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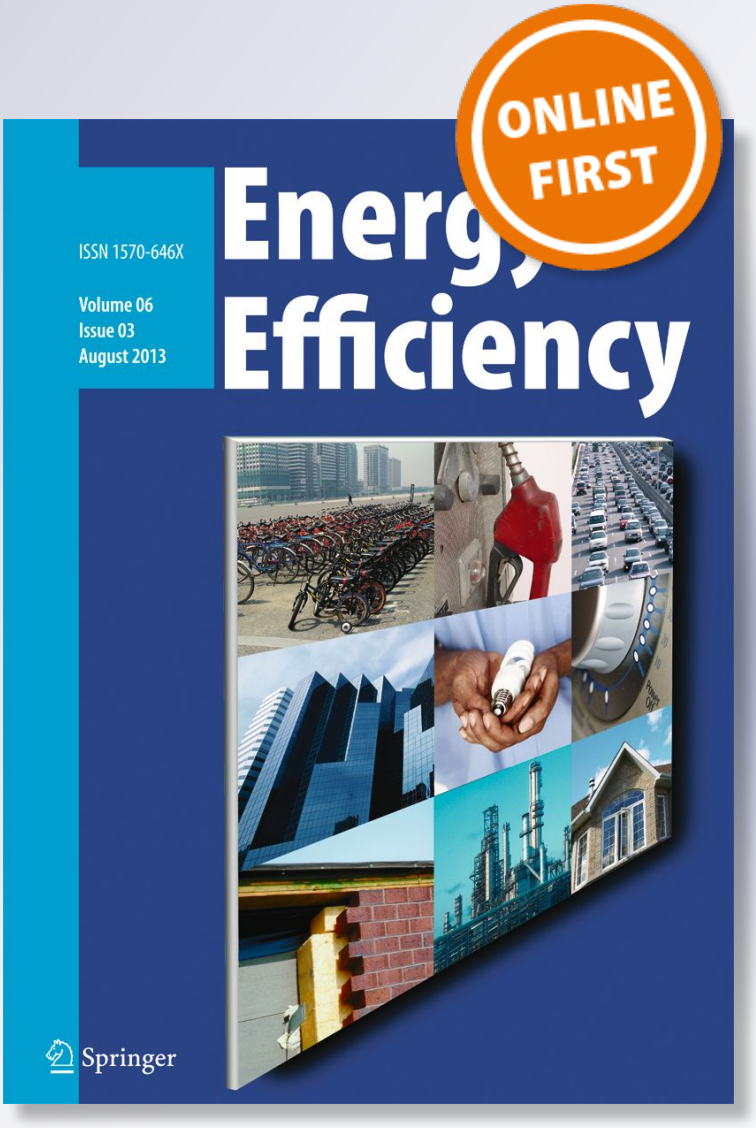

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ORIGINAL ARTICLE

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Abstract Energy efficiency contributes significantly to the reduction of greenhouse gas emissions and the associated mitigation of climate change. The uptake of energy efficiency measures in the residential sector requires significant effort on the part of homeowners or residents. Past research has revealed that cost savings and social interaction motivate energy efficiency behavior. This study expands on this research by examining the hypothesis that there are regional differences in what motivates individuals to implement home energy efficiency upgrades. Two surveys ($N = 320$ and $N = 423$) examine the perceived benefits of and barriers to undertaking home energy efficiency improvements in varying geographic regions across the USA and test marketing materials that target these benefits and barriers. The hypothesis that there are regional differences in perceptions of energy efficiency was confirmed. Cost savings were found to be the most important benefit to individuals across the country. Energy efficiency being a good investment is either the second or third most important benefit across all regions. Increased comfort is the last of the top three most important benefits to those in the South and Midwest, while those in the Northeast demonstrated interest in the increase in home retail value associated with energy efficiency, and those in the West found the environmental benefits to be important. High costs of energy efficiency improvements were found to be the most commonly perceived barrier. Reported likelihood to enroll in a home energy efficiency program offered by one's employer was predicted by perceived likelihood that coworkers would enroll, income level, and personal opinions about the importance of energy efficiency.

Keywords Energy efficiency · Behavioral energy efficiency · Home energy efficiency · Social marketing

Jessica B. McDonald and Xinyuan Wen contributed equally to this work.

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Climate change is considered one of modern society's greatest challenges (Smalley 2005). Energy efficiency can effectively mitigate climate change, as it allows for the same outcome to be produced by less energy and with less associated greenhouse gas emissions. Behavioral change is a key component in achieving energy efficiency because individuals' decision-making and actions are involved in every step of the energy efficiency process, from designing more efficient technologies to deciding to purchase, install, and operate them. This study seeks to expand the theory of what motivates

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individuals to carry out energy efficiency behaviors in their homes.

Despite the fact that only a small portion of the recent literature on increasing energy efficiency has focused on behavior change (Sovacool 2014), many scholars in both the behavioral sciences and the environmental field espouse the importance of considering behavior change when seeking to increase environmental sustainability. According to Doug McKenzie-Mohr, "behavior change is the cornerstone of sustainability" (McKenzie-Mohr 2011). Thomas Dietz and colleagues identify numerous "wedges," actions that can be taken by society to significantly reduce output of carbon emissions (Dietz et al. 2009). Among these wedges, the behavioral wedge is credited with the potential to reduce the USA's carbon dioxide emissions by up to 7.4% over the next 10 years if behavioral patterns are optimized for energy savings. In addition to significant emission reductions, behavioral changes can be implemented more quickly and on a larger scale than technological upgrades or energy grid changes, further increasing the importance and significance of behavior change in the pursuit of lowering greenhouse gas emissions (Dietz et al. 2009). Furthermore, Asensio and Delmas report that, "Energy conservation through both behavioral and technological change has a savings potential of 123 million metric tons of carbon per year, which is representative of 20 percent of direct emissions from households in the United States" (Asensio and Delmas 2015). Guerin et al. (2009) espouse that to increase building energy efficiency, both a building itself and its occupants' behavior matter.

Because of the significant energy savings available in the residential sector, and the power of behavior change in achieving energy efficiency, the need is clear for research on how to motivate individuals to make energy efficiency improvements in their homes. Much past research has focused on informing and educating individuals about the benefits of energy efficiency, but there is evidence that education alone does not lead to reliable behavior change (Southwell and Murphy 2014). Recently, the focus has shifted onto what other factors may motivate individuals to implement energy efficiency measures in the home, including the role of social networks, demographic characteristics, incentives, and policy, among other personal and social factors (Southwell et al. 2016; Southwell and Murphy 2014).

Southwell and Murphy (2014) found that social interaction about energy efficiency predicted partaking in home energy efficiency behaviors for the purpose of weatherization, over and above simple knowledge about energy efficiency. Of individuals who had partaken in weatherization behaviors in the past month, they reported doing so for cost savings, increasing home comfort, reducing energy consumption, reducing draftiness, and protecting the environment (Southwell and Murphy 2014).

One study in Ireland on motivation to make energy efficiency improvements at home found that the most important motivating factor was monetary or economic gains, followed by increased comfort in the home. Environmental benefits were found to have little importance. These conclusions held true for motivation throughout the decision-making process and for the ultimate decision to invest in energy efficiency measures Aravena et al. (2016). Aravena recommends that energy efficiency investments should be marketed in terms of their monetary advantages and potential to increase home comfort.

Research conducted by Resources of the Future investigated the success of energy audits across the USA. A survey of energy auditing companies across the USA revealed that the top barriers to energy audits are as follows: individuals cannot afford upgrades and retrofits that the audit may recommend, individuals do not know what information audits provide, they are unaware that energy audits exist, and the actual or perceived costs of audits may be high. A similar survey distributed to energy auditors revealed that the top motivations for homeowners to implement efficiency improvements were: high savings on utility bills, low upgrade costs, and available financing. Protecting the environment and increasing property values received the lowest number of responses and did not appear to be important incentives for homeowners (Palmer et al. 2011). Many individuals focus on curtailment measures, such as turning off the lights, turning down the air conditioning, or unplugging appliances that are not in use, rather than efficiency measures that include one-time home upgrades which provide continuous energy savings. In Attari et al. 2010, Attari, Dekay, Davidson, and Bruin carried out a study in which participants were asked to rate the most effective ways to reduce household energy consumption and to predict energy use and potential savings related to various behaviors. An overwhelming number of participants in this study named conservation and curtailment behaviors such as turning off the lights, rather than efficiency improvements such as upgrading

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appliances and HVAC systems and better insulating the home. The authors of this study posited that energy efficiency upgrades involve additional effort, out-of-pocket costs, and research on the part of the resident, which may be deterrents. Additionally, participants in this study underestimated energy use and savings by a factor of 2.8 for high-energy activities, which demonstrates a lack of information and understanding of residential energy use (Attari et al. 2010). The present research makes the distinction between energy efficiency behavior, which consists of one-time investments and technological upgrades that allow the same home activities and processes to be performed with less energy, and energy conservation behavior, which consists of smaller, habitual behavior changes that save energy through engaging in less of energy-intensive behaviors. Throughout this paper, "energy efficiency behavior" refers to the former type of behavior, and not the latter.

This research investigates how individuals across the USA perceive energy efficiency in their homes, specifically what they view as the important benefits of and barriers to home energy efficiency. It adds to the existing literature on the theory of energy efficiency behavior by exploring whether there are regional differences in what motivates engagement in energy efficiency behaviors.

The research draws from the behavior-change method prescribed by McKenzie-Mohr's theory of community-based social marketing (McKenzie-Mohr 2011), which specifies that the development of successful behavior-change interventions should be carried out in several steps: (1) select behaviors to be changed, (2) identify the benefits and barriers for individuals to change these behaviors, (3) develop strategies to change these behaviors, (4) pilot the behavior change strategies, and (5) implement the strategies on a large scale. This research contributes to steps 2 and 3 in regard to motivating one-time, technological energy efficiency upgrades in the home by adding to the literature on what motivates individuals to implement home energy efficiency and exploring how individuals respond to marketing materials about home energy efficiency.

Two studies investigate perceived benefits of and barriers to home energy efficiency. Hypotheses for this research were developed from anecdotal information about home energy efficiency program implementation by the Clinton Climate Initiative (CCI) (Clinton Climate Initiative, Personal Communication 2015). CCI found that messages about increased home comfort due to energy efficiency resonate with individuals in the Northeast of the USA, while messages about the cost savings associated with energy efficiency resonate more with individuals in the Southeast.

Two hypotheses were tested:

1. Environmental benefits of energy efficiency are perceived as less important than other benefits (e.g., increased comfort, increased home value, advanced technology).
2. There are regional differences in how individuals perceive energy efficiency. Individuals from the northeastern USA value comfort as the most important benefit, while individuals from the southern USA value savings on energy bills.

Study 1: Perceived benefits and barriers to home energy efficiency

The first study investigated perceptions of energy efficiency for individuals across the USA.

Methods

An online survey was distributed via Amazon Mechanical Turk to US residents. Participants were compensated $0.10 for completing the survey.

Amazon Mechanical Turk Amazon MTurk is a marketplace for online tasks, through which workers sign up to complete human intelligence tasks or (HITs), in exchange for small amounts of compensation. The platform gives researchers access to a diverse sample of participants that is more representative than samples obtained through other convenience sampling processes, but is not representative of the general population (Berinsky et al. 2012).

The majority of workers on MTurk are from the USA and India, and it is estimated that 5,950,000 tasks are performed per week (Fort et al. 2011). Participants may be younger and more ideologically liberal than the general public, because this is reflective of the population that actively uses the Internet (Berinsky et al. 2012). However, MTurk respondents may even be more demographically diverse than participants recruited through methods for typical online studies (Berinsky et al. 2012; Casler et al. 2013). A study conducted in 2013 found

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indistinguishable results between tests administered through MTurk, in person, and through social media (Casler et al. 2013). MTurk does not provide a representative sample of respondents. However, overall, data collection from MTurk is valid in conducting human subject research, and research has been published based on data collected entirely from the platform (Paolacci and Chandler 2014; Sheehan and Pittman 2016).

In order to assess the generalizability of the samples in this research, demographic characteristics are compared to the demographics of the general US population, as reported by the US census. The limitations of a non-representative sample are discussed in the "Discussion" and "Conclusion" sections. Though the samples used in this research are not accurately generalizable to the US population, they provide valuable initial information about how individuals think about home energy efficiency, and the findings from this study can be looked for in nationally representative samples in the future.

Procedure Participants opted in to completing the survey via Amazon MTurk. They provided informed consent to participate in the research and then answered a series of questions about their demographics and their perceptions of energy efficiency. The survey was distributed through Qualtrics and took approximately 20 min to complete. Participants were told that the research focused on perceptions of residential energy efficiency and were told that they could opt out at any time.

Measures The survey questions were written in consultation with the Duke Carbon Offsets Initiative and the Clinton Climate Initiative, based on their work implementing home energy efficiency programs in the past (Clinton Climate Initiative, Personal Communication, 2015; Duke Carbon Offsets Initiative, Personal Communication 2015). Opinions about energy efficiency were measured through agreement on a 5-point Likert scale that ranged from Strongly Disagree to Strongly Agree to the following three statements:

1. Increasing the energy efficiency of my home is important to me.
2. Increasing the energy efficiency of my home is a good investment.
3. I consider home energy efficiency when purchasing new appliances, lighting, and retrofits.

It should be noted that these three questions do not comprehensively measure opinions towards energy efficiency; they measure certain specific components of attitudes towards energy efficiency that were deemed relevant by the Clinton Climate Initiative (Clinton Climate Initiative, Personal Communication, 2015).

Participants were asked whether they own their own home, how many people live in their home, how long they have lived in their home, when their home was built, and what type of home they live in from the response options of a single-family home, a condo/townhouse, a manufactured or mobile home, and an apartment or duplex.

They were also asked which energy efficiency measures they had considered and completed from a list of nine possible options, including the following:

1. Replacing or upgrading windows
2. Installing or repairing insulation
3. Installing a more efficient heating and/or cooling system
4. Installing a more efficient water heater
5. Caulking and air sealing
6. Installing weather-stripping on doors and windows
7. Installing a programmable thermostat
8. Installing Energy Star™ appliances, and
9. Replacing lightbulbs with CFL or LED bulbs.

Participants then read a description of an employer-sponsored home energy efficiency program, through which employers would provide some funding, approved time off, and connections to qualified energy auditors and contracted, among other types of support. They then were asked how likely they would be to enroll in such an employer-sponsored home energy efficiency program, and how likely they thought their coworkers would be to enroll, on a 5-point Likert scale that ranged from Extremely Unlikely to Extremely Likely.

Perceived benefits of and barriers to home energy efficiency were measured by asking participants to rank nine benefits of energy efficiency from the most to least important and to check off on a list of nine potential barriers ones that had prevented them from completing energy efficiency measures. The benefits of energy efficiency that participants ranked included the following:

1. Energy efficiency improvements lower my energy bills.

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2. Energy efficiency improvements are good investment.
3. Energy efficiency improvements increase the comfort of my home.
4. Energy efficiency improvements also improve the indoor air quality of my home.
5. Energy efficiency improvements reduce my impact on the environment.
6. Energy efficiency improvements increase the resale value of my home.
7. Energy efficiency improvements contribute to my energy independence and security.
8. Energy efficiency improvements bring better technology into my home.
9. Energy efficiency improvements highlight me as a role model for my family and/or community.

The barriers included the following:

1. The project was restricted by a homeowner's association, historical society, or similar organization.
2. My spouse/partner did not want to do the project.
3. I could not find a contractor that I trusted.
4. The project was not feasible in my home.
5. I did not have enough information about the project.
6. I have other home improvements that need to be done first.
7. I do not own my home.
8. I did not have enough time.
9. The project was too expensive.

The order with which these benefits and barriers were displayed to participants was randomized. The fourth benefit on the list, "Energy efficiency improvements also improve the indoor air quality of my home," was intended to measure perception of some of the health benefits of energy efficiency, such as reduced occurrence of asthma.

Demographics The survey received 320 responses. 59.1% of the respondents were female. Participants reported their age by selecting from one of six brackets, and 40% of the respondents reported that they were between 25 and 34 years of age, with a range from 18 to more than 65. Of the respondents, 17.2% were younger than 25, and 37.2% were 35 or older.

The home location of participants was divided into four categories, defined by the U.S. Census Bureau's regional division of the USA (U.S. Census Bureau n.d.). Of the respondents, 39.1% were from the South, 15.9% from the Northeast, 18.8% from the Midwest, and 19.7% from the West. Participants reported their education level by selecting from one of seven categories. The majority reported having completed some college (29.1%) or graduating from college as their terminal degree (34.7%). Of the respondents, 17.5% reported lower education levels than this, and 13.5% reported higher education levels.

Income was reported by a selection from one of seven income brackets. The largest group of respondents (25.6%) reported earning between $50,000 and $74,999 per year, with 49.2% reporting earning less than that, and 19.4% reporting earning more.

These demographics can be compared to the US national census to evaluate how representative this sample is of the general population, given that MTurk samples are generally more representative than other types of convenience samples, but still have biases (Berinsky et al. 2012; U.S. Census Bureau 2010, 2015a, b). In the general US population, 49.2% of individuals are male and 50.8% are female, and 13.3% of the population is between 25 and 34 years of age, with 33.9% of the population below the age of 25 and 47.2% above the age of 34 (U.S. Census Bureau 2010). By geographic region, 17.4% of Americans live in the Northeast, 21.0% in the Midwest, 23.7% in the West, and 37.9% in the South (U.S. Census Bureau 2016). The Census Bureau reports that of the population 18 to 24 years old, 55.9% have some college, a bachelor's degree, or higher as their highest level of education, and of the population 25 years and older, 47.7% have some college or a bachelor's degree as their highest level of education. For 18–24-year-olds, 44.1% are less educated than this, and for 25-year-olds and older, 11.2% are more educated than the bachelor's degree level, while 41.1% are less educated (U.S. Census Bureau 2015a, b). In the general population, 17.8% of individuals earn between $50,000 and $74,999 per year, with 35.6% earning more than that and 46.6% earning less than that (U.S. Census Bureau 2015a, b).

Compared to the general US population, the sample in this study was more female, and about equally distributed across the regions of the country. The 25–34 age group was greatly overrepresented in this sample, and the overall sample was younger than the general population. The reported education levels indicate that this sample is more educated than the general population, with far fewer individuals than in the general population

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reporting holding a high school diploma or lower as their terminal degree. The sample earns less than the general population, with more individuals reporting earning less than and up to $74,999 per year. Overall, these characteristics indicate that the sample cannot generalize to the US population, but it still can provide informative data about how individuals think of home energy efficiency.

Results

Ranking of benefits of energy efficiency Lowering one's energy bills was the top-ranked benefit of home energy efficiency on average. The second highest-ranked benefit was energy efficiency improvements being good investments, followed by the benefit that energy efficiency increases home comfort. The average rankings of all nine benefits are provided in Table 1 below.

A Friedman test was performed to examine whether the average rankings of the nine benefits of energy efficiency were significantly different from each other. The test found that there was a statistically significant difference ($\chi 2(8) = 576.05$, $p < 0.001$).

While participants from all four regions ranked saving money on energy bills as the top benefit, participants from the Northeast and Midwest ranked the second most important benefit as energy efficiency being a good investment, on average. Participants from the South ranked increased home comfort as the second most important benefit, and participants in the West ranked reducing their impact on the environment as the second most important benefit. The top three benefits for each region are presented in Table 2 below.

Table 1 Ranking of benefits of home energy efficiency

Benefit	Average rank
Energy efficiency improvements lower my energy bills.	2.26
Energy efficiency improvements are good investments.	4.39
Energy efficiency improvements increase the comfort of my home.	4.53
Energy efficiency improvements also improve the indoor air quality of my home.	4.90
Energy efficiency improvements reduce my impact on the environment.	4.90
Energy efficiency improvements increase the resale value of my home.	5.12
Energy efficiency improvements contribute to my energy independence and security.	5.64
Energy efficiency improvements bring better technology into my home.	6.06
Energy efficiency improvements highlight me as a role model for my family and/or community.	7.24

Additional Friedman tests revealed that there were statistically significant differences in rankings of the benefits in all four regions: the Northeast ($\chi 2(8) = 99.83$, $p < 0.001$), South ($\chi 2(8) = 236.99$, $p < 0.001$), Midwest ($\chi 2(8) = 114.15$, $p < 0.001$), and West ($\chi 2(8) = 139.60$, $p < 0.001$).

In each region, the 2nd- and 3rd-ranked benefits were much closer in average rank than the 1st- and 2nd-ranked benefits. Post hoc Nemenyi tests revealed that the 2nd- and 3rd-ranked benefits were not significantly different in the Northeast, South, Midwest, or West (all $p > 0.05$). The Nemenyi test can be used as a post hoc test after a significant Friedman test reveals differences in rank scores (Pohlert 2014).

Barriers to implementing home energy efficiency improvements The cost of energy efficiency improvements was the most commonly perceived barrier to implementation, followed by a lack of time, and then not owning one's home. Figure 1 below shows the frequencies with which survey participants reported that each potential barrier had prevented them from implementing energy efficiency measures.

Predicting likelihood to enroll A multiple regression analysis was performed to determine which factors predicted likelihood to enroll in an employer-sponsored energy efficiency program. Perceived likelihood that a coworker would enroll, education level, age, average level of agreement to the three questions measuring opinions about energy efficiency, income, whether the respondent owned their home, the number of people living in the home, the length of time living in the home, whether the respondent had had an energy audit, gender, and how many energy efficiency projects the respondent had considered and completed were tested as predictors. The overall model fit the data ($R^2 = 0.40$, $F(11, 235) = 14.41$, $p < 0.001$).

The only significant predictors were perceived likelihood that coworkers would enroll ($b = 0.58$, $F(1,235) = 100.88$, $p < 0.001$), age ($b = -0.10$, $F(1,235) = 5.65$, $p < 0.05$), and average agreement to the three statements that measured personal opinions about energy efficiency ($b = 0.25$, $F(1,235) = 7.97$,

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Table 2 Ranking of energy efficiency benefits by region

Region	Ranked position	Benefit	Average ranking
Northeast	First	Lowering energy bills	2.25
	Second	Good investment	4.06
	Third	Increasing home resale value	4.62
South	First	Lowering energy bills	2.25
	Second	Increasing home comfort	4.46
	Third	Good investment	4.51
Midwest	First	Lowering energy bills	2.36
	Second	Good investment	4.15
	Third	Increasing home comfort	4.39
West	First	Lowering energy bills	2.15
	Second	Reducing environmental impact	4.48
	Third	Good investment	4.53

$p < 0.01$). This model indicates that thinking coworkers are more likely to enroll in a home energy efficiency program, being younger, and having a more positive opinion about energy efficiency all predict self-reported personal likelihood to enroll in a home energy efficiency program.

Education level, income, whether the respondent owned their home, the number of people living in the home, the length of time living in the home, whether the respondent had had an energy audit, gender, and how many energy efficiency projects the respondent had considered and completed were all found to be non-significant (all $p > 0.05$).

Discussion

The results demonstrate that money is the most important factor when individuals make decisions about energy efficiency improvements. Saving money was the top-ranked perceived benefit of energy efficiency, with energy efficiency being a good investment and raising home value as other top-ranked benefits, while high costs of energy efficiency projects was the top-reported barrier. This aligns with other recent research on what motivates energy efficiency, such as the studies by Southwell and Murphy (2014), Aravena et al. (2016), and Palmer et al. (2011).

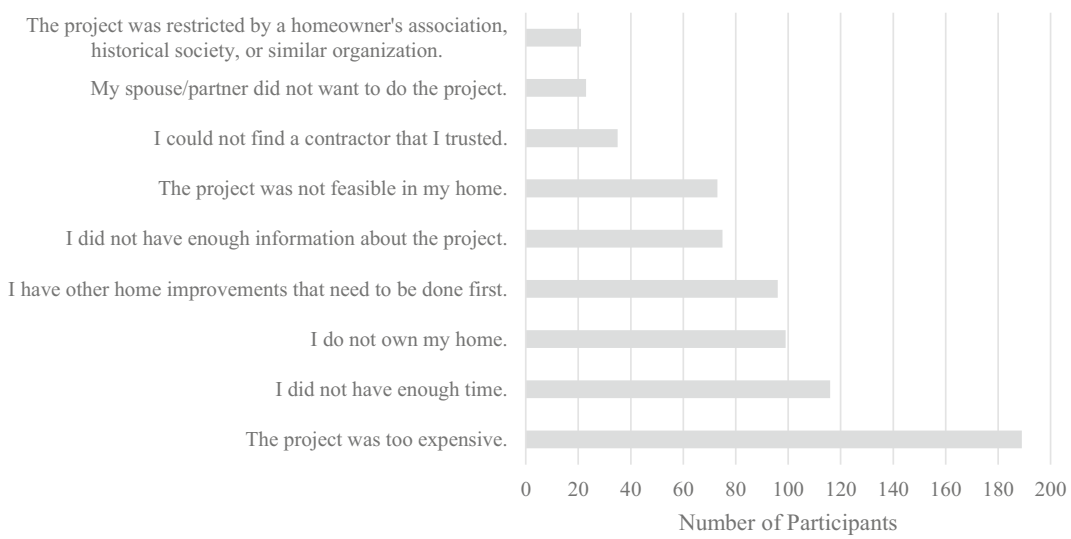

Fig. 1 Perceived barriers to implementing home energy efficiency improvements

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These results hold true across geographic regions of the US. Other top-ranked benefits of energy efficiency included increasing home comfort and air quality and lowering one's environmental footprint. While the ranking of the benefits were significantly different across regions, tests of the differences between just the 2nd- and 3rd-ranked benefits in each region reveal no significant differences in average rank.

Increasing home comfort may not have been ranked as highly as it would have been if the elements of home comfort had been listed separately, such as noise level, light level and shade, and temperature and draftiness. The phrasing of this item about home comfort is a potential limitation; participants may not have thought about these specific elements of comfort that might actually matter quite a bit to them when reading this item.

Income, personal values of energy efficiency, and perceived likelihood of coworkers enrolling in a home energy efficiency program were the only significant predictors of participants' reported likelihood to enroll in such a program, which indicates that social norms, personal values, and the availability of financial resources are the most important motivators for individuals to make their homes more energy efficient. It did not matter whether participants owned their home or not, whether they had previously considered or implemented energy efficiency measures, what gender they were, how educated they were, or how old they were. These results indicate that enabling individuals with financial resources to invest in energy, making sure they value its importance, and establishing a social norm of investing in energy efficiency would be powerful ways to motivate higher uptake rates of residential energy efficiency improvements.

Additional limitations to this study include that it was based on self-report data, which could be subject to social desirability bias and other systematically inaccurate patterns of response. Participants may have ranked financial benefits and barriers as more highly than they actually perceived them if they thought that valuing financial concerns in energy efficiency decisions was more socially desirable than valuing environmental concerns, or others. Furthermore, this study was correlational and therefore causality cannot be determined; there may be moderating variables between the reported perceptions of benefits and barriers to energy efficiency and actual enrollment in an energy efficiency program. Perceptions of coworkers' likelihood to enroll in an energy efficiency program may be associated with personal intent to enroll, but may not be a causal factor; the direction of causality could be in the opposite way, or both measures may be caused by a third unmeasured variable.

Despite these limitations, the results of this survey shed light on how individuals consider energy efficiency decisions for their homes. According to the theory of community-based social marketing as it applies to environmental behaviors (McKenzie-Mohr 2011), the next step in the process is to design and test methods to inspire the target behavior. To carry this out, a series of focus groups were held and a second survey was implemented to investigate how marketing materials can be designed to target perceived benefits and barriers.

Study 2: Marketing energy efficiency

Two focus groups were conducted after Survey 1 to investigate the results found from the previous study in another setting, and the focus groups again demonstrated that cost savings, increased comfort, and environmental benefits are all highly regarded aspects of energy efficiency. Participants in the focus groups were also interested in the technological benefits of energy efficiency. A second survey was then distributed to individuals in the US via Amazon MTurk and participants were again compensated $0.10 for their responses. The content of this survey was developed based on the results of Study 1 and the focus groups. According to the theory of community-based social marketing, after exploring perceived benefits and barriers to a target behavior, the next step is to design and test behavior change strategies (McKenzie-Mohr 2011). Accordingly, marketing content for a home energy efficiency program was developed and tested in this study.

Methods

Participants opted in to completing the survey via Amazon MTurk. They provided informed consent to participating in the research, and then answered a series of questions about their perceptions of marketing materials for a home energy efficiency program. The survey took about 10 min to complete. Again, participants were told that the research was investigating perceptions of residential energy efficiency and were given the choice to opt out at any time.

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Measures Participants answered questions about their demographic characteristics, and then read a short description of an employer-sponsored home energy efficiency program. They were asked which of the following marketing messages would make them most likely to enroll in such a program:

1. Have you heard? There are a wide variety of energy efficiency technologies available at a low cost to you to improve your home comfort and reduce your carbon footprint!
2. Let us help you increase your home's values by investing in home energy efficiency improvements.
3. Investing in energy efficiency improvements can reduce your impact on the environment while making your home even more comfortable.
4. The newest energy efficiency technologies are now just within your reach and will save you money for years to come.
5. Did you know? Small and affordable energy efficiency improvements in your home can have a large positive impact for the environment.
6. With the new energy efficiency technologies you can add to the comfort of your home and do your part to protect the environment!

The order of these messages was randomized among participants. These messages were developed around the top three perceived benefits from Study 1, referencing these benefits individually and in combination. Additionally, some references to the technological benefits of energy efficiency were added to the messages because this theme arose during the focus groups.

Lastly, participants were presented with six images and asked which image, if included in marketing materials, would make them most likely to enroll in an employer-sponsored home energy efficiency program. The six images included the following:

1. *Money and House:* A stack of bills with a small, wooden house figure and a small piece of paper with a chart on top (Fig. 2).
2. *Talking in Kitchen:* A middle-aged white woman and a young Asian male engaged in conversation in a kitchen. The women are pictured writing or drawing something on a piece of paper (Fig. 3).
3. *Blower Door Test:* A picture of a young white male setting up a blower door test at the front door of a house (Fig. 4).

Fig. 2 Money and house (Source: Bigstock.com)

4. *Light Bulbs on Paper:* An LED and an incandescent light bulb sitting on a piece of paper that is printed with tables and chart (Fig. 5).
5. *Money in Light Bulb:* A dollar bill stuck in an LED light bulb, set against a green background (Fig. 6).
6. *Infrared Sensor:* A hand holding up an infrared sensor in an empty and light room (Fig. 7).

The order in which images were presented to participants was randomized. Participants were asked to explain their answers to the questions about the messages and the images in writing.

Demographics The survey received 423 responses. Of the respondents, 60.9% were female. Participants reported their age by selecting from one of six brackets, and 42.1% of the respondents reported that

Fig. 3 Talking in kitchen (Source: Clinton Climate Initiative)

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Fig. 4 Blower door test (Source: Clinton Climate Initiative)

they were between 25 and 34 years of age, with a range from 18 to more than 65. 15.5% of respondents were younger than 25, and 46.7% were 35 or older.

Similar to Study 1, the home location of participants was divided into four categories, following the U.S. Census Bureau's regional division of the USA. Of the respondents, 39.0% were from the South, 18.7% from the Northeast, 20.6% from the Midwest, and 21.5% from the West. Participants reported their education level by selecting from one of seven category levels, and the majority reported having completed some college (30.8%) or graduating from college as their terminal degree (36.6%). Of respondents, 15.5% reported lower education levels than this, and 15.1% reported higher education levels.

Income was reported by a selection from one of seven income brackets. The largest group of respondents (21.3%) reported earning between $50,000 and $74,999 per year, with 52.4% reporting earning less than that, and 24.2% reporting earning more.

Fig. 5 Light Bulbs on Paper (Source: Bigstock.com)

Fig. 6 Money in light bulb (Source: Bigstock.com)

In comparison to the general US population, this sample was again more female, the 25–34 age group was overrepresented, but this sample was not as much younger than the general population as the previous sample (U.S. Census Bureau 2010). Geographic spread across the four regions was again about the same as the spread of the general population (U.S. Census Bureau 2016). The sample was again more educated than the general population, with more individuals reporting that they had completed some college or a bachelor's degree as their highest level of education. Again, reported income levels were less than those from the general population, with fewer individuals reporting earning more than $74,999 per year (U.S. Census Bureau 2015a, b).

Results

Marketing messages The message that was most frequently selected (37.1%) as the one most likely to inspire individuals to enroll in an energy efficiency program across all geographic regions was, "The newest energy efficiency technologies are now just within your

Fig. 7 Infrared sensor (Source: Bigstock.com)

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reach and will save you money for years to come." The second most frequently selected message overall (17.5%) was, "Let us help you increase your home's values by investing in home energy efficiency improvements." This message was chosen second most by participants in the South and Midwest. Participants in the Northeast chose, "Have you heard? There are a wide variety of energy efficiency technologies available at a low cost to you to improve your home comfort and reduce your carbon footprint!" with the second highest frequency. Participants in the West showed no strong leaning in their second most preferred message; the distribution between several of the messages besides the top choice was approximately even.

Chi-squared tests were run to investigate whether geographic region, age, gender, ownership of home, education level, income level, job level, and political orientation related to participants' choice of marketing messages. The effect of gender was found to be significant ($\chi 2(10) = 23.367$, $p < 0.01$). While both males and females selected the same message with the highest frequency (40% of males and 34% of females), "The newest energy efficiency technologies are now just within your reach and will save you money for years to come," females' second most preferred message (17%) was, "Have you heard? There are a wide variety of energy efficiency technologies available at a low cost to you to improve your home comfort and reduce your carbon footprint!" while males' second most preferred message (23%) was, "Let us help you increase your home's values by investing in home energy efficiency improvements." This was females' third most preferred message (15%), while males' third most preferred message (18%) was, "Investing in energy efficiency improvements can reduce your impact on the environment while making your home even more comfortable." All other effects were found to be non-significant (all $p > 0.05$).

Marketing images The Money and House image was selected by 32% of respondents as the one most likely to inspire them to enroll in a home energy efficiency program. The Money in Light Bulb image was selected by 30% of the respondents. 16% chose the Light Bulbs on Paper image, 13% chose the Infrared Sensor image, 5% chose the Blower Door image, and 4% chose the Talking in Kitchen image.

Again, chi-squared tests were run to investigate the effects of demographic variables on image selection. Geographic region was found to have a significant effect ($\chi 2(20) = 25.258$, $p < 0.05$) as well as political orientation ($\chi 2(30) = 43.880$, $p < 0.05$).

The Money and House image was chosen most often by participants in the West, while the Money in Light Bulb was selected more often by participants in the Northeast and Midwest. Participants in the South selected both with about the same frequency. The Light Bulbs on Paper image was chosen more often by participants in all three regions besides the Midwest. The Infrared Sensor image was chosen more often by participants in the Northeast and the Midwest than by those in the South and the West.

The top most preferred image of politically conservative participants was the Money and House image (36%), while the top most preferred image of politically liberal participants was the Money in Light Bulb image (32%). Liberals' second most preferred image was the Money and House image (28%), while conservatives' second most preferred image was the Money in Light Bulb image (24%). Liberals' third most preferred image was the Light Bulbs on Paper image (18%), while conservatives' third most preferred image was the Infrared Sensor (16%).

Discussion

The results reinforce the findings from Study 1 that money is one of the most important factors in energy efficiency decisions. Participants preferred images depicting money over images illustrating other aspects of the energy efficiency upgrade process. Though there were differences between political groups in image preference, the two images containing money were the top two images for both groups.

Participants in the Northeast and Midwest and politically conservative participants liked the image showing an infrared sensor.

The most preferred marketing message emphasized the new technology of energy efficiency. It is interesting to note that technology was not rated as an important benefit of energy efficiency in Study 1, but the message about technology was the most preferred message in Study 2. This indicates that individuals' perceptions of how technology relates to energy efficiency and how beneficial energy efficiency technology is may be sensitive to wording; individuals may not understand the link between energy efficiency and technology well enough to have a consistent opinion independent of

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the framing of a message. This should be investigated in future research.

Messages about home value and reducing one's carbon footprint were also rated highly. Though there were gender differences in the choices of marketing messages, both genders overall liked messages that referenced cost savings, home value, and the environment. The gender difference should be further investigated in future research to determine whether the difference was due to true differing perceptions of energy efficiency between males and females, or due to differing sensitivities to the wording of the items.

One limitation of this study was the fact that all participants viewed all of the images at once and all of the marketing messages at once, and therefore their interpretation of one message or image may have been impacted by their perceptions of the others. When seeing one of these images or messages in isolation, as one would in actual marketing materials for home energy efficiency, each image or message may make a different impression than it did in this study. While the format of these questions was efficient at measuring preferred images and messages, this limitation should be noted and should be considered in future research.

General discussion

These studies demonstrate that individuals think most about money when they consider energy efficiency, and secondary concerns include increased home comfort and air quality, environmental benefits, and keeping up with new technology. The studies confirmed the researchers' first hypothesis, that the environmental benefit of energy efficiency would be perceived as less important than other benefits. The results of these studies reveal that saving money and increasing home comfort are perceived as more important than protecting the environment everywhere except for in the West.

The second hypothesis was partially confirmed. Geographic differences between perceptions of energy efficiency were found, but not in the predicted direction. It was predicted that individuals from the Northeast would value improved home comfort while individuals from the South would prioritize savings on energy bills. It was found that individuals from all regions perceived saving money on energy bills as the most important benefit, while increasing home comfort was one of the top three most important benefit for individuals in the South and Midwest, but was not one of the top three benefits for individuals in the Northeast. The results of these studies align with previous work on perceptions of home energy efficiency such as work by Southwell and Murphy (2014), Aravena et al. (2016), and Palmer et al. (2011).

Conclusion

Two studies provide an analysis of how individuals perceive home energy efficiency, using the framework of community-based social marketing. Study 1 found that the top perceived benefits are saving money on energy bills, investing in one's home, and increasing the comfort of one's home. Regional differences were found, such that individuals in the West valued the environmental benefits more highly than individuals in other regions, and those in the Northeast valued improving the resale value of their homes more than individuals in other regions. Study 2 revealed that messaging focusing on new technologies associated with energy efficiency improvements selected as the most effective, while messaging and images emphasizing saving money, environmental benefits, and increasing home value were also preferred by many participants.

Overall, these studies show that those who seek to increase the uptake of energy efficiency measures in the residential sector should tailor their marketing materials to make home energy efficiency seem cheap and easy and to emphasize that energy efficiency is a good investment, brings new technology into the home, and increases home comfort. They should keep in mind that individuals in the West may be more easily persuaded with messaging about the environmental benefits, while those in the Northeast may care more about the resale value of their homes.

Three important limitations of both studies are that the research was based on self-report, was correlational, not causal, and did not include a nationally representative sample of participants. The research provides a starting point for understanding individuals' perceptions of energy efficiency in the home, but the findings should be further investigated both experimentally, using randomized controlled trials, so that causal factors for enrolling in a home energy efficiency program or implementing home energy efficiency upgrades can be determined, and in nationally representative samples, so the findings can be generalized to the US population as a

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whole. Further research should test marketing materials for home energy efficiency in real-world settings, beyond online surveys and the limited subject samples on Amazon MTurk. Additionally, examining whether different types of energy efficiency projects can be more effectively motivated by different types of marketing would be a valuable next step. This research lumped all home energy efficiency behaviors into one category, for the sake of reaching broad conclusions about perceptions of energy efficiency, but it may be the case that specific behaviors have different perceived benefits and barriers and require varied marketing strategies. Additionally, this research focused only on efficiency behaviors: one-time behaviors intended to decrease the amount of energy consumed in one's home without changing habitual behaviors. Future research could include curtailment behaviors, which consist of altering small, repetitive behaviors in order to use less energy without changing the technology in one's home. Finally, future research should further investigate the gender difference found in preferred marketing messages in Study 2, as well as the differing results about the importance of technology as a benefit of energy efficiency between Studies 1 and 2.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Aravena, C., Riquelme, A., & Denny, E. (2016). Money, comfort or environment? Priorities and determinants of energy efficiency investments in Irish households. *Journal of consumer policy, 39*(2), 159–186.

Asensio, O., & Delmas, M. (2015). Nonprice incentives and energy conservation. *Proceedings of the National Academy of Sciences*, *112*(6), E510–E515.

Attari, S., Dekay, M., Davidson, C., & Bruin, W. (2010). Public perceptions of energy consumption and savings. *Proceedings of the National Academy of Sciences, 107*(39), 16054–16059. https://doi.org/10.1073/pnas.1001509107

Berinsky, A. J., Huber, G. A., & Lenz, G. S. (2012). Evaluating online labor markets for experimental research: Amazon.com's Mechanical Turk. *Political Analysis, 20*(03), 351–368. https://doi.org/10.1093/pan/mpr057

Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior, 29*(6), 2156–2160. https://doi.org/10.1016/j.chb.2013.05.009

Dietz, T., Gardner, G. T., Gilligan, J., Stern, P., & Vandenbergh, M. P. (2009). Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences, 106*(44), 18452–18456. https://doi.org/10.1073/pnas.0908738106

Fort, K., Adda, G., & Bretonnel Cohen, K. (2011). Amazon Mechanical Turk: Gold mine or coal mine? *Computational Linguistics, 37*(2), 413–420. https://doi.org/10.1162/COLI_a_00057

Guerin, D. A., Yust, B. L., & Coopet, J. G. (2009). Occupant predictors of household energy behavior and consumption change as found in energy studies since 1975. *Family and Consumer Science Research, 29*(1), 48–80.

McKenzie-Mohr, D. (2011). *Fostering sustainable behavior: an introduction to community-based social marketing*. Gabriola Island: New Society Publishers.

Palmer, K., Walls, M., Gordon, H., & Gerarden, T. (2011). Assessing the energy-efficiency information gap: Results from a survey of home energy auditors. *Energy Efficiency*, *6*(2), 271–292.

Paolacci, G., & Chandler, J. (2014). Inside the Turk: understanding Mechanical Turk as a participant pool. *Current Directions in Psychological Science, 23*(3), 184–188. https://doi.org/10.1177/0963721414531598

Pohlert, T. (2014). The pairwise multiple comparison of mean ranks package (PMCMR). R package. http://CRAN.R-project.org/package=PMCMR.

Sheehan, K. B., & Pittman, M. (Eds.). (2016). *Amazon's Mechanical Turk for academics: The HIT handbook for social science research*. Irvine: Melvin and Leigh.

Smalley, R. (2005). Future global energy prosperity: the Terawatt challenge. *Materials Research Society Bulletin, 30*(06), 412–417. https://doi.org/10.1557/mrs2005.124

Southwell, B. G., & Murphy, J. (2014). Weatherization behavior and social context: the influences of factual knowledge and social interaction. *Energy Research and Social Science, 2*, 59–65. https://doi.org/10.1016/j.erss.2014.03.019

Southwell, B. G., Doran, E. M. B., & Richman, L. S. (Eds.). (2016). *Innovations in home energy use: a sourcebook for behavior change*. Research Triangle Park: RTI Press. https://doi.org/10.3768/rtipress.2015.bk.0015.1512

Sovacool, B. K. (2014). What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research and Social Science, 1*, 1–29. https://doi.org/10.1016/j.erss.2014.02.003

U.S. Census Bureau. (2010). Profile of general population and housing characteristics: 2010. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

Author's personal copy

U.S. Census Bureau. (2015a). Educational Attainment: 2011–2015 American Community Survey 5-Year Estimates. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

U.S. Census Bureau. (2015b). Selected economic characteristics: 2011–2015 American community survey 5-Year estimates. Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

U.S. Census Bureau. (2016). Retrieved from https://www.census.gov/popclock/data_tables.php?component=growth.

U.S. Census Bureau. (n.d.) Census bureau regions and divisions with state FIPS codes. Retrieved from https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf.

U.S. Department of Energy (DOE). (2015). Better buildings challenge: overview. Retrieved from http://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Better Buildings Challenge Overview.pdf.