have, and how they may differ. For example, for those who did some of the recommended upgrades outside of SustainableWorks (the DIY/Outside Contractor group), more information about how to pay will likely not affect them, whereas it may help the homeowners in the Non-Participant group to better understand their options and could possibly increase their likelihood to invest.

It also provides some insight into what SustainableWorks is doing well, and thus what the organization does not need to take great strides for improvement. For example, Non-Participants’ most common response about the need to improve communication was “disagree,” showing that this is not a problem for that group. Also, DIY/Outside Contractor group most often responded “disagree” that they needed more information about quality assurance. This allows the SustainableWorks staff to better understand what is working well, and where they should put effort into improvement.

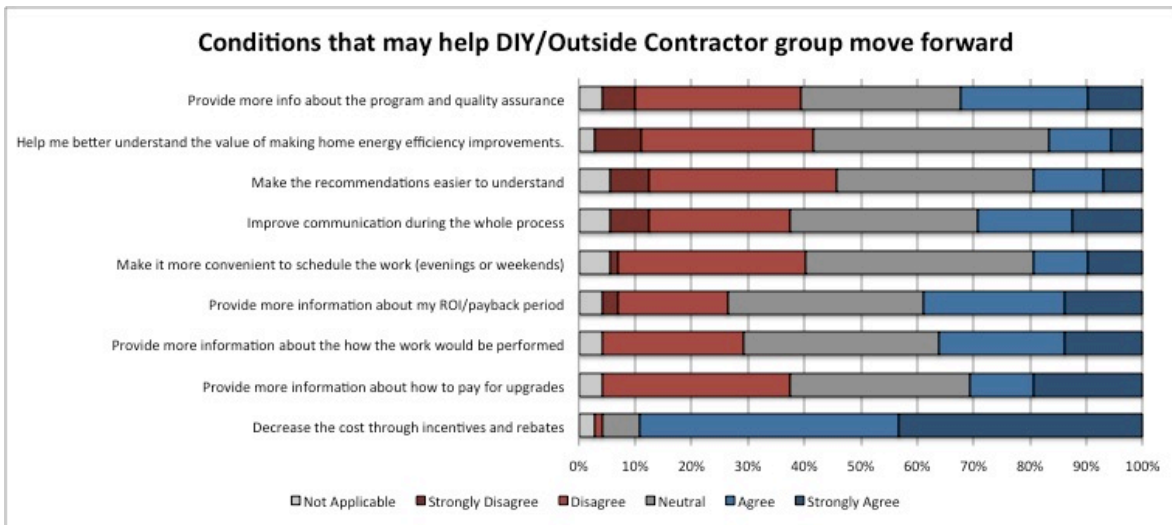


Figure 28. Conditions to Help DIY/Outside Contractor Group to Invest in Upgrades. DIY/Outside Contractor group’s responses when asked, “Would any of the following conditions help you move forward with making home energy efficiency upgrades? Select all that apply.”

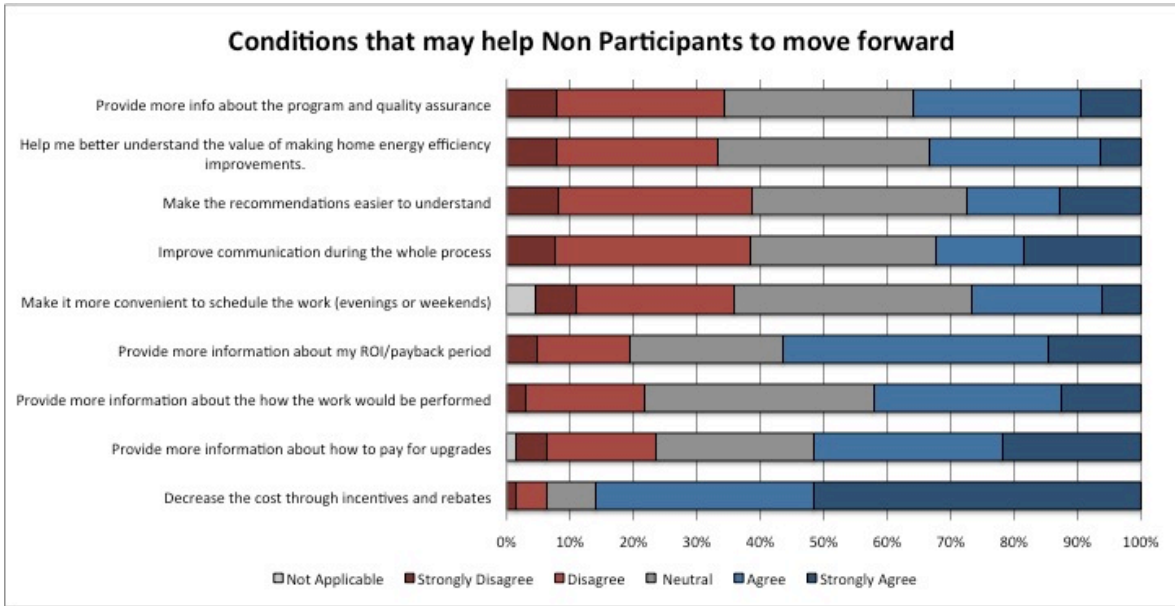


Figure 29. Conditions to Help Non-Participants Invest in Upgrades. Non-participant responses when asked, “Would any of the following conditions help you move forward with making home energy efficiency upgrades? Select all that apply.”

### Implications and Recommendations for Social Marketing Campaigns

SustainableWorks already uses many social marketing techniques that attempt to reduce barriers, including utilization of neighborhood block leaders, attending various community events and working with local community organizations.

Partnering with local municipalities and utilities has helped to increase both their reach and their credibility. By acting as a general contractor, they remove the barrier of homeowners having to find multiple sub-contractors. They also have removed the inconvenience of having to apply for multiple rebates and incentives; the amounts are removed from the SustainableWorks bill immediately and their staff works to apply for the rebates through the state and local utilities on the homeowners’ behalf.

These are great ways to overcome barriers, but if the only commonly reported barrier is affordability, to increase participation more must be done to bring the prices



down in some way. While they are able to provide some incentives above what the local utilities and state provides, this is apparently not enough to overcome the barrier of cost for many homeowners.

Even though the amount of subsidies provided by utilities and the state is out of control of SustainableWorks, there are a few things that could help homeowners to better realize the cost savings of investing in home energy efficiency over time. The organization already provides the client a prioritized list of recommended work after the comprehensive audit, starting with the projects that would have the highest impact for their cost, or “bang for their buck.”

To further remove barriers related to finances, a tailored, easy-to-understand explanation of how the investment can financially benefit the homeowner should be provided. This is especially true in regards to the concepts of return on investment and payback periods, which can be difficult to calculate. This explanation can help to illustrate that even with high initial cost, energy efficiency upgrades can be wise investments over time. Also, highlighting the partnership that SustainableWorks has with a local credit union can encourage homeowners to invest. However, if a homeowner simply does not have the capital to make the initial payment, these points are irrelevant.

Home energy audits provide a very important step to making the decision to have retrofit work done. This opportunity to have face-to-face interaction with homeowners allows organizations like SustainableWorks to help overcome potential barriers, especially reducing uncertainty and gaining trust in the program. Research like this study in which I attempt to identify the most significant barriers is crucial to

effectively use this valuable time with homeowners. Studies have found that the most effective information to promote home energy efficiency is simple, relevant, and easily understandable, rather than very technical, factual information that is difficult for the homeowner to relate to (Kempton & Montgomery, 1982; Yates & Aronson, 1983).

Home energy audits not only offer homeowners the rare ability to have personal contact with someone in their own home, they also provide auditors the ability to use a variety of social marketing tools in order to encourage homeowners to choose to make their home more energy efficient. The following section provides some possible methods to overcome a variety of barriers, using the home energy audit as an opportunity to tailor their messaging to the specific homeowner.

### **Using Social Marketing Techniques during Home Energy Audits**

Primarily, audits allow an opportunity for education, through explaining options for increasing energy efficiency by literally walking the homeowner through the home, explaining how it consumes energy. The auditor then provides a comprehensive report to go over. It helps to reduce uncertainty by listing potential upgrades in order of which changes will be most effective in conserving energy and most cost effective. When an organization is able to act not only as auditor but also as a general contractor, like SustainableWorks does, the difficulty of finding a reliable contractor is removed as well. Studies have found that programs that did all of these elements were much more successful than those that only did one or two (Stern et al., 1986; Stern, 2000).

In a review of home audit programs, Hirst (1984) comes to the conclusion that auditors should spend more time with household members rather than just collecting the necessary measurements. By encouraging them to participate in the audit, the auditor can attempt to make the homeowner more interested in the process. This will likely also increase their commitment to conservation measures in general. Gonzales et al (1988) states that involving the homeowner in the process invokes the feeling that they care about the audit, which in turn makes them feel like they should follow through with improving their home's efficiency. In spending more time interacting with household members, less time should be spent on the technical details of the audit. This is not an issue, according to Hirst (1984), who states that in a comparison of technical versus simple procedures, the simpler audits were just as effective.

Framing can be used in an audit situation as well. Rather than explaining benefits of upgrades in terms of saving or gaining money, auditors can refer to the current losses that the homeowner is experiencing by not having an insulated home or having an inefficient technology (Gonzales et al., 1988).

There is an important need to take time to explain the benefits of investing in home energy efficiency. Even if the auditor provides perfectly accurate information, if it is not presented in a manner that is very understandable and easy to act upon, then the audit will likely fail to encourage the desired behavior, which is improving the energy efficiency of the home (Yates & Aronson, 1983). For example, many homeowners do not appropriately measure the amount of energy they use, often measuring their consumption in dollars rather than technical units such as kilowatt-hours, which is inaccurate since rates can change. Kempton and Montgomery (1982)

refer to this as “folk quantification.” This often creates an inaccurate picture of how much energy they are consuming and makes their cost-benefit analyses inaccurate. If home auditors can clearly explain energy consumption and the potential return on investment, homeowners may be more likely to invest in retrofit work.

In order to use the tool of social diffusion, the actions of the homeowners must be made more visible to their friends and neighbors. One way SustainableWorks does this is by providing yard signs to clients who implement the recommended upgrades. They also provide case studies on their website with photos of clients in front of their home with “before and after” information including costs of heating, energy use, and tons of carbon emitted.

### **Limitations To This study**

One limitation to this study was the ability to analyze Likert-type data. As mentioned before, it is not entirely appropriate to assume equal distances between each given option on the 5-point scale, so some liberty was taken with the decision to report results as averages.

Another limitation was the inability to ask further question in a survey, as would be possible in focus groups. For example, after asking a homeowner to rate the importance of a factor, a follow up question could have been asked to explain their choice and gain further insight into how the homeowner makes his or her decision.

## **Recommendations for Future Research**

This research brings up other questions that can be further investigated. Though most motivational factors were rated highly, having respondents rank their top motivations would provide better insight into what is truly important in making their decision. This would allow practitioners to design campaigns completely tailored to the homeowner's strongest motivational factors.

The effect of increasing knowledge through education could also be researched for the factors that were identified as barriers and motivators. For example, does increasing knowledge about how much money can be saved increase that factor as a motivator? For a barrier such as concern about payback period, could calculating the specific payback period for each homeowner reduce this concern?

Since affordability was the only highly rated concern, it would be beneficial to research further into this problem for homeowners. Though income level was not shown to be different among groups, there are other financial factors such as savings and debt that may play a large part into whether or not a homeowner can afford the initial payment or project cost.

Finally, another interesting follow-up study would be identifying the reasons that the DIY/Outside contractor group did not want to use SustainableWorks as their general contractor. It is possible that some had personal or professional connections to contractors who could do the upgrades, or they were able to do the upgrades themselves. However, finding out if there were any other reasons may benefit SustainableWorks in contracting the highest possible percentage of those who have audits through the organization.

## **Chapter Five: Conclusion**

This survey of nearly 300 homeowners in the Puget Sound region of Washington State who had home energy audits conducted for their homes by SustainableWorks found no significant difference in demographic characteristics or ratings of barriers among the Participants, DIY/Outside Contractor group and Non-Participants. Studies that attempt to identify important barriers are crucial to a social marketing campaign. If barriers are assumed, much time and money may be wasted in overcoming barriers that simply do not exist for the target audience.

The only factor that was commonly rated as a barrier was the affordability of the project or initial payment, and that held true for all three groups. Understandably, the two groups who did not participate in the SustainableWorks program were more likely to report that they did not want SustainableWorks to act as a general contractor. Also, the DIY/Outside Contractor group was more likely to be concerned about the length of the payback period.

By continuing practices to reduce uncertainty while increasing credibility and knowledge of the numerous benefits of increasing a home's efficiency, SustainableWorks can continue to work to overcome the barriers that are within their control. One opportunity for improvement may be to better explain payment options and provide more information about the return on investment and payback period for investments, since both of these factors were identified by non-participants as something that may help them move forward with making upgrades.

Though ideally homeowners who have audits would move forward with upgrades through SustainableWorks, the audits can be considered partially successful

from the finding that over half of the homeowners do invest in some upgrades, whether through another contractor or doing it themselves. Future research could identify why some homeowners chose to implement the work outside of SustainableWorks in attempt to encourage more to take advantage of the non-profit, state-funded program.

SustainableWorks already utilizes many social marketing techniques and tools in their program to encourage homeowners to have home energy audits and efficiency upgrades. The finding that many factors were not identified as barriers to investing in efficiency upgrades may be a testament to their neighborhood-based, community-organizing model that utilizes partnerships with community organizations and volunteers.

## Appendices

### Appendix A: Participant Survey

#### SustainableWorks Participant Survey

Dear SustainableWorks Participant,

Thank you for participating in the SustainableWorks program. You are receiving this letter because you have participated in a home energy assessment with SustainableWorks.

SustainableWorks is one of eight non-profit organizations in Washington State helping homeowners save energy through home energy assessments and improvements. Our community-based program believes in the continued improvement of our services through input from our community and program participants.

Our organization has been asked by Jana Fischback, Master of Environmental Studies Candidate with The Evergreen State College, to participate in her graduate study about what motivates people to improve their home for energy efficiency and what some of the barriers are for making improvements. Ms. Fischback provides more information about her study in the following documentation. Your participation in the study will help us better understand the opportunities and challenges around home energy efficiency in our community. This study is completely optional, and only Ms. Fischback will see your personal responses to the survey.

Thank you for your participation in the SustainableWorks program. If you have any questions about SustainableWorks, please contact me at (206) 575-2252 or [kellie.stickney@sustainableworks.com](mailto:kellie.stickney@sustainableworks.com).

Sincerely,

Kellie Stickney  
Director of Marketing and Outreach

Dear Participant,

I am a graduate student at The Evergreen State College earning my Masters of Environmental Studies. As part of my thesis research, I am studying motivations and barriers to energy efficiency improvements for homeowners in Washington State. The purpose of my project is to gather information about homeowners who have had energy audits and produce a thesis research paper and presentation about my findings.

Your responses will be confidential and the survey will not collect identifying information such as your name, email address or IP address. All data is stored in a password protected electronic format. Only I will be able to access your individual responses to the survey. Aggregates and summaries of the responses, however, will be shared with SustainableWorks and may appear in publications and presentations of the research findings.



## SustainableWorks Participant Survey

*Your participation is completely voluntary.* You may withdraw your participation at any point or skip any question you do not wish to answer without penalty. As a way of thanking those who participate, **all participants who complete the survey will be entered in a random drawing for one of three \$50 gift cards to a home improvement store of your choice** (Home Depot, Lowes, or Ace Hardware).

If you have any questions about this project or your participation in it, you can email me at [fsjan16@evergreen.edu](mailto:fsjan16@evergreen.edu). The person to contact if you experience problems as a result of your participation in this project is John McLain, Academic Grants Manager at The Evergreen State College, Library 3821, Olympia, WA 98505; Phone (360) 867-6045.

Thank you for your participation.

Sincerely,  
Jana Fischback

Master of Environmental Studies Candidate

## Consent Form

## SustainableWorks Participant Survey

I hereby agree to serve as a participant in the research project titled “Motivations for and Barriers to Energy Efficiency Investments for Homeowners in Washington State.” It has been explained to me that its purpose is to gather information about my home energy audit and reasons why I did or did not move forward with recommended upgrades. This online survey should take about 10 minutes.

I also understand that my responses will be reported in publications and presentations of the research findings, and my identity will be kept confidential and no identifying information about me will be included. Ms. Fischback has agreed to provide, at my request, a copy of the final draft of the research report.

I understand that the risks to me are minimal, would likely be nothing more than inconvenience from filling out the survey and sharing about my reasons on why I did or didn’t move forward with recommended energy efficiency upgrades. I understand the results from my personal survey will only be seen by Ms. Fischback and her faculty advisor. The findings of the research will be shared with SustainableWorks after Ms. Fischback has processed the data and my identity will remain confidential.

I understand that I can skip any question or stop the survey and withdraw my full participation from the research at any time without penalty. I understand that if I have any questions about this project or my participation in it, I can contact Mrs. Fischback at [fisjan16@evergreen.edu](mailto:fisjan16@evergreen.edu). Likewise, the person to contact if I experience problems as a result of my participation in this project is John McLain, Academic Grants Manager at The Evergreen State College, Library 3821, Olympia, WA 98505; Phone (360) 867-6045.

**\* 1. By clicking “I agree” below you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this research study.**

I Agree

I Do Not Agree

### Questions 2-6

**2.**

**How did you hear of SustainableWorks?**

## SustainableWorks Participant Survey

**3.**

**When did you have a home energy audit performed? (If exact date is unknown, please estimate)**

Date / Time      MM    DD    YYYY  
                          /  /

**4.**

**Which upgrades did you invest in through SustainableWorks? (Please check all that apply)**

- Attic insulation
- Wall insulation
- Insulation of flooring or crawl space
- Air-sealing
- Duct-sealing
- New hot water heater
- New furnace or heating system
- New heat pump
- New windows
- Solar PV system

Other (please specify)

**5. After your audit, did you make any of the recommended home energy efficiency improvements outside of the SustainableWorks program?**

- Yes
- No

## SustainableWorks Participant Survey

**6.**

**If yes, which types of improvements did you make?**

- Attic insulation
- Wall insulation
- Insulation of flooring or crawl space
- Air-sealing
- Duct-sealing
- New hot water heater
- New furnace or heating system
- New heat pump
- New windows
- Solar PV system

Other (please specify)

### Question 7

## SustainableWorks Participant Survey

7.

**Please rate the importance of the following factors in your decision to invest in home energy efficiency upgrades that were recommended after your audit from SustainableWorks.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
I wanted to save money on my energy bills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted to reduce my carbon footprint.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted to increase the value of my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted my home to be more comfortable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted my home to be safer.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted to support quality jobs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted to support a local, non-profit program.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt it was a good financial investment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A friend or family member recommended increasing my home's energy efficiency.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify)

## Question 8

## SustainableWorks Participant Survey

### 8. Were any of the following factors barriers to moving forward with home energy efficiency improvements? Please rate the following factors.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
I was concerned about affording the project or initial payment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I didn't believe there would be a good return on my investment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt the payback period in the investment might be too long.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It was inconvenient to schedule the work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I disagreed with what was recommended to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was not fully convinced of the benefits of the recommended upgrades.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was planning to move soon so I wasn't sure about investing in the home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I did not feel that the upgrades would add resale value to my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The audit wasn't what I expected.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was more interested in quick, inexpensive options.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wanted the work done but I wasn't sure I wanted to go through SustainableWorks' program to make the improvements.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I didn't feel the auditor did a thorough enough job in assessing my home.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SustainableWorks' pricing was too expensive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify)

### Questions 9 & 10

## SustainableWorks Participant Survey

9.

**How did you overcome any of the barriers listed previously? Select all that apply.**

- I qualified for incentives to reduce the project cost.
- I used the financing through SustainableWorks to help finance the project.
- I financed the work separately from SustainableWorks' partner lender.
- I asked my auditor for more information about the improvements and my options.
- I found out more information by reading through my audit report.
- I did my own research about the recommended improvements.
- I was reassured by the quality assurance and warranty.
- I know of others who have invested and been satisfied with their results.
- I calculated the return-on-investment or payback time.

Other (please specify)

**10. Please share anything else you'd like about your experience with SustainableWorks:**

### Demographic Information

**11. Are you the primary decision-maker for your household?**

- Yes, or equal with another
- No, someone else is the primary decision maker

## SustainableWorks Participant Survey

### 12. Which category below includes your age?

- 17 or younger
- 18-20
- 21-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70 or older

### 13. What is the highest level of education you have completed?

### 14. What is your race?

- White
- Black or African-American
- American Indian or Alaskan Native
- Asian
- Native Hawaiian or other Pacific Islander
- From multiple races

Some other race (please specify)

## Home Information

### 15. Do any children aged 17 or younger live in your household?

- No
- Yes



## SustainableWorks Participant Survey

### 16. What is your approximate average household income?

- \$0-\$24,999
- \$25,000-\$49,999
- \$50,000-\$74,999
- \$75,000-\$99,999
- \$100,000-\$124,999
- \$125,000-\$149,999
- \$150,000-\$174,999
- \$175,000-\$199,999
- \$200,000 and up

### 17. In what year was your house built? (Please estimate if exact year is unknown)

### 18. What is the approximate size of your home?

- Less than 1,000 square feet
- 1,000-1,499 square feet
- 1,500-1,999 square feet
- 2,000-2,499 square feet
- 2,500-2,999 square feet
- 3,000 square feet or more

## Drawing for one of three \$50 gift cards

Thank you for participating in my thesis research. Your responses will be kept completely confidential. If you would like to be entered into the **drawing to win one of three \$50 gift cards** to a home improvement store of your choice, please provide your contact information below. This information will be in no way linked with your responses.

### 19. Contact Information

Email Address

Phone Number

### 20. If your name is drawn, which store would you like a gift card to?

- Home Depot
- Lowe's
- Ace Hardware

## Appendix B: Non-Participant Survey

*Note:* Only the additional question for Non-Participants and DIY/Outside is included. The rest of the survey was similar to the Participant survey found in Appendix A.

**SustainableWorks Survey**

**Questions 8 & 9**

**8.**

**Would any of the following conditions help you move forward with making home energy efficiency upgrades? Select all that apply.**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
Decrease the cost of upgrades through increased incentives and rebate programs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide more information about how I could pay for the home energy efficiency improvements.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide more information about how the work would be performed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide more information about my return on my investment or the payback period.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Make it more convenient to schedule the work, such as evenings, weekend and non-traditional hours.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve communication during the whole process.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Make the recommended improvements easier to understand.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help me better understand the value of making home energy efficiency improvements.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provide more information about the program and quality assurance.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>


**9. Please share anything else you'd like about your experience with SustainableWorks:**

## Appendix C: Demographic Information

	Participants	DIY/Outside	Non-Participants
<b>Age</b>			
21-29	1.38%	5.41%	2.99%
30-39	15.86%	14.86%	10.45%
40-49	22.07%	22.97%	32.84%
50-59	24.83%	28.38%	28.36%
60-69	28.97%	20.27%	20.90%
70+	6.90%	8.11%	4.48%
<b>Education level</b>			
HS/GED	3.62%	1.37%	0%
< College	10.87%	8.22%	10.77%
Bachelors	31.88%	13.70%	7.69%
Associates	3.62%	26.03%	23.08%
<Graduate	4.35%	9.59%	10.77%
Graduate	36.23%	32.88%	36.92%
8 PhD	2.90%	4.11%	7.69%
Professional	6.52%	4.11%	3.08%
<b>Income (thousands of dollars)</b>			
Under \$24	2.44%	1.45%	1.67%
\$25-49	11.38%	10.14%	15.00%
\$50-74	21.95%	21.74%	21.67%
\$74-99	24.39%	27.54%	20.00%
\$100-124	19.51%	11.59%	15.00%
\$125-149	9.76%	13.04%	1.67%
\$150-174	4.07%	5.80%	10.00%
\$175-199	3.25%	0%	8.33%
\$200+	3.25%	8.70%	6.67%
<b>Home size (approximate square feet)</b>			
<1000	10.96%	4.11%	10.45%
1000-1499	27.40%	27.40%	16.42%
1500-1999	24.66%	28.77%	25.37%
2000-2499	21.23%	21.92%	22.39%
2500-2999	8.90%	6.85%	16.42%
3000+	6.85%	10.96%	8.96%
<b>Home Age</b>			
Mode	1954	1955	1904
Average	1948.36	1945.64	1948.66

## Appendix D: Example of Energy Performance Report from SustainableWorks

# ENERGY PERFORMANCE SCORE



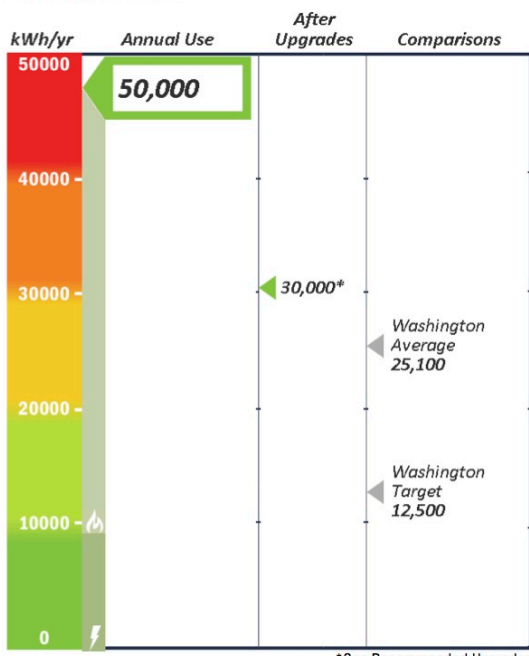
**EPS**  
Energy Performance Score

Address: ██████████  
██████████

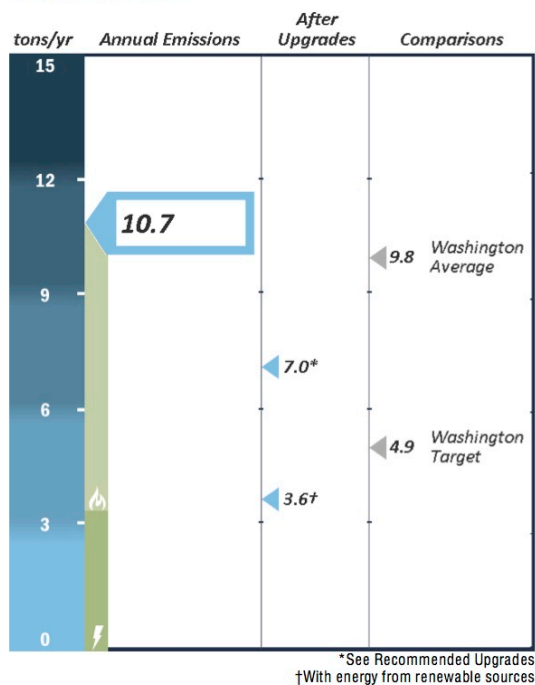
Reference Number: 530500858  
Score Status: Official

	Current Energy Use	Energy Cost		Carbon
● Energy Score:	50,000 kWh/yr	\$ 2,353	● Carbon Score:	10.7 tons/yr
⚡ Electric:	10,500 kWh/yr	\$ 894	⚡ Electric:	3.5 tons/yr
🔥 Natural Gas:	1,400 therms/yr	\$ 1,459	🔥 Natural Gas:	7.2 tons/yr

### Energy Score



### Carbon Score




The energy score measures the estimated total energy use (electricity, natural gas, propane, heating oil) of this home for one year. The lower the score, the less energy required for normal use. Actual consumption and costs may vary.  
 Measured in kilowatt hours per year (kWh/yr).

The carbon score measures the total carbon emissions based on the annual amounts, types, and sources of fuels used in this home. The lower the score, the less carbon is released into the atmosphere to power this home.  
 Measured in metric tons per year (tons/yr).

4 Bedroom, 2,646 sq ft Single Family Detached Home, built in 1944

Audit Date: 09/30/2013      Auditor: Sustainable Works Vollan, David

SIMPLE EPS Version 2.0 v20121005



Conserving Energy. Creating Jobs.

Visit [www.energy-performance-score.com](http://www.energy-performance-score.com) to maximize energy savings

## Energy Performance Score

### ► What is the Energy Performance Score?

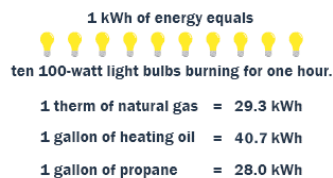
A Certified Score The Energy Performance Score calculation is based on a home energy assessment. Anyone may use the EPS assessment methodology for evaluating energy performance and upgrades of a home, but only a certified EPS analyst has been trained and qualified to conduct an EPS.

### ► Energy

**Energy Score Calculation** The energy score is based on a home's shape, size, insulation levels, air leakage, heating and cooling systems, major appliances, lighting, and hot water heating. Occupancy, behavior, indoor temperature, and regional weather are standardized to calculate normal energy use. A home's actual energy use will vary with behavior, weather, and changes to the home.

#### Measurements Defined

Electricity is measured in kilowatt hours (kWh). Natural gas is measured in therms. Oil and propane are measured in gallons (gal). Units of energy can be converted from one to another. Total energy use is represented in kilowatt hour equivalents.



**Energy Costs** - Fuel costs are based on prices at the time the EPS is issued\* and do not include taxes, surcharges, or fees for renewable energy.

#### Benchmarks Defined

**After Upgrades** indicates the improvement in the predicted energy use if the lower and higher cost Recommended Energy Upgrades are implemented.

**Washington Average** is the average energy use of households in Washington State as of 2006.

**Washington Target** is equivalent to 50% of the Washington average energy use, and represent the state's energy reduction goals.

### ► Carbon

**Carbon Score Calculation** The Carbon Score is based on the greenhouse gas emissions for the annual amounts, types, and sources of fuels used in the home. For electricity, the carbon emissions are based on electricity consumed and the mix of sources used in the sub-region. For natural gas, heating oil, and propane, carbon emissions are based on the therms or gallons used in the home.

#### Measurements Defined

While site energy is used to determine a home's annual energy consumption, source energy is used to calculate the home's associated carbon emissions. This is reflected in the sub-region emissions factor for electricity.

#### Benchmarks Defined

†With energy from renewable sources indicates the carbon emissions produced if the homeowner chooses to offset the carbon emissions associated with electrical use. Check with your utilities to learn more about these options.

**After Upgrades** indicates the improvement in the predicted carbon emissions if all of the Recommended Energy Upgrades suggested on the Energy Analysis Report are implemented.

**Washington Average** is the average carbon emissions of households in Washington State as of 2007.

**Washington Target** is equivalent to 50% of the Washington Average carbon emissions benchmark, and is associated with a single family residence in Washington.

\*Estimated energy costs are based on the following rates.  
Electric = \$ 0.08/kWh      Oil = \$ 2.95/gal  
Natural Gas = \$ 1.07/therm      Propane = \$ 3.45/gal

► Contents

- Annual Estimated Energy Use and Fuel Costs
- Comparing Your Utility Bills with the EPS Score
- Summary of Energy Performance Related Elements
- Summary of Recommended Energy Upgrades
- Detailed Notes Explaining Energy Upgrades
- Energy Upgrade Descriptions
- No- and Low-Cost Energy-Savings Strategies
- Financial Incentives

► Annual Estimated Energy Use and Fuel Costs

	Current Home			After Upgrades		
	Energy (kWh)*	Fuel Cost†	Carbon (tons)	Energy (kWh)*	Fuel Cost†	Carbon (tons)
Heating	33,900	\$ 1,239	6.1	13,800	\$ 503	2.5
Cooling	NA	NA	NA	NA	NA	NA
Water Heating	6,000	\$ 220	1.1	6,000	\$ 220	1.1
Lighting & Appliances	10,500	\$ 894	3.5	10,300	\$ 876	3.4
<b>Total (Rounded-off)</b>	<b>50,000‡</b>	<b>\$ 2,353</b>	<b>10.7</b>	<b>30,000</b>	<b>\$ 1,599</b>	<b>7.0</b>

\*All energy forms are converted to their electrical energy equivalents, expressed in kilowatt-hours electric (kWh).  
 †Fuel costs are based on prices at the time this report is issued and do not include taxes and surcharges.  
 ‡Total Annual Estimated Energy Use is rounded to the nearest 1000 kWh.


Comparing Your Utility Bills with the EPS Score

You can determine how your household's energy use compares to the estimated average use for your home by comparing the energy totals on your utility bills with the EPS Score.

To calculate your actual annual energy use, you will need to know the amount of energy that you used for each fuel type in your home for a full year. This information is available on your utility bills. The formulas on the back of the EPS Scorecard will allow you to convert combustion fuels to KWH. The EPS Score should be compared to the annual totals of all fuel types.

If the totals from your utility bills are:

- lower than the Energy Score, you are using less energy than would be average for your home. Reasons for this may include housing fewer people than would be average in this home, and/or the occupants of this home are using energy more conservatively than is typical.
- similar to the Energy Score, you are using a typical amount of energy for the condition of your home.
- higher than the Energy Score, you are using more energy than average for your home. Reasons for this may include housing more people than would be average in this home, and/or occupants in this home are using more energy than is typical. There may be no- and low-cost ways that you can use to save energy.

Bedrooms: 4	Audit Date: 09/30/2013	
Year Built: 1944	Auditor: Sustainable Works Vollan, David	
SIMPLE EPS Version 2.0 v20121005		

## Energy Performance Score

### ► Summary of Energy Performance Related Elements



Element	Description	Notes	Current Performance
Very Poor • Poor • Average • Good • Excellent			
<b>Air Leakage</b> How tight your home is against air leaks.	Major leakage areas include: Attic hatch, Crawl space doors	You are losing about 60% of all the hot air out of your home every hour. See detailed notes.	Very Poor
<b>Ceiling and Attic</b> The amount of insulation above the ceiling or in the roof.	Batts	You have about 3" or less of insulation in your attic. Energy Code today calls for 18" of fiberglass insulation (R49). See detailed notes.	Poor
<b>Ducts</b> How well sealed and insulated are the ducts.	All ducts in conditioned space	Your heating system duct work is located within heated space so any losses will flow up into your rooms above.	Not Applicable
<b>Walls</b> The amount of insulation inside the walls.	2x4	While you have some insulation in the remodeled walls on the top floor your main floor walls are not insulated. See detailed notes.	Poor
<b>Floors/Foundation Walls</b> The amount of insulation below the floors.		Most of your basement walls are insulated. You aren't going to see significant savings by insulating the last bit. See detailed notes.	Average
<b>Windows</b> The insulation value of the windows.	Single pane, Double pane, Wood frame, Vinyl frame, Metal frame	You have quite a mixture of window types but from a comfort/efficiency perspective windows should be your last priority. See detailed notes.	Poor
<b>Water Heating</b> How efficient and insulated is the hot water system.	Gas, Storage tank	Your gas water heater isn't the most efficient option but all the alternatives are really expensive. See detailed notes.	Average
<b>Lights and Appliances</b> How efficient are the lighting and appliances.	Energy Star Refrigerator, Energy Star dishwasher, Electric clothes dryer	About 75% of your lighting is inefficient. Your appliances are efficient with the exception of your washing machine. See detailed notes.	Poor
<b>Heating</b> How efficient is the heating system.	Below 78% efficient	You have probably the oldest gas furnace I have ever seen;) and it probably is the original one that came with the house. See detailed notes.	Very Poor
<b>Cooling</b> How efficient is the cooling system.	None	N/A	Not Applicable



Priorities

Hi Jana and Tyler,

It was nice to meet you. Below are my recommended projects in order of priority. Let me know if you have any questions.

HEALTH & SAFETY

1. If you don't know how old the existing carbon monoxide detectors are it would probably be a good idea to replace them as the sensors only last 5 years. If you have us complete weatherization work on your home you get one for free.
2. Consider upgrading your kitchen microwave/range hood to a dedicated range hood only design and ensure it is vented to outside. See detailed notes under "appliances".

WEATHERIZATION

- Replace all the incandescent bulbs that aren't on dimmers with CFL light bulbs.
- Seal and insulate the attics and attic access doors on your top floor.
- Insulate your main floor walls.
- Replace your furnace with a 95% efficient model.



## Energy Performance Score

### ► Summary of Recommended Energy Upgrades



These recommended upgrades will improve the energy performance of this home. The cost for the upgrades will vary with the size and complexity of the home and the scope of work required. The Approximate Annual Savings are based on the estimated energy reductions with each upgrade.

	Notes	Typical Cost Range	Approximate Annual Savings \$	kWh Equivalent
<b>Air Sealing</b>				
Attic / Ceiling Insulation	If it is not possible for attic to achieve R-38, then completely insulate attic to highest practical level using best practices.	\$ 2.00 - \$ 5.00 /sf	\$ 157	4,200
<b>Duct Sealing</b>				
<b>Duct Insulation</b>				
Wall Insulation	Dense pack uninsulated wall cavity with cellulose insulation.	\$ 1.25 - \$ 2.50 /sf	\$ 284	7,600
<b>Floors / Foundation Walls</b>				
Windows	Upgrade to high efficiency windows.	\$ 500 - \$ 1,500 /window	\$ 146	3,900
<b>Water Heater Upgrade</b>				
<b>Solar Water Heater</b>				
<b>Appliances</b>				
Heating System Upgrade	Upgrade to condensing gas furnace (Primary HVAC System)	\$ 3,000 - \$ 6,000	\$ 169	4,600
<b>Cooling System Upgrade</b>				
<b>Solar PV</b>				

#### ► Financial Incentives See web site for more sources of financial assistance.

See <http://www.dsireusa.org/> for incentives in your area.

DSIRE is a comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency. Established in 1995 and funded by the U.S. Department of Energy, DSIRE is an ongoing project of the N.C. Solar Center and the Interstate Renewable Energy Council.

## Energy Performance Score

### ► Air Leakage



These attic access doors are one of the primary reasons for your discomfort on the top floor.

One of your top flat attic access panels is stuck part way open and should be replaced or cut down to fit.

#### Current Conditions Observed by Auditor

Your home loses about 60% of all the hot air out of it every hour. Most homes lose between 60 and 100% every hour. The tightest homes in the world lose about 3% per hour. It would be difficult if not impossible to seal your home too tightly by implementing the projects I recommend in this report.

Tech note: CFM50 3600 , ACH50 10.45 , ACHn .6 , Volume 21,162ft3

#### Recommended Upgrades Detail

- Your #1 project is to air seal and insulate the two side attic access doors and the two top flat attic access panels.
- Cut in rigid foam blocking beneath your attic knee walls to prevent cold air from flowing beneath your main and top floors.

#### Deep Energy Retrofit Options

#### Energy Upgrade Description

**Air Sealing** Air sealing is one of the most cost-effective energy upgrades you can make and should be done before installing insulation. Cold air can infiltrate small cracks and openings during the winter, while hot outdoor air can over-heat your home in the summer resulting in drafts, moisture, and indoor air quality issues. There are many types of air leaks and many strategies for sealing them. You can under-take this work yourself or hire a contractor who can use a blower door to identify and measure the

effectiveness of various air sealing measures.

After your home is sealed, it is important to make sure that there is adequate ventilation to maintain proper indoor air quality and to prevent back drafting of combustion appliances. An EPS Auditor or qualified professional will identify any potential ventilation problems.

#### No-Cost or Low-Cost Strategies

Close your fireplace damper when your fireplace is not in use (but first allow the fireplace to cool completely). If you have fireplace doors, keep them closed.

Put bathroom ventilation fans on a timer or on a humidity sensor which will automatically switch off the fan when the room is dry.

## Energy Performance Score

### ► Ceiling and Attic



Your attic is composed of lower flat attics, insulated knee walls, sloping un insulated rafters and top flat attic.

Here you can see the undersized opening for your roof vents (it should be about 6" by 9").

#### Current Conditions Observed by Auditor

You have 2 to 6" of insulation in your attic. Energy Code today calls for 18" of fiberglass insulation (R49). While the North and West walls and knee walls are insulated on the top floor the sloping rafters are not insulated. The top flat attic only has 3" of insulation and isn't properly ventilated. Overall, your average attic insulation number is under R10 and code is R50.

#### Recommended Upgrades Detail

- Install cardboard baffles held 1" off the roof sheathing to maintain the pathway for ventilation air from bird blocks to existing mushroom vents. Enlarge holes leading to roof vents.
- Blow lower and upper flat attics to 18" with fiberglass insulation. It is pretty easy to "whip" air into loose blown fiberglass insulation such that while it appears to be blown to the correct level the density is too low and it won't perform as expected. The best way to prevent this is to request the number of bags blown into the attic and compare it with the number suggested by the manufacturer on their insulation coverage chart. For example, here is a link to Certainteed's attic coverage chart: <http://www.certainteed.com/resources/30-49-189%20TrueComfort.pdf>.
- While in violation of current building code I suggest you dense pack cellulose insulation in your attic rafters. The building code is concerned that moisture could migrate through the drywall ceiling and condense on the cool underside of the roof sheathing, causing rot. Of course, the question is how much moisture will make it to this surface. If, as is the case in your home, there aren't a lot of pathways for moist indoor air to reach the rafter cavity (lots of can lights, T&G ceiling without drywall etc.) I suspect the risk of condensation induced rot is minimal (low income weatherization contractors have been dense packing short sections of rafters for a long time - 30+ years). There are definitely energy efficiency/comfort benefits of dense packing rafters but ultimately you have to be ok with some risk. Alternately, you could add rigid foam to the underside of the rafter and then cover it in new drywall and paint but this would be significantly more expensive.
- The last piece of the puzzle would be adding an additional blanket of insulation (6" R19 fiberglass) to the back side of the attic knee walls.

#### Deep Energy Retrofit Options

#### Energy Upgrade Description

Ceiling & Attic Insulation Attic or ceiling insulation is one of the most cost-effective upgrades you can make and should be done after air sealing in the attic. Attic or ceiling insulation slows heat loss through the roof in the winter and also slows heat gain through the roof in the summer. The insulation is usually installed on the floor of an unfinished attic (the ceiling of the finished room below) and under the roof if the attic space is

finished. Insulation is measured with an R-value, and the higher the R-value, the more effective the insulation value. Insulation is made of different materials and comes in several forms: batts, loose-fill or blown-in, foam, and rigid. Each type of insulation varies in terms of advantages, applications, and pricing.

## Energy Performance Score

### ► Walls



Insulating your main floor walls is one of the top priority projects that should be completed on your home.

#### Current Conditions Observed by Auditor

With the exception of your West, North walls and knee walls on the top floor - your main floor and 2nd floor walls are not insulated.

#### Recommended Upgrades Detail

I recommend you insulate your walls from the exterior by pulling a row of siding and "dense packing" the walls with the "tube fill method". This method gives the installer feedback as to the presence of blocking and ensures an even high density, which prevents settling of the insulation. Make certain you have the wall insulation checked with an infrared camera while the insulation crew is still on site so they can fill any missed wall cavities (a common occurrence).

#### Deep Energy Retrofit Options

If at some point in the future you consider replacing your siding, add as much rigid foam to the exterior of the wall as you can afford.

#### Energy Upgrade Description

Wall Insulation Insulating walls will help you to keep heat inside your home during the winter and slow heat gain into your home during the summer. Retrofitting walls with insulation is generally more work and more costly than insulating an attic ceiling or a floor. Walls may be insulated

from the outside or inside and this is more easily accomplished during remodeling work which involves removal of or painting either of these surfaces.



While technically you should insulate the exposed concrete basement walls it is such a small area that it isn't going to make much of a difference in how your home functions.

**Current Conditions Observed by Auditor**

Your basement walls are already mostly insulated.

**Recommended Upgrades Detail**

None. It wouldn't make a noticeable difference if you insulated the walls in the furnace/laundry room and it would be a fairly expensive project.

**Deep Energy Retrofit Options**

Remodel the basement with a single stud wall (spaced 10" off the concrete walls). Make certain at least one inch of foam is applied to the concrete wall prior to framing the wood stud wall as this will prevent condensation forming on the concrete and should prevent pipes from freezing in the wall. Net and blow dense pack fiberglass into this assembly for about an R40 wall.

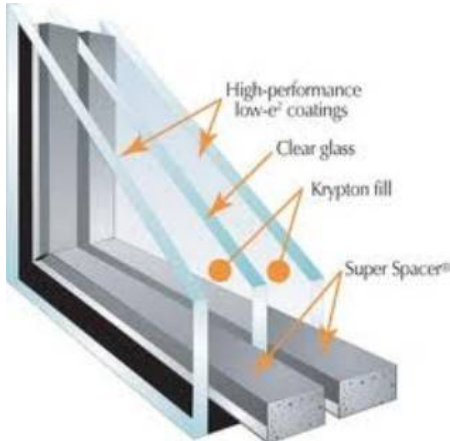
**Energy Upgrade Description**

**Floor Insulation** Floor insulation is mainly a cold climate energy saving measure. The importance of floor insulation varies with the type of foundation in the home. The lowest floor cavity in a home should only be insulated if the basement or crawlspace below it is unheated. In a heated

basement or crawlspace the insulation will be found in a different location. Slab floors on-grade or in a basement can be retrofitted with insulation above the slab if no insulation was installed beneath the slab before it was poured.

## Energy Performance Score

### ► Windows



If you want to significantly influence how your home feels with windows you need to explore triple glazed window technology.

#### Current Conditions Observed by Auditor

You already have mostly double pane windows so you aren't going to see a big difference in terms of comfort or energy bill savings if you replace the aluminum and wood framed windows with double pane vinyl frame windows.

#### Recommended Upgrades Detail

None.

#### Deep Energy Retrofit Options

After you have completed all the other weatherization work I have recommended the heat loss and discomfort generated by your windows will be a more significant part of the problem. At this point you could upgrade to triple glazed windows with low conductive spacers for R values in the 5 to 7 range (Alpen, Euroline, Cascadia etc.) vs your current R3 windows. These high performance windows actually will feel quite a bit warmer than your current windows.

#### Energy Upgrade Description

Windows Older windows can be responsible for drafts, heat loss in winter and heat gain in summer. They can significantly impact your comfort and energy use for heating and cooling. Storm windows can help eliminate

some of these issues. High efficiency, double-paned, low-e, argon-filled windows with insulated frames can help save energy, make rooms more comfortable and also makes them quieter.

#### No-Cost or Low-Cost Strategies

Capture free solar heat. On cooler days, open curtains to catch the heat from the sun and warm your home.

Block the sun in hot weather. To keep your home cool, adjust window coverings to block the sun's hot summer rays. In the evening, open windows to catch cool breezes.

Plant trees, bushes, and trellises that block unwanted sun in the summer. Strategically located plants on the east, west, and south sides of a house can provide natural cooling through shade. Deciduous plants will shade in summer and allow more light in winter. Plants can also form windbreaks to protect your home from winter winds. Be sure to plant away from the house so you do not trap moisture against the building.

## Energy Performance Score

### ► Water Heating



Your water heater drafts well and still has a lot of life left in it.

#### Current Conditions Observed by Auditor

Your gas water heater isn't the most efficient option but all the alternatives are really expensive. Your water heater was installed in 2007. Water heaters have between a 6 and 12 year warranty. Given that you are leasing it from PSE I bet it has a 12 year warranty and they will get in contact with you when it gets close to wearing out.

#### Recommended Upgrades Detail

None. You have much higher priorities elsewhere.

#### Deep Energy Retrofit Options

Replace your current water heater with a "sealed combustion 95% efficient" gas water heater (\$ 4k to 5k). Sealed combustion water heaters are the most efficient water heaters (either tankless or storage tank models). Water heater efficiency is measured by something call an Energy Factor (EF). This energy factor attempts to quantify what percentage of the heating fuel actually ends up as hot water during normal usage. The most efficient sealed combustion water heaters are in the .95 EF range or 95% of the heating fuel ends up as hot water. Old gas water heaters are in the .65 EF range or 65% of the energy in the gas ends up as hot water. I typically don't recommend tankless models as their design inherently takes longer to deliver hot water to the faucet and people tend to be disappointed. If you are ok with waiting longer then probably the best model on the market is the Navien as it has a recirculation pump that reduces the time it takes to get hot water to the faucet.

#### Energy Upgrade Description

**Water Heater Upgrade** The life cycle of water heaters is approximately 12-15 years. If your water heater is older, consider replacing it with a newer, more efficient one. All new tank water heaters have a built-in insulation layer to conserve energy. Solar water heating may also be an option: it can provide as much as 75% of your hot water needs and offers significant savings over time.

**Solar Water Heater** Installing a solar water heater on a roof that received adequate sunlight can be a relatively cost-effective means of reducing your energy costs over the long term. These systems can preheat the water going to your hot water heater and significantly reduce, and at times eliminate, the need for additional water heating.

#### No-Cost or Low-Cost Strategies

Lower your water heater thermostat to 120 degrees, or the lowest setting that is acceptable to you for bathing and dishwashing.

Don't let the hot water run while shaving or washing dishes.

Turn off hot water during vacations. Turn your electric water heater off at the breaker panel if you are leaving town for more than a couple of days. But don't do this during freezing weather. If you have a natural gas water heater, turn it to the "low" or "vacation" setting, but do not turn it off.

Install high-efficiency showerheads and faucet aerators. New showerheads are required to meet a 2.5 gallon per minute standard; the lower the number, the more you will save. If you have a pre-1992 showerhead, it could be using 5.5 gallons of water per minute or more. Look for low-flow aerators of 2.5 gallons or less to fit bathroom and kitchen faucets.



The new LED lighting technology looks great and is fully dimmable.

**Current Conditions Observed by Auditor**

As I walked through your home I noticed the majority of your lighting is inefficient and the washing machine is also on the older side. Your main floor fridge is an efficient Energy Star model while the 1950s era model in your basement uses 4x as much energy as a Energy Star Fridge today.

**Recommended Upgrades Detail**

- Replace your incandescent bulbs that aren't on dimmers with CFL bulbs.
- Replace your washing machines with side loading models when you get a chance as they use half as much water as a standard washing machines.
- Consider replacing your incandescent bulbs on dimmers with LED lights. The technology has come a long way in the last 4 years. Cree has recently come out with probably the best and most cost effective LED A lamp (the normal old style 60w light bulb we are used to). They can be purchased at Home Depot for about \$ 14. See this link for more info: <http://www.cree.com/lighting/products/indoor/lamps/60w-replacement-warm-white-type-a-led-bulb>. The light is produced in a "donut" of light which is much better than cheaper LED bulbs.

**Deep Energy Retrofit Options**

**Energy Upgrade Description**

Appliances Older appliances can use significantly more energy than newer, energy efficient appliances. Look for ENERGY STAR refrigerators, freezers, dishwashers, clothes washers, and air conditioners. Even within ENERGY STAR there are more and less efficient models and you should

look for the most efficient appliance that fits your budget and needs. If you consider the full life cycle costs, more efficient appliances often make up for any difference in price within a few years of operations.

**No-Cost or Low-Cost Strategies**



Wash laundry in cold water whenever possible. Ninety percent of energy used for washing laundry goes toward heating water. Only run the washer when you have a full load.

Use the dishwasher energy-saver mode and run the dishwasher only when it is full.

Eliminate Phantom Loads. Many home electronics such as computers, televisions, and battery chargers use energy when not in use or turned off. Unplug these or plug them into a power strip that can be turned off when not in use.

Hang your clothes outside to dry whenever possible to reduce the use of your energy-intensive electric or gas dryer.

Eliminate unnecessary lights and replace incandescent bulbs with energy-saving compact fluorescents (CFLs) or LED lights. You can save at least 75% of the energy used for lighting. CFLs that emit a warm color similar to incandescent bulbs (soft white color) and that turn on more quickly are now available. It is important to handle and recycle broken and burned out CFLs appropriately as they contain small amounts of mercury. Motion detectors and timers can eliminate unnecessary lighting outside and in infrequently used rooms.

## Energy Performance Score

### ► Heating



Your furnace isn't producing large amounts of Carbon Monoxide.



While not inexpensive these units do a great job of heating open floor plans like your top floor.

#### Current Conditions Observed by Auditor

You have a 70% efficient gas furnace.

#### Recommended Upgrades Detail

- Upgrade to a 95% efficient model when you get a chance.
- If after you complete the weatherization work on your top floor you still aren't comfortable consider installing a mini-split heat pump to heat/cool your master bedroom.

#### Deep Energy Retrofit Options

#### Energy Upgrade Description

Heating System Upgrade Older, poorly maintained, and less efficient furnaces and heat pumps use more energy than newer, high-efficiency models. You may achieve energy savings by upgrading your system. Additionally, you should have your existing system periodically

inspected to identify potential problems and extend the life of your system. When upgrading a heating system, you should also have any connected duct system inspected for air leaks.

#### No-Cost or Low-Cost Strategies

Turn down the heat. A good energy-saving setting when you are at home is 67-68 degrees and 55 degrees at night or when you are away. Each degree you lower your thermostat saves an estimated two percent (2%) on your heating bill. In summer, turn off your heating system or raise the thermostat setting to save on air conditioning.

Higher heat is not faster heat. Turning the thermostat higher will not warm your house faster; it just wastes energy. Lowering the air conditioning setting won't cool your house faster either.

Use a programmable thermostat. Older, manual thermostats are often not as accurate as new electronic models, and they require that you manually set them back each night. Some programmable thermostats have smart features such as preprogrammed "night" and "vacation" energy-saving settings that lower the temperature automatically. Different heating systems require different thermostats. Check the owner's manual to be sure that your thermostat and heating system work effectively together.

## Energy Performance Score

### ► Cooling



#### Current Conditions Observed by Auditor

N/A

#### Recommended Upgrades Detail

#### Deep Energy Retrofit Options

#### Energy Upgrade Description

Cooling System Upgrade. Cooling is not the predominant energy use in a home in our climate zone. However, older, poorly maintained cooling equipment will still use more energy than newer, more efficient equipment. Heat pumps should be commissioned and regularly

maintained to maximize their efficiency potential. Air conditioners should be inspected and serviced by a professional to help extend the life of the system.

#### No-Cost or Low-Cost Strategies

Block the sun in hot weather. To keep your home cool, adjust window coverings to block the sun's hot summer rays. In the evening, open windows to catch cool breezes.

Use air movement to cool people during hot days. When it's warm, use natural ventilation or window and ceiling fans to keep cool. Remember that fans cool people, not rooms. If these are insufficient, consider installing a whole house fan which will vent warm air from the home and pull in cooler outside air throughout the house at night.

Plant trees, bushes, and trellises that block unwanted sun in the summer. Strategically located plants on the east, west, and south sides of a house can provide natural cooling through shade. Deciduous plants will shade in summer and allow more light in winter. Plants can also form windbreaks to protect your home from winter winds. Be sure to plant away from the house so you do not trap moisture against the building.

## Appendix E: Example of Quote from SustainableWorks



Prepared For: ██████████ ██████████	Reference Quote: All Measures  Quote #: 00004697  Date: 10/1/2013
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### Spreading the Cost over Time with Energy Efficiency Financing

Energy efficiency financing helps spread the cost of an energy efficiency upgrade over time to match the energy savings generated from the upgrade. SustainableWorks works with the Puget Sound Cooperative Credit Union to provide attractive loan rates, long terms and access for most homeowners. Energy Efficiency loans feature:

- No-money Down:** Finance 100% of your energy upgrade with no upfront cost
- Attractive Loan Rates:** Fixed rates between 4.25% -8.74%!
- Affordable:** Up to 20 year terms for low monthly payments
- Flexible Qualification:** You could be eligible for a loan — even with a less-than-perfect credit score
- Easy Repayment:** Options include check, credit card or online bill pay, no pre-payment penalties!

Standard Program	Puget Sound Cooperative Credit Union
<b>Total Project Cost:</b>	\$13,093.92
<b>Maximum</b>	\$50,000
<b>Interest Rate – as low as (credit qualified)</b>	4.25%
<b>Maximum Term – Years</b>	15
<b>Payment Options</b>	Check, Automatic Deduction, Bill Pay
<b>Estimated Payment*</b>	<b>\$98.50</b>
*Monthly payment will vary depending on credit score, income, fees and other factors. For PSCCU Loans there is a \$50 minimum monthly payment with adjusted term of loan. Initial payments may be lower than term payments after project completion. The financial institution will be able provide the exact monthly payment for your loan.	

How to Apply	
Online	<a href="http://psccu.org">psccu.org</a> (Click "Loan Application" in the top right corner)
Phone	425-4 2-3811 toll free in WA 800-273-1550.
Mail or Fax (Download)	<a href="http://psccu.org/pdf/express_pp.pdf">http://psccu.org/pdf/express_pp.pdf</a>

4000 Airport Way S, Seattle WA 98108 | 206.575.2252 Office | 206.552.7779 Fax | [www.sustainableworks.co](http://www.sustainableworks.co)

## Scope of Work

Tier 1 – House Shell Measures – Prevent heated or cooled air from escaping your home.		
Attic Insulation - Utility Incentives*: \$400.00		
Attic Ventilation - Rafter Bay Channels - Standard - Labor (each)	7	Install baffles in a 4/12 pitched roof or larger. These will maintain the flow of ventilation air from low vents to high vents in the attic.
Attic Ventilation - Rafter Bay Channels - Materials (each)	7	Cardboard or foam baffles to ensure attic ventilation.
Attic Insulation - Blown-in Fiberglass - Blower Set-up	1	
Attic Insulation - Blown-in Fiberglass - Labor (cu ft)	430	Labor to prepare attic and install Loose fill fiberglass insulation.
Attic Insulation - Blown-in Fiberglass - Materials (cu ft)	430	Loose fill fiberglass insulation materials.
Attic Insulation - R-19 Knee Wall (2X6) - Fiberglass Batt - Difficult - Labor (sq ft)	96	R-19 Fiberglass batt.
Attic Insulation - R-19 Knee Wall (2X6) - Fiberglass Batt - Materials (sq ft)	96	R-19 Fiberglass batt.
Attic Insulation - Vaulted Roof - Blown-in Cellulose - Standard - Labor (cu ft)	120	Blown-in cellulose insulation materials.
Attic Slope Wall Insulation - Blown-in Cellulose - 2X4 Interior Walls - Materials (sq ft)	120	Mountain Fiber or Green Fiber.
Install Vent Pipe for Fan	2	Replace existing flex duct or install new hard pipe and insulate to a minimum of R-8. Required for blown cellulose. This will cover venting the bath fan and the dryer duct through the roof.
Roof Jack for venting Bathroom fan no damper	2	Install 4" roof jack to supply bathroom vent in attic. These are the new roof vents for the bath fan and the dryer.
Attic Insulation - Blocking at Joist Bays (ln ft)	24	Labor and materials to install foam blocking at joist bays to reduce air movement between conditioned and unconditioned spaces, establish continuous thermal boundary, and retain blown-in insulation. This is the foam blocking we discussed that will prevent the cold air from flowing between the main and top floor.

Subtotal (before tax): **\$2,717.22**

Tier 1 – House Shell Measures – Prevent heated or cooled air from escaping your home.		
Air Sealing - Utility Incentives*: \$300.00		
Air Sealing - Labor & Materials	4	Includes CAZ test and completing Air Seal Forms. This will cover weather stripping and insulating 6 attic access panels.

Subtotal (before tax): **\$431.20**

<b>Tier 1 – House Shell Measures – Prevent heated or cooled air from escaping your home.</b>		
<b>Wall Insulation - Utility Incentives*: \$400.00</b>		
Carpentry - Additional Work - Labor (hrs)	5	This covers cutting in a new attic access point into the lower attic area without access. We will also expand the undersized opening for the roof vents.
Wall Insulation - Blown-in Cellulose - 2X4 Exterior Walls - Labor (sq ft)	983	Remove and replace siding. Touch up paint- Customer supplied paint. This covers the main floor and uninsulated sections of the top floor walls.
Wall Insulation - Blown-in Cellulose - 2X4 Exterior Walls - Materials (sq ft)	983	Mountain Fiber or Green Fiber.
Rim Joist Insulation - 2" Rigid Foam Board - Materials (In ft)	24	Rigid Foam Insulation. R-11 minimum.
Rim Joist Insulation - 2" Rigid Foam Board - Standard - Labor (In ft)	24	Labor to install rigid foam blocks installed against rim joist. Unhindered access. Installed from a standing position. This rigid foam board will be used to block the bottom of the rafter cavities so we can blow them full of insulation.
Subtotal (before tax): <b>\$4,659.32</b>		

<b>Tier 2 – Home Energy Systems – Improve the efficiency of equipment that heats and cools your home.</b>		
<b>Heating - Utility Incentives*:</b>		
American Standard Freedom Upflow 60K 2 Stage Variable Speed 95% Efficient Gas Furnace	1	Kit # GF-SA-10 American Standard Gas Furnace packages include Honeywell F100 4 in. Media filter, condensate pump and TH8320U1008 Control.
Furnace -Lowboy removal and duct rework	1	Remove old oil furnace and reconfigure duct for new furnace or air handler
Gas -New service bonding - standard	1	Bond furnace or hot water tank gas line to service. Easy access, less than 50 ft.
Subtotal (before tax): <b>\$6,046.60</b>		

<b>Tier 3 – Windows and Renewable Energy Sources</b>		
<b>- Utility Incentives*:</b>		
Subtotal (before tax): <b>\$0.00</b>		

<b>Ventilation</b>		
Ventilation - Bathroom Fan Panasonic FV-11VHL2 110 CFM Heater / Fan / Light Combo - Labor & Materials (each)	1	Install Panasonic FV-11VHL2 110 CFM. Power and controls from existing circuit. Additional control not included.
Subtotal (before tax): <b>\$826.00</b>		

<b>Permits</b>		
Tacoma - Electrical Permit	1	Modify 1-4 Circuits for boiler, furnace, heat pump, mini split recirc water pump, etc
Tacoma - Mechanical Permit	1	
Subtotal (before tax): <b>\$229.25</b>		

<b>Other</b>		
Weatherization - Additional Work - Labor (hrs)	4	This is labor to protect the plants around the house with plastic.
Subtotal (before tax): <b>\$336.00</b>		



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