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The Impact of Framing and the Influence of Environmental Literacy on Consumer's Housing Selection: An Experiment of Energy Labels

Mieko FUJISAWA*

Abstract

Through conducting experiments on information displays in real estate advertisements, this study indicates that information disclosure policies can change consumers' housing choice behaviors toward a focus on reducing CO_2 emissions. The experiment was conducted using a controlled experimental method, with subjects divided into two groups: a control group and a treatment group. The treatment group was divided into three subgroups based on information framing differences. Logistic regression analysis results showed that all treatment groups chose more energy-saving houses than the control group. The greater the consumers' environmental literacy, the greater the choice of energy-saving houses. Differences in knowledge of and emphasis on thermal insulation performance (i.e., components of environmental literacy) were associated with differences in energy-saving housing choice. Comparisons according to high/low environmental literacy found that all framing effects were greater for subjects with low environmental literacy. For energy labels to achieve their purposes, it is preferable to present the energy efficiency score and content information together, regardless of consumer environmental literacy. This finding was supported by the highest odds ratio being related to the combined use of label and content information. This confirms the necessity of making the disclosure of energy labels in real estate advertisements obligatory in Japan.

Keywords: Energy labels, Framing effect, Environmental literacy, Real estate advertising, Energy-saving house

JEL classification numbers: C91, D82, Q59

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1. Introduction

The household sector accounts for 15.9% of the CO_2 emissions in Japan, which is problematic owing to the urgent need to reduce CO_2 emissions from houses. Considering this need, displaying energy labels of houses (i.e., that show the house's energy consumption) in real estate advertisements may encourage people to choose energy-saving houses. Energy labels are being introduced in many countries. Although they have been discussed in Japan, the obligation to display such labels has been postponed for an indefinite period; this is because the time and effort associated with label processing is considered a problem. Therefore, to make energy labeling mandatory in Japan, evidence of its efficacy is needed.

The display of energy labels in advertisements allows for people to visualize the energy consumption level of an object and simplifies the calculation of the expected energy use from its design (Bull, 2012), helping consumers make conscious pro-environment decisions (Heinzle and Wüstenhagen, 2012). This is done specifically through promoting behavioral changes in consumers regarding energy consumption (Dolan et al., 2012). Potter et al. (2021) suggest that consumers respond positively to easy-to-understand labels in their eco-label reviews. Simultaneously, consumers tend to make decisions based on simple rules of thumb, heuristics, and mental shortcuts (Frederiks et al., 2015). In particular, people may use heuristics when making decisions about goods that require cognitively costly assessments, such as houses, which are complex goods that include many judgment items (Blasch et al., 2019).

The initial information provided to people about a product at the gathering phase may influence the judgment of the items presented later, thus affecting consumers as an anchoring heuristic (Tversky and Kahneman, 1974). Importantly, when decision-makers are disproportionately influenced to make decisions biased by their initial information, subsequent decisions can then be influenced even by irrelevant anchoring numbers (Englich et al., 2006; Critcher and Gilovich, 2008). This highlights the importance of energy label display, which serves as an anchor or default reference point, in advertisements and other media during the information gathering phase (Bucchianeri and Minson, 2013). Thus, obtaining important information at the point of decision-making and prior to purchase allows consumers to effectively change their behavior. Meanwhile, the availability heuristic influences consumer decision-making when consumers repeatedly look at energy labels that advertise good energy efficiency (Kahneman, 2003). The availability heuristic, a judgmental heuristic, is defined as the ease with which relevant instances come to mind (Tversky and Kahneman, 1973).

Indeed, information interventions (e.g., energy labeling) have been deemed as the best options for increasing energy efficiency (Allcott and Greenstone, 2012). By enabling comparisons among goods regarding their energy efficiency, energy labels attract the attention and change the perceptions of consumers, incentivize businesses, and reduce energy consumption in society (He et al., 2022). Notwithstanding, Blasch et al. (2019) noted that the societal goal of increasing energy efficiency may be inconsistent with consumers' cost-minimization choices. This is because consumers must typically pay an initial surplus cost to choose energy-efficient products or houses. It has been shown that increased energy efficiency increases building prices (Kahn and Kok, 2014; Stanley et al., 2016).

Higher levels of energy and investment literacy, rather than heuristic decisions, can lead to more rational decisions when choosing energy-efficient appliances (Blasch et al., 2019). This paradoxically means that energy labels are worth displaying because some consumers with low energy literacy may rely on heuristics. Therefore, to confirm the effectiveness of energy labels, it is important to study their effects on house choices based on two approaches: intuitive heuristics about the displayed design, and information and rational decision-making. Accordingly, this study examined whether energy label display on real estate advertisements increases energy-saving housing choice compared to control conditions without energy label display. The goal was to clarify the effectiveness of energy label design and of the provision of information in advertisements on consumer behavior. Additionally, whether consumers make a rational (i.e., based on consumers' high literacy) or a heuristic decision was also investigated.

The remainder of this paper is organized as follows: Section 2 summarizes the previous research and describes the hypotheses of this study. Section 3 describes the experimental design, model equations, and data. Section 4 presents the results of the analysis. Section 5 discusses the results and Section 6 concludes the paper.

2. Literature Review

First, previous studies on the effectiveness of energy labels are reviewed. Second, previous research on energy label design and information, rationality, decision-making heuristics, and literacy is presented. Subsequently, the study's hypotheses are presented.

2.1 Energy Label Validity

The energy label effect has been validated in the appliances and housing markets. For example, Sammer and Wüstenhagen (2006) found a positive effect of energy labels on consumers' willingness to pay (WTP) for washing machines. Similarly, energy labels were found to have a positive effect on the WTP for refrigerators (Andor et al., 2020). In a randomized controlled trial (RCT) of actual purchase behavior comparing the EU energy label (a categorical scale label) with extended or no labels, participants who saw the energy label chose more efficient appliances than those who did not see the label (Stadelmann and Schubert, 2018; Blasch et al., 2019). Conversely, Waechter et al. (2015a) confirmed that consumers did not choose higher-efficiency refrigerators based on energy labels, and instead chose larger refrigerators that ultimately increased total energy consumption.

One reason for the non-validation of the positive effect of energy labels is the potential detrimental effects of scale design fragmentation. Heinzle and Wüstenhagen (2012) suggested that a revised version of the energy rating scale that added new classes ranging from A+ to A+++ would result in less perceived importance. Waechter et al. (2016) also investigated the use of this revised scale, focusing on the letters, symbols, and colors of labels, and demonstrated that consumers did not choose energy-efficient products based on the revised scale. These results have led the revised categorical scale label design to be substituted with the original scale presentation.

Previous studies have not only focused on energy labels' energy efficiency scores but also on the information displayed on the label. By displaying the operating costs of home appliances on energy labels, consumers can choose to pay additional upfront costs to benefit from the product's energy-efficiency (Zhou and Bukenya, 2016; Andor et al., 2017). Furthermore, when energy operating costs are presented in monetary terms rather than in annual energy consumption in physical terms (kWh), consumers tend to place more importance on the energy efficiency of their homes (Heinzle, 2012). It was also verified that expressing energy cost information as light-bulb minutes had the same effect as expressing energy cost (Camilleri et al., 2019). Therefore, energy label effectiveness varies by design and content.

With design and information aside, it is also the case that the consumer's understanding and interpretation of the information displayed on energy labels are determined by various individual characteristics and values, including beliefs, attitudes, norms, and intentions (Steg et al., 2014; Codagnone et al., 2016). One of these is energy literacy, which consists of knowledge, attitudes and values, and behaviors about energy (DeWaters and Powers, 2011). Mills and Schleich (2010) found a positive correlation between knowledge about energy efficiency scales on appliances and selecting energy-efficient products. Nair et al. (2010) confirmed that higher levels of education and knowledge about building energy efficiency measures were associated with a greater likelihood of households investing in building envelope measures. Consumer pro-environmental behavior and habits have also shown a positive correlation with the selection of energy efficient options (Van den Broek, 2019).

2.2 Energy Label Design

An energy label works when it is noticed and the information it presents is understood, trusted, and believed to lead to the achievement of a desired goal, such as environmental protection (Thøgersen, 2000). Energy label designs differ across countries, with Energy Star being common in the United States of America. Walls et al. (2017) confirmed the positive impact of the Energy Star design on housing prices. Categorical rating scale labels are common in the EU, and Brounen and Kok (2011) found a positive relationship between housing prices and energy labels in the EU. Using eye tracking, Waechter et al. (2015b) also showed that the energy efficiency class of the categorical rating scale plays a leading role when selecting a product, and that consumers tend to pay less attention to actual energy consumption information. These previous studies also noted that categorical rating scale labels can be misleading owing to reference-dependent preferences and decision heuristics. This is particularly true for individuals with low levels of cognition (Andor et al., 2019). Both studies refer to the phenomenon of "class valuation effect" caused by the stair-step design of the categorical rating scale label. Despite the influence of the class valuation effect, Boyano et al. (2020) advocated for the importance of scale design in energy labels for dishwashers. Allcott (2011) also emphasized that the American "home energy score," which does not change depending on factors such as energy price, number of people living in the house, and how the house is used, can measure house efficiency. That is, the display of energy efficiency scores in advertisements may not only encourage heuristic decisions but also transmit objective information about goods.

The effectiveness of continuous scale labels, which have a design different from those of categorical rating scale labels and the Energy Star, was also confirmed. Schubert and Stadelmann (2015) found that continuous scale labeling is more effective than categorical rating scale labeling and allows consumers to make direct comparisons between goods, especially when energy efficiency is low. Researchers have also compared these multiple energy label designs, showcasing that the effects of design differ depending on the country. In Brunei, continuous scale labels are preferred over rating scale labels (Abas and Mahlia, 2018), and similar results have been verified in Japan (Fujisawa et al., 2020). Based on tests of continuous scale labels conducted in Asia, He et al. (2022) experimented with samples from China and the Netherlands and emphasized the significance of these labels in facilitating purchasing decisions, and confirmed the impact of energy literacy on decision-making. Using the same continuous scale label, housing purchase surveys conducted in the United States of America confirmed the importance of information content and anchoring heuristics for labels (Sussman et al., 2021).

However, it has not been verified whether energy label design can support heuristic decisions, nor whether energy literacy, through enabling an understanding of label meaning, affects the rational selection of energy-saving houses.

2.3 Framing of Design and Information

Energy labels typically include three elements: energy efficiency visualization, standardized information on environmental impact, and technical specification summaries (Leenheer et al., 2014). Therefore, not only energy label design but also content information play an important role in the effect of energy labels. Research on the effectiveness of content information suggests that presenting costs and savings using larger units, such as lifetime costs, is more effective than using smaller ones (Bull, 2012; Heinzle, 2012). The presentation of annual energy consumption in monetary terms has been shown to be highly effective (e.g., Andor et al., 2020).

According to Ölander and Thøgersen (2014), the use of both information and energy labels is important when considering the effect of the information and the subsequent stimulus to the consumer. Moreover, the disclosure of operating costs helps draw attention to costs and overcome the misleading class valuation effect (Andor et al., 2020). This is also true for high value items such as houses; Lakić et al. (2021), for instance, verified that consumers' WTP for energy-saving buildings is higher when the energy bills are displayed. However, a disadvantage of expressing energy efficiency in monetary terms is that the information can be misleading or confusing when electricity prices fluctuate. Indeed, a study on refrigerators failed to verify a positive relationship between the annual operating cost information on energy labels and WTP (Skourtos et al., 2021).

Additionally, the framing of labels, including the presentation of energy efficiency scores and content information, influences consumer decision-making. Framing in this context refers to the process of directing consumers toward a particular goal based on how energy labels present energy efficiency, including the framing of the messages with content information (Sussman et al., 2018). Levin et al. (1988) demonstrated the existence of framing effects on consumer choice behavior, and that consumer choices change depending on how information is communicated. Moreover, framing about losses (vs. about gains) has a stronger impact on changes in consumer behavior (Van de Velde et al., 2010). By testing different frames of energy labels, it is possible to test methods to correct market and behavioral failures (e.g., inadequate information and limited attention), thereby guiding consumers to make energy-efficient and cost-effective choices (Schubert and Stadelmann, 2015).

However, no study has comprehensively examined the designs and content information used on energy labels displayed in real estate advertisements or conducted a detailed analysis using quantitative models.

2.4 Environmental Literacy

Energy labels serve as signposts that activate consumers' pre-existing values and attitudes, and tell them how likely the product is to meet energy-efficiency goals (Ungemach et al., 2017). Among previous studies, there were differences in decision-making according to consumer pre-existing values and attitudes, and they used consumers' energy label literacy as a measure to assess such differences. This literacy is often derived from education; for example, Brounen et al. (2013) conducted a survey in the Netherlands about the impact of energy literacy on energy and investment, finding that Dutch responders who were more educated in heating system examples were more likely to make rational investment decisions. Van den Broek (2019) verified that highly literate consumers tended to choose energy-efficient products.

There are also other tools and indices for measuring literacy about the environment. For example, one can measure knowledge of environmental problems through quizzes on the environment developed by the National Environmental Education & Training Foundation (Coyle, 2005). Another measure that has been widely used since Dunlap and Van Liere (1978) is the New Environmental Paradigm (NEP). The NEP can be utilized to assess environmental morality, the concept proposes a limit to human society growth and evaluates the right of humans to control the natural environment. Another measure is the Cognitive Reflection Test (Frederick, 2005), which was used by Andor et al. (2019) to confirm that when faced with energy label evaluation information that focuses on cognitive levels, some consumers make intuitive decisions at low cognitive levels.

These methodologies have often been used to measure the impact of consumer literacy on decision-making pertaining to energy labels. However, discrepancies between knowledge and pro-environmental behavior have been identified (DeWaters and Powers, 2011; Sovacool and Blyth, 2015). Even if consumers hold technological knowledge literacy, they may not choose energy-efficient products (Min et al., 2014). Furthermore, although academicians improved the methodology surrounding the NEP (Dunlap, 2008), some studies did not confirm a relationship between the NEP and pro-environmental behavior (e.g., Langenbach et al., 2020). These pieces of evidence imply that simply improving consumer literacy through education does not necessarily lead to decision-making toward buying energy-efficient products.

Poortinga et al. (2004) investigated the role of personal values in household energy use, and noted that a multifaceted approach is necessary to analyze environmental behavior rather than simply focusing on environmental concerns. Therefore, further studies are needed to gauge the impact of energy labels on consumer decision-making using “environmental literacy,” which encompasses a wide range of environmental issues and energy literacy. However, no study thus far has used environmental literacy, which is a new concept encompassing energy literacy and environmental knowledge, to measure the effectiveness of energy labels.

2.5 Hypothesis

This study measures the effects of both heuristic and rational decision-making on consumer choices about energy-saving houses. Based on previous studies, it is assumed that heuristic decisions are made based on framing and rational decisions are based on literacy. Given the affinity of Asian populations for continuous scale labels (e.g., He et al., 2022), this type of scale was assumed to be an effective and rational choice for application in the Asian sample of the current study. Hence, the effects of displaying an energy label using a continuous scale design were rigorously examined. This led to Hypothesis 1 (H1), as follows:

H1. Continuous scale labels promote the choice of energy-saving houses.

Next, multiple framings were prepared based on differences in the methods of displaying the energy label and content information. Following Allcott (2011), this experiment displayed energy efficiency information as contextual information. However, if H1 is supported, all framings would likely be effective; particularly, using both the energy label and content information is assumed to lead to the largest framing effect. This led to Hypothesis 2 (H2), as described herein:

H2. The condition that uses a framing combining content information and energy label is the most effective in promoting the choice of energy-saving houses.

Finally, it was assumed that the greater the consumers' environmental literacy, the greater the selection of energy-saving houses. In addition, building on the results of energy literacy studies (e.g., Andor et al., 2019), this study hypothesized that energy labels have different effects depending on environmental literacy level, leading to Hypotheses 3a and 3b, as follows:

H3a. The greater the environmental literacy of consumers, the greater the choice of energy-saving houses.

H3b. The lower the environmental literacy, the greater the label effect on the making of heuristic decisions.

3. Methods

This section explains the experimental design, and the measurement methods of framing effect and of the influence of environmental literacy.

3.1 Experimental Design

This experiment followed the methodology proposed by Sussman et al. (2021), who used continuous scale labels for housing advertisements based on the search method used when purchasing a house. The experiment was conducted in two stages, namely "narrowing down the housing" and "selecting a house."

At the narrowing down the housing stage, subjects were requested to select three (out of 12) house exterior photos on a screen that matched their desired location. The 12 house photos used in the experiment were selected from 30 house photos that received favorable reviews in a cooperative survey conducted with housing industry experts in their 30s to 50s (i.e., persons of comparable age to the subjects of the current study). Participants in the cooperative survey were asked about their interest in purchasing each of the 30 houses in the photos on a five-point scale, with responses collected using Google Forms. This cooperative survey was conducted from 14–16 March 2022.

The subjects of the current study were selected using a two-stage random sampling process from a pool of monitors registered with an Internet-based research company[1]. The monitors were mandated to provide informed consent to the research company upon enrollment. Based on the "Housing Market Trends Survey[2]" by the Ministry of Land, Infrastructure, Transport and Tourism

[1] The research company is the Macromill Group company. https://www.macromill.com/
[2] This survey referred to the 2019 Housing Market Trends Survey was published in 2020. https://www.mlit.go.jp/report/press/content/001348001.pdf (Accessed: 23/2/2022)

(MLIT), which showed regional differences regarding the Japanese housing market, the target of this study was the Tokyo metropolitan area, which includes Tokyo and three prefectures. As the survey developed by the MLIT revealed that most Japanese homebuyers were in their 30s–40s, the preliminary survey of the current research was conducted with a focus on this age group. The preliminary survey asked three questions regarding the price range of the desired house; it was conducted for seven days from 18–24 March 2022.

For the experimental design, the RCT method was employed. Specifically, subjects selected in the preliminary survey were randomly classified into three treatment groups, and there was a total of four groups (including a control group). As shown in Table 1, the control group received no information, Treatment group 1 was given only content information, Treatment group 2 was given only an energy label, and Treatment group 3 was given a combination of content information and energy label. This structure allowed for comparisons of not only the control and treatment groups but also of the effects of information framing (i.e., content information, energy label, and content information and energy label).

Table 1. Content presented to each group during the experiment

	Price	**Plan**	**Thermal insulation performance**	
			Context	**Label**
Control group (No information)	○	○	×	×
Treatment group 1 (Content information)	○	○	○	×
Treatment group 2 (Energy label)	○	○	×	○
Treatment group 3 (Content information and energy label)	○	○	○	○

At the selecting a house stage, subjects were requested to choose a house after checking the displayed information. Figure 1 shows the experimental screen. In the control group, the subjects saw the items, which comprised floor plan and price and a housing photo, and selected one (out of the three) option. The price presented on the screen was defined based on the preliminary survey about housing product budget. The treatment groups were presented with specific energy-usage information, and the subjects had to choose one of three house options that related to energy-saving performance (high, neutral, or low).

In addition to the house-choosing experiment, the subjects were asked 19 questions about aspects that they considered important when purchasing a house. The sociodemographic characteristics of the subjects were also collected, including family status, as well as data on environmental literacy. This experiment was conducted for six days from 25–30 March 2022.

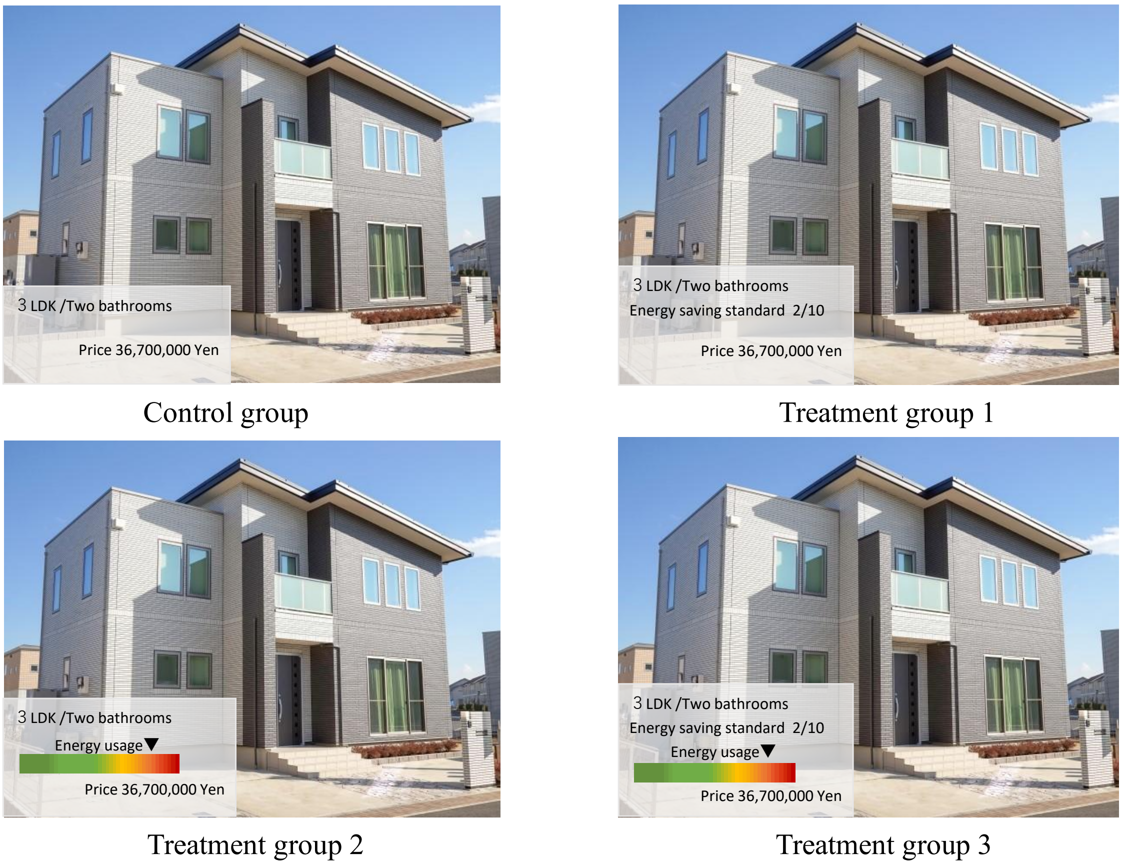

Figure 1. Screenshots shown to the control and treatment groups

3.2 Framing Effect Measurement

To analyze energy-saving house selection, logistic regression analysis was performed using a binary variable (0,1). Specifically, Y=1 indicates that the subjects selected the most energy-saving house from the three options, and Y=0 indicates that they did not select it. The dependent variable (Y*) indicates the probability of selecting energy-saving houses. Regarding sample size, 1,648 observations were collected for each group of 206 subjects, which was deemed sufficient for the study models and for assessing degrees of freedom or number of variables (Peduzzi et al., 1995, 1996). The descriptive statistics of the dependent and independent variables are shown in Table 2.

The independent variables were classified into three factors: experimental design, environmental literacy, and sociodemographic characteristics (Table 2). The experimental design factor consisted of three variables: *Treatment group 1*, *Treatment group 2*, and *Treatment group 3* for each treatment group, based on the control group. These variables revealed the effects of each framing.

The environmental literacy factor focuses on values, knowledge, and attitudes toward the environment and comprises five variables (*Emphasis on insulation*, *Knowledge of insulation*, *Knowledge of the environment*, *Interest in the environment*, *Pro-environment*) that were created based on previous studies (e.g., Walls et al., 2017). *Emphasis on insulation* is a dummy variable equal to 1 for subjects who emphasized the thermal insulation performance of the house during decision-making. *Knowledge of insulation* was input into the model as the total number of correct answers to technical questions that demonstrated technical knowledge of thermal insulation performance. The technical questions were created based on regulations, such as building codes. Similarly, the *Knowledge of the environment* variable was developed based on Coyle (2005) and questions from the Certification Test for Environmental Specialists of Japan. These two variables on knowledge were entered into the model as the total number of correct answers to the questions. For the *Interest in the environment* and *Pro-environment* variables, the NEP method was adopted; *Interest in the environment* implied that subjects held some environmental values, perceiving the

Table 2. Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Dependent variables					
Energy-saving housing choice	1,648	0.3562	0.4790	0	1
Experiment set up					
Treatment 1 dummy	1,648	0.2500	0.4331	0	1
Treatment 2 dummy	1,648	0.2500	0.4331	0	1
Treatment 3 dummy	1,648	0.2500	0.4331	0	1
Values for environment					
Emphasis on insulation	1,648	0.2858	0.4519	0	1
Knowledge of insulation	1,648	1.1517	1.3891	0	6
Knowledge of the environment	1,648	1.6493	1.2697	0	5
Interest in the environment	1,648	3.1223	0.5298	1	4
Pro-environment	1,648	2.7700	0.6326	1	4
Sociodemographic characteristics					
Gender dummy	1,648	0.7458	0.4356	0	1
Age	1,648	40.0473	5.7046	30	49
Education	1,648	0.7227	0.4478	0	1
Experience dummy	1,648	0.5000	0.5002	0	1
Married dummy	1,648	0.8028	0.3980	0	1
Family size	1,648	2.6851	0.7633	1	7
Child dummy	1,648	0.6523	0.4764	0	1
Household income	1,471	4.4480	1.4108	1	9
Detached house dummy	1,648	0.6414	0.4797	0	1

balance of nature as fragile because of human activity. Regarding the pro-environment variable, subjects who answered "Yes" to engaging in daily environmentally conscious behavior, such as declining to use plastic bags (e.g., Dunlap, 2008), were regarded as having pro-environmental behaviors. These two variables were queried on a four-point scale and averaged to be entered into the model.

The sociodemographic demographic factors comprised nine variables (*Experience dummy*, *Detached house dummy*, *Gender dummy*, *Age*, *Education*, *Married dummy*, *Family size*, *Child dummy*, and *Household income*). These variables were used as control variables and based on previous studies (e.g., Ungemach et al., 2017). *Experience dummy* was used to distinguish those who had purchased a house within the past three years from those who had not. *Detached house dummy* was coded 1 if the subject lived in a detached house, and 0 otherwise; these two variables were considered as sociodemographic characteristics, but were entered into the model as subjects' possessions that complement their environmental literacy. *Gender dummy* was coded 1 if the subject was male and 0 if female; *Age* was the actual age; *Education* was the education category, which was used as ordinal data. The *Married dummy* variable was used to distinguish those who were married from those who were not, and *Family size* refers to the number of family members living together under the same household while including the subject. The *Child dummy* was coded 1 if the subject lived with children under 18 years of age, and 0 otherwise. *Household income* was obtained as categorical and used as ordinal data.

3.3 Measurement of Environmental Literacy Influence

The concept of environmental literacy is based on individual values and information-gathering efforts and can be said to be an individual judgment (self-selection). This self-selection is usually unobservable, and consumers' environmental literacy may lead them to be affected by a selection bias when making decisions. Therefore, this study used the five environmental literacy variables in the logistic regression model to measure their impact on decision-making pertaining to energy-saving housing choice.

The sample was categorized into two groups of high and low environmental literacy according to a calculation based on total scores (i.e., encompassing all five variables) for environmental literacy—following the procedures in the study by Blasch et al. (2019). Therefore, it was possible to compare differences between groups about decision-making regarding energy-saving housing choice. The difference was considered to be the impact of environmental literacy and was validated using chi-square test.

4. Results

First, the results obtained using balance tests for each group are explained. Next, the results of the logistic regression analysis and the chi-square test are summarized.

4.1 Balance Test

It was confirmed that there was no difference in the basic statistics of each treatment group, and there was no difference compared to the control group (Table 3). Balance tests between each treatment and control group were also performed (Table 4), with the findings indicating that there were no differences in p-values across all groups and all variables compared to the control group. Thus, the randomization was successful, enabling for strict comparisons between groups.

4.2 Impact of Framing Effects and Environmental Literacy

Logistic regression analysis was performed using Stata 16.1, and Table 5 shows the results of each group and for the whole dataset. After confirming the analysis results for the whole dataset (Model 1), the analysis results of each group (Models 2–4) were compared. Owing to missing values (see Table 2), the final sample size used for the analysis was 1,471 observations, and the Pseudo R2 was 0.0923 in Model 1.

The probability of choosing an energy-saving house increased when subjects belonged to the treatment groups and had high environmental literacy, such as high environmental awareness. Especially, all variables in the treatment groups were positive and statistically significant at the 1% level. Moreover, there was a difference in the effect of framing by treatment group; specifically, *Treatment group 3* had the highest odds ratio (OR), and the difference in OR between *Treatment groups 1* and *3* was only 0.0168. Almost the same results were observed for content information. The OR for energy-saving housing choice was somewhat lower in *Treatment group 2*, in which only the energy label is displayed.

The results for *Emphasis on insulation*, *Knowledge of insulation*, *Knowledge of the environment*, *Interest in the environment*, and *Pro-environment* were statistically significant. Subjects that emphasized thermal insulation performance when choosing a house, who had knowledge of thermal insulation and environmental issues, higher *Interest in the environment*, and engaged in pro-environmental actions daily were more likely to choose energy-saving houses. In particular, for those who emphasized thermal insulation performance, the OR was 1.4368, which increased the probability of choosing the most energy-saving house. Thus, the greater the environmental literacy, the greater the chance of choosing an energy-saving house, suggesting the need for providing people with knowledge and education regarding thermal insulation performance and environmental impacts. However, the analysis results for each group data show that not all presented significant findings, and that the findings for various variables were statistically significant. It is possible that *Treatment group* 2 was more intuitive for subjects because it included fewer environmental literacy variables; however, this result was inconclusive.

Table 3. Descriptive statics for each group

	Control group		Treatment Group 1		Treatment Group 2		Treatment Group 3	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Emphasis on insulation	0.3058	0.4613	0.2646	0.4416	0.2816	0.4503	0.2913	0.4549
Knowledge of insulation	1.1481	1.3986	1.1553	1.3830	1.1238	1.3497	1.1796	1.4285
Knowledge of the environment	1.6335	1.3029	1.6311	1.2937	1.6262	1.2619	1.7063	1.2217
Interest in the environment	3.1388	0.5129	3.1189	0.5396	3.1189	0.5175	3.1126	0.5497
Pro-environment	2.7670	0.6362	2.7893	0.6276	2.7884	0.6122	2.7354	0.6545
Gender dummy	0.7233	0.4479	0.7379	0.4403	0.7718	0.4202	0.7500	0.4335
Age	39.9053	5.6304	40.0680	5.7261	40.2306	5.7939	39.9854	5.6826
Education	0.7233	0.4479	0.7160	0.4515	0.7087	0.4549	0.7427	0.4377
Experience dummy	0.5000	0.5006	0.5000	0.5006	0.5000	0.5006	0.5000	0.5006
Married dummy	0.8131	0.3903	0.8107	0.3922	0.7840	0.4120	0.8034	0.3979
Family size	2.7015	0.7866	2.7136	0.7581	2.6165	0.7406	2.7087	0.7658
Child dummy	0.6505	0.4774	0.6699	0.4708	0.6214	0.4856	0.6675	0.4717
Household income	4.5028	1.4721	4.4266	1.3226	4.3856	1.4469	4.4796	1.4002
Detached house dummy	0.6214	0.4856	0.6723	0.4699	0.6481	0.4782	0.6238	0.4850

Table 4. Balance tests for each group

	Control group vs Treatment Group 1	Control group; vs Treatment Group 2	Control group; vs Treatment Group 3
Emphasis on insulation	0.3110	0.8200	0.7230
Knowledge of insulation	0.8290	0.7590	0.7270
Knowledge of the environment	0.5150	0.9970	0.5790
Interest in the environment	0.7810	0.5950	0.8180
Pro-environment	0.4720	0.6690	0.6510
Gender dummy	0.8970	0.4520	0.9480
Age	0.8350	0.6750	0.9250
Education	0.6500	0.4900	0.5470
Experience dummy	0.2340	0.5900	0.8530
Married dummy	0.8210	0.8540	0.7120
Family size	0.4060	0.1040	0.5590
Child dummy	0.4240	0.6100	0.4510
Household income	0.5190	0.5830	0.8900
Detached house dummy	0.0740	0.2090	0.9700

Note: The numbers in this table are P values.

Table 5. Logistic regression analysis results

	Model 1					Model 2				
	Coef.		Std. Err.	z	Odds Ratio	Coef.		Std. Err.	z	Odds Ratio
Treatment 1 dummy	1.7876	***	0.1900	9.4100	5.9650	1.7864	***	0.1926	9.2700	5.9681
Treatment 2 dummy	1.4679	***	0.1906	7.7000	4.3385	-		-	-	-
Treatment 3 dummy	1.7892	***	0.1898	9.4300	5.9826	-		-	-	-
Emphasis on insulation	0.3704	***	0.1307	2.8300	1.4368	0.3353		0.1993	1.6800	1.3984
Knowledge of insulation	0.1117	**	0.0439	2.5500	1.1125	0.1059		0.0661	1.6000	1.1118
Knowledge of the environment	0.0838	*	0.0472	1.7800	1.0795	0.1452	**	0.0705	2.0600	1.1562
Interest in the environment	0.2609	**	0.1119	2.3300	1.2895	0.0427		0.1715	0.2500	1.0436
Pro-environment	0.2575	***	0.0976	2.6400	1.2848	0.3374	**	0.1528	2.2100	1.4014
Gender dummy	-0.0051		0.1471	-0.0300	0.9985	0.1886		0.2291	0.8200	1.2075
Age	0.0082		0.0108	0.7600	1.0080	-0.0112		0.0170	-0.6600	0.9889
Education	0.0446		0.1350	0.3300	0.9572	-0.0155		0.2083	-0.0700	0.9846
Experience dummy	0.2608		0.1670	1.5600	1.2899	0.2406		0.2634	0.9100	1.2720
Married dummy	-0.0667		0.1896	-0.3500	0.9375	-0.4674		0.3046	-1.5300	0.6266
Family size	-0.0287		0.1279	-0.2200	0.9666	-0.1024		0.2003	-0.5100	0.9026
Child dummy	0.1929		0.1987	0.9700	1.2225	0.5039		0.3152	1.6000	1.6551
Household income	0.0569		0.0442	1.2900	1.0614	0.0659		0.0683	0.9700	1.0682
Detached house dummy	-0.1667		0.1694	-0.9800	0.8480	0.0264		0.2698	0.1000	1.0267
Constant	-4.4696	***	0.6548	-6.8300	0.0129	-3.2679	***	0.9801	-3.3300	0.0381
Number of obs.	1,471					728				
Log likelihood	-876.2889					-383.6491				
Pseudo R2	0.0928					0.1399				

	Model 3					Model 4				
	Coef.		Std. Err.	z	Odds Ratio	Coef.		Std. Err.	z	Odds Ratio
Treatment 1 dummy	-		-	-	-	-		-	-	-
Treatment 2 dummy	1.4634	***	0.1925	7.6000	4.3206	-		-	-	-
Treatment 3 dummy	-		-	-	-	1.7908	***	0.1909	9.3800	5.9940
Emphasis on insulation	0.3571		0.2013	1.7700	1.4292	0.0846		0.2015	0.4200	1.0882
Knowledge of insulation	0.0718		0.0675	1.0600	1.0745	0.1130	*	0.0674	1.6800	1.1196
Knowledge of the environment	0.1807	**	0.0729	2.4800	1.1981	-0.0156		0.0738	-0.2100	0.9846
Interest in the environment	0.1415		0.1796	0.7900	1.1520	0.1068		0.1693	0.6300	1.1127
Pro-environment	0.1813		0.1537	1.1800	1.1988	0.4090	***	0.1494	2.7400	1.5054
Gender dummy	0.0860		0.2342	0.3700	1.0899	0.1511		0.2249	0.6700	1.1632
Age	0.0098		0.0166	0.5900	1.0099	0.0234		0.0169	1.3800	1.0237
Education	0.2694		0.2136	1.2600	1.3092	-0.1756		0.2114	-0.8300	0.8390
Experience dummy	-0.2704		0.2424	-1.1200	0.7631	0.1320		0.2609	0.5100	1.1411
Married dummy	0.4419		0.2963	1.4900	1.5557	-0.2143		0.2835	-0.7600	0.8071
Family size	-0.1071		0.2040	-0.5200	0.8985	0.0133		0.1808	0.0700	1.0134
Child dummy	0.1229		0.3111	0.4000	1.1308	0.1201		0.2980	0.4000	1.1276
Household income	-0.0533		0.0676	-0.7900	0.9481	0.1168	*	0.0658	1.7800	1.1239
Detached house dummy	0.1906		0.2477	0.7700	1.2100	-0.2775		0.2612	-1.0600	0.7577
Constant	-3.9254	***	0.9872	-3.9800	0.0197	-4.7997	***	0.9859	-4.8700	0.0082
Number of obs.	736					727				
Log likelihood	-380.0275					-384.9636				
Pseudo R2	0.1069					0.1379				

Note: the superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Additionally, no factor was found to reduce the probability of choosing energy-saving houses. The *Experience dummy, Detached house dummy*, *Gender dummy*, *Age*, *Education*, *Family size*, and *Household income* did not show significant results. Given that the framing effects were confirmed by the OR, these findings imply that information on energy use and efficiency is more important than any other variable explored in this study.

4.3 Impact of Environmental Literacy

In Table 6, cross-tabulation was used to assess the differences in the choice of energy-saving houses between subjects that chose (choice) and those that did not choose (no choice) energy-saving houses, between the high and low environmental literacy groups, and between the control and treatment groups. Chi-square test was employed to assess the differences between groups and confirm statistical significance.

Table 6. Energy-saving housing choice ratio

	Low			High		
	No choice	**Choice**	**Total**	**No choice**	**Choice**	**Total**
Control group	182	20	202	175	35	210
Treatment group 1	126	76	202	97	113	210
Treatment group 2	152	63	215	107	90	197
Treatment group 3	118	80	198	104	110	214
Total	578	239	817	483	348	831

Note: The chi-square test results were 0.044 for the control group, 0.001 in *Treatment group 1*, 0.001 in *Treatment group 2*, and 0.025 in *Treatment group 3*. These findings indicate that differences in environmental literacy influenced the choice of energy-saving houses, based on a statistical significance set at the 5% level.

In the control group, which did not receive information on energy-efficiency performance, subjects with both high and low environmental literacy were the least likely (vs. treatment groups) to choose energy-saving houses, and this is clearly different from the treatment groups (Fig. 2). These findings once more suggest the importance of providing information about energy efficiency, and information provision was more effective for subjects with low environmental literacy than for those with high environmental literacy. In addition, the use of content information and energy label was the most effective condition for subjects with a low environmental literacy, making subjects in this condition be 4.1 times more likely to choose energy-saving houses than subjects in the other treatment conditions and those in the control group.

The logistic regression analysis showed that subjects with higher environmental literacy tended to choose energy-saving houses. Therefore, it may be important to target interventions at consumers with a low environmental literacy. The use of content information and energy label showed the smallest difference between the groups with high and low environmental literacy (Fig. 2), suggesting that many consumers easily accept this framing. Hence, this study suggests the efficiency of the combined provision of information content and energy label.

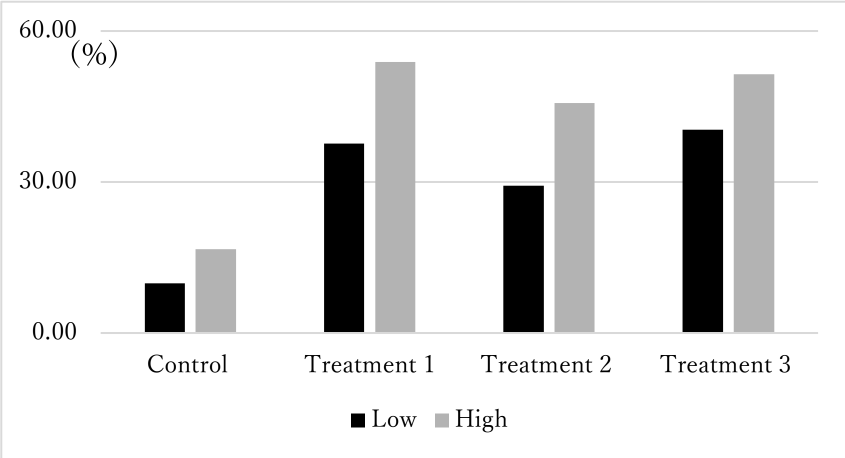

Figure 2. Energy-saving housing choice ratio by group

5. Discussion

The analyses results verified the effects of the display of energy labels on the choice of energy-saving houses. The logistic regression analysis specifically confirmed the magnitude of the influence of the energy labels, as the effects in all treatment groups were statistically significant at the 1% level. Therefore, the use of a continuous scale label induced the choice of energy-efficient housing products, supporting H1. The current evidence suggests that continuous scale labels work in a similar way to other label types; the effect was similar to that of the display of a categorical scale label reported in previous studies (e.g., Blasch et al., 2019). This means that energy label display seems to be effective regardless of label type.

The results of the framing effect verification confirmed that the effect was the largest in Treatment group 3 (i.e., frame with content information and energy label). The findings for this combination of energy label with content information replicates the effects reported in previous studies that used categorical scale labels (e.g., Andor et al., 2020). These descriptions indicate that H2 was supported.

The difference between Treatment groups 2 and 3 was measured, and the OR for the effect of adding content information to energy labels (i.e., Treatment group 3) was 1.6847. This quantification of the framing effect represents a novel finding of this study that advances past literature. This showcases that framing energy labels with additional content information is an effective and recommended method for advertising energy-saving houses. Although the methodology of the current study differs from that of previous studies, the results are similar. For example, Nair et al. (2010) confirmed such an effect while using energy labels in conjunction with content information.

This study also suggests the potential of using information content alone, as the findings for Treatment group 1 (i.e., only content information) were statistically significant at the 1% level. Moreover, the difference in OR between Treatment groups 1 and 3 was only 0.0168, indicating that the provision of content information alone had nearly the same effect as the combination of content information and energy label.

Moreover, all five environmental literacy variables showed statistically significant results, supporting H3a was supported. This result differs from those in the research conducted by Min et al. (2014), who reported that consumer knowledge had no effect on energy-efficient choices, and from those in the study performed by He et al. (2022), who found that energy literacy does not have a strong effect on choice behavior. In contrast, the significance of *Interest in the environment* and pro-environmental behavior in the current study was found to be consistent with that in the study conducted by Van den Broek (2019), who revealed that behavior and habits affect energy-efficient choices. The novelty of the current study lies in the clarification of the OR for each element and by considering the concept of environmental literacy using five variables. Subjects who emphasized thermal insulation performance had an OR of 1.4446 compared to those who did not emphasize this aspect. As aforementioned, all environmental literacy variables showed a high OR, albeit some of them had a stronger impact, such as emphasis on insulation, and others had a weaker impact, such as knowledge of environment.

In the comparison using environmental literacy scores, all framing effects were greater for subjects with low environmental literacy scores. This finding supported H3b. The effect of framing on energy-saving housing choice was greater for subjects with lower scores in the Treatment groups than for those with lower scores in the control group. Andor et al. (2019) verified that the lower the environmental literacy, the greater the effect of categorical scale labels, and the current study corroborates these past findings, but now for continuous labels. Simultaneously, this effect appeared both in the condition with the energy label, which is accompanied by heuristic decisions, and in that with content information, implying that further verification of these framing effects is necessary.

6. Conclusion and Policy Implications

This study conducted an experiment on housing advertisements to determine whether consumers' housing choice decision-making can be changed by information disclosure, including via energy labels. The subjects were divided into control and treatment groups that differed in the information they received on the energy efficiency of housing products. The treatment group was divided into three subgroups, each of which received different information.

Logistic regression analysis revealed that the subjects in the Treatment groups were more likely to choose energy-saving houses than those in the control group. The analysis also revealed that differences in personal knowledge of and emphasis on thermal insulation performance, as components of environmental literacy, were associated with differences in energy-saving housing choices. Furthermore, regardless of the degree of environmental literacy, it is preferable to present consumers with both the energy efficiency score and content information to ensure that the goal of energy labels is achieved. This finding and suggestion was supported by the finding that the highest OR appeared in Treatment group 3.

In this study, environmental literacy, rather than sociodemographic characteristics, induced the choice of energy-saving houses. Specifically, there was no positive effect of education nor of sociodemographic characteristics, which is contrary to the findings of past research using these variables. Moreover, it was verified that the effect of the energy label was greater when the degree of environmental literacy was lower; however, it was not concluded that this result stemmed solely from heuristic decisions. The inability to confirm these results is a limitation of this study and an issue for future research.

The results suggest that it is important for real estate advertisements to disclose information on the energy conservation levels of houses and present energy labels. In addition, it is important to disclose information that may deal with, and possibly enrich, consumers' lack of knowledge and understanding about energy efficiency. Thus, while the mandatory use of energy labels in advertisements has been postponed in Japan, this study shows that it may be important for residential energy efficiency information to be disclosed. Therefore, making these energy labels mandatory by law is an urgent matter that should be tackled the Japanese government and society.

References

Abas, A. E. Pg., and Indra T. M. Mahlia. 2018. Development of Energy Labels Based on Consumer Perspective: Room Air Conditioners as a Case Study in Brunei Darussalam Energy Reports 4:671–81. doi: 10.1016/j.egyr.2018.10.003.

Allcott, Hunt. 2011. Consumers' Perceptions and Misperceptions of Energy Costs American Economic Review 101(3):98–104.

Allcott, Hunt, and Michael Greenstone. 2012. Is There an Energy Efficiency Gap? Journal of Economic Perspectives 26(1):3–28.

Andor, Mark A., Manuel Frondel, and Colin Vance. 2017. Germany's Energiewende: A Tale of Increasing Costs and Decreasing Willingness-To-Pay. Energy Journal 38, Special Issue 1:211–228. https://doi.org/10.5547/01956574.38.SI1.mand

Andor, Mark A., Manuel Frondel, Andreas Gerster, and Stephan Sommer. 2019. Cognitive Reflection and the Valuation of Energy Efficiency. Energy Economics 84. doi: 10.1016/j.eneco.2019.104527.

Andor, Mark A., Andreas Gerster, and Stephan Sommer. 2020. Consumer Inattention, Heuristic Thinking and the Role of Energy Labels. Energy Journal 41(1):83–112. doi: 10.5547/01956574.41.1.mand.

Blasch, Julia, Massimo Filippini, and Nilkanth Kumar. 2019. Boundedly Rational Consumers, Energy and Investment Literacy, and the Display of Information on Household Appliances. Resource and Energy Economics 56:39–58. doi: 10.1016/j.reseneeco.2017.06.001.

Boyano, Alicia, Nieves Espinosa, and Alejandro Villanueva. 2020. Rescaling the Energy Label for Washing Machines: An Opportunity to Bring Technology Development and Consumer Behaviour Closer Together. Energy Efficiency 13(1):51–67. doi: 10.1007/s12053-019-09829-4.

Brounen, Dirk, and Nils Kok. 2011. On the Economics of Energy Labels in the Housing Market. Journal of Environmental Economics and Management 62(2):166–79. doi: 10.1016/j.jeem.2010.11.006.

Brounen, Dirk, Nils Kok, and John M. Quigley. 2013. Energy Literacy, Awareness, and Conservation Behavior of Residential Households. Energy Economics 38:42–50. doi: 10.1016/j.eneco.2013.02.008.

Bucchianeri, Grace W., and Julia A. Minson. 2013. A Homeowner's Dilemma: Anchoring in Residential Real Estate Transactions. Journal of Economic Behavior and Organization 89:76–92. doi: 10.1016/j.jebo.2013.01.010.

Bull, Joe. 2012. Loads of Green Washing-Can Behavioural Economics Increase Willingness-to-Pay for Efficient Washing Machines in the UK? Energy Policy 50:242–52. doi:

10.1016/j.enpol.2012.07.001.

Camilleri, Adrian R., Richard P. Larrick, Shajuti Hossain, and Dalia Patino-Echeverri. 2019. Consumers Underestimate the Emissions Associated with Food but Are Aided by Labels Nature Climate Change 9(1):53–8. doi: 10.1038/s41558-018-0354-z.

Codagnone, Cristiano, Giuseppe Alessandro Veltri, Francesco Bogliacino, Francisco Lupiáñ. Ez-Villanueva, George Gaskell, Andriy Ivchenko, Pietro Ortoleva, and Francesco Mureddu. 2016. Labels as Nudges? An Experimental Study of Car Eco-Labels. Economia Politica 33:403–32. doi: 10.1007/s40888-016-0042.

Critcher, Clayton R., and Thomas Gilovich. 2008. Incidental Environmental Anchors. Journal of Behavioral Decision Making 21(3):241–51. doi: 10.1002/bdm.586.

Coyle, Kevin. 2005. Environmental Literacy IN AMERICA National Environmental Education & Training Foundation,.1-152.

DeWaters, Jan E., and Susan E. Powers. 2011. Energy Literacy of Secondary Students in New York State (USA): A Measure of Knowledge, Affect, and Behavior. Energy Policy 39(3):1699–710. doi: 10.1016/j.enpol.2010.12.049.

Dolan, P., M. Hallsworth, D. Halpern, D. King, R. Metcalfe, and I. Vlaev. 2012. Influencing Behaviour: The Mindspace WayJournal of Economic Psychology 33(1):264–77. doi: 10.1016/j.joep.2011.10.009.

Dunlap, Riley E., and Kent D. Van Liere. 1978. The 'New Environmental Paradigm. Journal of Environmental Education 9(4):10–9. doi: 10.1080/00958964.1978.10801875.

Dunlap, Riley E. 2008. The New Environmental Paradigm Scale: From Marginality to Worldwide Use. Journal of Environmental Education 40(1):3–18.

Englich, Birte, Thomas Mussweiler, and Fritz Strack. 2006. Playing Dice with Criminal Sentences: The Influence of Irrelevant Anchors on Experts' Judicial Decision MakingPersonality and Social Psychology Bulletin 32(2):188–200. doi: 10.1177/0146167205282152.

Frederick, Shane. N.D. 2005. Cognitive Reflection and Decision Making. Journal of Economic Perspectives 19(4):25–42.

Frederiks, Elisha R., Karen Stenner, and Elizabeth V. Hobman. 2015. Household Energy Use: Applying Behavioural Economics to Understand Consumer Decision-Making and Behaviour. Renewable and Sustainable Energy Reviews 41:1385–94.

Fujisawa, Mieko, Kazuhisa Takemura, Yukihiko Funaki, Nobuyuki Uto, and Ryo Takahashi. 2020. An Experimental Study of the Effect of Energy Label Design on the Correct Evaluation of Buildings' Energy Performance and Promotion of Energy Saving. International Real Estate Review, Vol. 23, 733-762.

He, Shutong, Julia Blasch, Pieter van Beukering, and Junfeng Wang. 2022. Energy Labels and

Heuristic Decision-Making: The Role of Cognition and Energy Literacy. Energy Economics 114. doi: 10.1016/j.eneco.2022.106279.

Heinzle, Stefanie Lena. 2012. Disclosure of Energy Operating Cost Information: A Silver Bullet for Overcoming the Energy-Efficiency Gap? Journal of Consumer Policy 35(1):43–64. doi: 10.1007/s10603-012-9189-6.

Heinzle, Stefanie Lena, and Rolf Wüstenhagen. 2012. Dynamic Adjustment of Eco-labeling Schemes and Consumer Choice - The Revision of the EU Energy Label as a Missed Opportunity? Business Strategy and the Environment 21(1):60–70. doi: 10.1002/bse.722.

Kahn, Matthew E., and Nils Kok. 2014. The Capitalization of Green Labels in the California Housing Market.Regional Science and Urban Economics 47(1):25–34. doi: 10.1016/j.regsciurbeco.2013.07.001.

Kahneman, Daniel. 2003. A Perspective on Judgment and Choice: Mapping Bounded Rationality. American Psychologist 58(9):697–720.

Lakić, Edin, James Carroll, and Andrej F. Gubina. 2021. The Role of Monetary Information in Energy Performance Certificates: A Slovenian Experiment. Energy Efficiency 14(7). doi: 10.1007/s12053-021-09995-4.

Langenbach, Benedikt P., Sebastian Berger, Thomas Baumgartner, and Daria Knoch. 2020. Cognitive Resources Moderate the Relationship Between Pro-environmental Attitudes and Green Behavior. Environment and Behavior 52(9):979–95. doi: 10.1177/0013916519843127.

Leenheer, Jorna, Millie Elsen, Nella Mikola, Maarten van der Wag, and Luke Lloyd. 2014. Study on the Effects on Consumer Behaviour of Online Sustainability Information Displays. European Commission. Directorate-General for the Information Society and Media., ECORYS., Universiteit van Tilburg., and GFK, 1-152. doi: 10.2759/52063

Levin, Irwin P., Sara K. Schnittjer, Shannon L. Thee, and P. Levitt. 1988. Information Framing Effects in Social and Personal Decisions Journal of Experimental Social Psychology 24(6):520–9.

Mills, Bradford, and Joachim Schleich. 2010. What's Driving Energy Efficient Appliance Label Awareness and Purchase Propensity? Energy Policy 38(2):814–25. doi: 10.1016/j.enpol.2009.10.028.

Min, Jihoon, Inês L. Azevedo, Jeremy Michalek, and Wändi B. de Bruin. 2014. Labeling Energy Cost on Light Bulbs Lowers Implicit Discount Rates. Ecological Economics 97:42–50. Doi: 10.1016/j.ecolecon.2013.10.015.

Nair, Gireesh, Leif Gustavsson, and Krushna Mahapatra. 2010. Factors Influencing Energy Efficiency Investments in Existing Swedish Residential Buildings. Energy Policy 38(6):2956–63. doi: 10.1016/j.enpol.2010.01.033.

Ölander, Folke, and John Thøgersen. 2014. Informing Versus Nudging in Environmental Policy Journal of Consumer Policy 37(3):341–56. doi: 10.1007/s10603-014-9256-2.

Peduzzi, Peter, John Concato, Alvan R. Feinstein, and Theodore R. Holford. 1995. Importance of Events Per Independent Variable in Proportional Hazards Regression Analysis II. Accuracy and Precision of Regression Estimates. Journal of Clinical Epidemiology 48(12): 1503-1510. Doi; 10.1016/0895-4356(95)00048-8.

Peduzzi, Peter, John Concato, Elizabeth Kemper, Theodore R. Holford, and Alvan R. Feinstein. 1996. A Simulation Study of the Number of Events per Variable in Logistic Regression Analysis. Journal of Clinical Epidemiology 49(12): 1373-1379. doi;10.1016/S0895-4356(96)00236-3.

Poortinga, Wouter, Linda Steg, and Charles Vlek. 2004. Values, Environmental Concern, and Environmental Behavior: A Study into Household Energy Use. Environment and Behavior 36(1):70–93. doi: 10.1177/0013916503251466.

Potter, Christina, Anastasios Bastounis, Jamie Hartmann-Boyce, Cristina Stewart, Kerstin Frie, Kate Tudor, Filippo Bianchi, Emma Cartwright, Brian Cook, Mike Rayner, and Susan A. Jebb. 2021. The Effects of Environmental Sustainability Labels on Selection, Purchase, and Consumption of Food and Drink Products: A Systematic Review. Environment and Behavior 53(8):891–925. doi: 10.1177/0013916521995473.

Sammer, Katharina, and Rolf Wüstenhagen. 2006. The Influence of Eco-labelling on Consumer Behaviour - Results of a Discrete Choice Analysis for Washing Machines. Business Strategy and the Environment 15(3):185–99. doi: 10.1002/bse.522.

Schubert, Renate, and Marcel Stadelmann. 2015. Energy-Using Durables – Why Consumers Refrain from Economically Optimal Choices. Frontiers in Energy Research.

Skourtos, M., D. Damigos, C. Tourkolias, and A. Kontogianni. 2021. Efficient Energy Labelling: The Impact of Information Content and Style on Product Choice. Energy Efficiency 14(6). doi: 10.1007/s12053-021-09950-3.

Sovacool, Benjamin K., and Pascale L. Blyth. 2015. Energy and Environmental Attitudes in the Green State of Denmark: Implications for Energy Democracy, Low Carbon Transitions, and Energy Literacy. Environmental Science and Policy 54:304–15. doi: 10.1016/j.envsci.2015.07.011.

Stadelmann, Marcel, and Renate Schubert. 2018. How Do Different Designs of Energy Labels Influence Purchases of Household Appliances? A Field Study in Switzerland Ecological Economics 144:112–23. doi: 10.1016/j.ecolecon.2017.07.031.

Stanley, Sarah, Ronan C. Lyons, and Sean Lyons. 2016. The Price Effect of Building Energy Ratings in the Dublin Residential Market. Energy Efficiency 9(4):875–85. doi: 10.1007/s12053-015-9396-5.

Steg, Linda, Jan Willem Bolderdijk, Kees Keizer, and Goda Perlaviciute. 2014. An Integrated Framework for Encouraging Pro-environmental Behaviour: The Role of Values, Situational Factors and Goals. Journal of Environmental Psychology 38:104–15.

Sussman, Reuven, Maxine Chikumbo, and Robert Gifford. 2018. Message Framing for Home Energy Efficiency Upgrades. Energy and Buildings 174:428–38. doi: 10.1016/j.enbuild.2018.06.032.

Sussman, Reuven, Steven Conrad, Christine Kormos, Celine Park, and Emma Cooper. 2021. Context and Meaningfulness in Energy Efficiency Labeling: Real Estate Listings. Journal of Environmental Psychology 78. doi: 10.1016/j.jenvp.2021.101681.

Thøgersen, John. 2000. Psychological Determinants of Paying Attention to Eco-labels. Journal of Consumer Policy, 23. 285–313.

Tversky, Amos, and Daniel Kahneman. 1973. Availability: A Heuristic for Judging Frequency and Probability. Cognitive Psychology, 5(2). 207-232. doi;10.1016/0010-0285(73)90033-9

Tversky, Amos, and Daniel Kahneman. 1974. Judgment Under Uncertainty: Heuristics and Biases: Biases in Judgments Reveal Some Heuristics of Thinking Under Uncertainty Science 185(4157):1124–31.

Ungemach, Christoph, Adrian R. Camilleri, Eric J. Johnson, Richard P. Larrick, and Elke U. Weber. 2017. Translated Attributes as Choice Architecture: Aligning Objectives and Choices Through Decision Signposts. Management Science, 64(5), 1-15. doi:10.1287/mnsc.2016.2703

Van den Broek, Karlijn L. 2019. Household Energy Literacy: A Critical Review and a Conceptual Typology Energy Research and Social Science 57.

Van de Velde, Liesbeth, Wim Verbeke, Michael Popp, and Guido van Huylenbroeck. 2010. The Importance of Message Framing for Providing Information About Sustainability and Environmental Aspects of Energy. Energy Policy 38(10):5541–9. doi: 10.1016/j.enpol.2010.04.053.

Waechter, Signe, Bernadette Sütterlin, and Michael Siegrist. 2015a. Desired and Undesired Effects of Energy Labels - An Eye-Tracking Study. PLoS One 10(7):e0134132. doi: 10.1371/journal.pone.0134132.

Waechter, Signe, Bernadette Sütterlin, and Michael Siegrist. 2015b. The Misleading Effect of Energy Efficiency Information on Perceived Energy Friendliness of Electric Goods. Journal of Cleaner Production 93:193–202. doi: 10.1016/j.jclepro.2015.01.011.

Waechter, Signe, Bernadette Sütterlin, Jonas Borghoff, and Michael Siegrist. 2016. Letters, Signs, and Colors: How the Display of Energy-Efficiency Information Influences Consumer Assessments of ProductsEnergy Research and Social Science 15:86–95. doi: 10.1016/j.erss.2016.03.022.

Walls, Margaret, Todd Gerarden, Karen Palmer, and Xian Fang Bak. 2017. Is Energy Efficiency Capitalized into Home Prices? Evidence from Three U.S. Cities. Journal of Environmental Economics and Management 82:104–24. doi: 10.1016/j.jeem.2016.11.006.

Zhou, Hui, and James O. Bukenya. 2016. Information Inefficiency and Willingness-to-Pay for Energy-Efficient Technology: A Stated Preference Approach for China Energy Label. Energy Policy 91:12–21. doi: 10.1016/j.enpol.2015.12.040.