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Does positive framing matter? An investigation of how framing affects consumers' willingness to buy green electricity in Denmark

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Abstract

We investigate how framing affect consumers' willingness to buy green electricity using a contingent valuation method. A sample of 1022 respondents was divided into two nearly equal sized sub-samples chosen from an Internet panel. One subsample received a positively framed version of the questionnaire regarding signing up to a green electricity contract, and the other subsample received a negatively framed version of the questionnaire. As expected, consumers displayed stronger intention to buy green electricity when the situation was framed in a positive manner (i.e., most Danish households have already bought it), as compared to the situation framed in a negative manner (i.e., only a few Danish households have bought green electricity). The theoretical explanation can be formulated in terms of the theory of social norms. The framing effect also signals the public good side of green electricity in that there seems to be a free rider problem. The relatively low intention to buy green electricity in the negatively framed question indicates that the free-rider incentive is particularly powerful in large groups, where an individual may perceive that her or his behavior will have only little influence on the collective outcome. The managerial implications are also discussed.

Keywords: Green power marketing; Willingness to pay; Question framing; Contingent valuation; Danish electricity market

1. Introduction

The green power industry is an emerging industry because of the electricity market deregulation and the increasing share of renewable energy in Denmark. Electricity suppliers are now able to differentiate their product offerings (i.e., electricity services in the form of service contracts) so they appeal to consumers' environmental concerns. A core feature of these products is the environmental profile, e.g. electricity delivered to the household come from wind power or hydro power.[1] Alternatively, households can also choose to offset the CO_2 emission that is equivalent to their electricity consumption through buying and removing the total CO_2 quota in the market. The offsetting of CO_2 will reduce the total CO_2 quota in the market and eventually it can help ensure that more renewable energy will be produced. In this study, we define those electricity products with an environmental profile as "green" electricity services. After signing up to a form of green electricity product consumers will receive a guarantee of origin/certification indicating the environmental effect from electricity generation (i.e. where and how the electricity is produced or whether the electricity consumed by the household has been CO_2 offset). Due to the inter-dependability and inter-connectivity of the electricity network, the grid contains a mix of fossil-fuel fired electricity, green electricity and nu- clear electricity. This guarantee will then be used to write off the amount of green electricity sold from the total green electricity generation account in the grid or in the CO_2 quota market, by doing so it prevents the same amount of green electricity from being sold more than once and hence it enhances the credibility of the green electricity sales. However, from a consumer perspective, any type of electricity functions exactly the same way, i.e. an intangible electron flow for powering the electric equipment. The homogenous nature at the point of consumption diminishes consumers' motivation to pay a higher price for obtaining green electricity and eventually it can threaten the success of the green power marketing. Besides, although electricity possess the features of a public good, namely, its non-rivalry and non-excludability in consumption [1] and the externalities associated with the electricity generation is borne by the society collectively, electricity is also a private good. For a public good, the free rider problem is well known. For a private good, the financial constraint is an often-mentioned issue for individuals' decision making, and individuals are likely to drop the high-priced alternative when two products are homogenous in nature. Thus, this mixed product nature can complicate the promotion of green energy.

In principle green power marketing practice is quite like the marketing of any other environmentally friendly product such as organic food marketing; both have put emphasis on minimizing the environ- mental impact in the production process. The way they differ is that consumers do not receive a physically different product when buying electricity; thereby consumers receive no social identity in a physical format. As consumers' environmental concerns increase prior studies have revealed that there is great potential for green electricity [2–4], but the sale of green electricity has only seen slow growth in the actual market place [2,5]. This may be attributed to the fact that the electricity sector has traditionally been a natural monopoly. In a natural monopoly consumers do not have the possibility to choose neither product nor supplier. This is bad because energy policy makers hope that consumers are willing to subscribe to green electricity on a volunteer basis. The higher the demand for green electricity, the more attractive it will be for energy investors to invest in green electricity. The back up from consumers can eventually help Denmark to implement its goal of being a fossil fuel independent nation. The aim of this study is therefore not only to investigate the WTP for green electricity but also the effect of question framing on willingness to pay. Specifically, we are trying to identify the determinants that will influence consumers' WTP for various types of green electricity services. The research setting is Denmark. The long-term energy goal of Denmark is to become a fossil fuel independent nation by 2050 [6]. Fig. 1 illustrates the progress of primary energy production in Denmark over the past decades. As is shown the share of fossil-fuel in the total primary energy production appears to fall continuously while the share of renewable energy production has been increasing since 2005. Fig. 2 presents the share of renewable en- ergy production from different renewable energy sources. Biomass and wind energy are two dominant forms of renewable energy over the past decades. The potential of biomass to replace fossil fuels is limited, as seen from the global and national perspective. Wind energy thus has been placed as one of the important renewable energy forms to achieve this goal due to its abundance and local availability. Wind, however, is unpredictable and non-storable. Thus, the amount of wind energy that flows into the grid varies dramatically depending on weather conditions making it difficult to fully utilize the generated power. Furthermore, the expansion of wind farms requires a large amount of capital investment, which will become a cost for consumers. Are consumers willing to subscribe to a green electricity contact? If so, what factors will motivate them to buy?

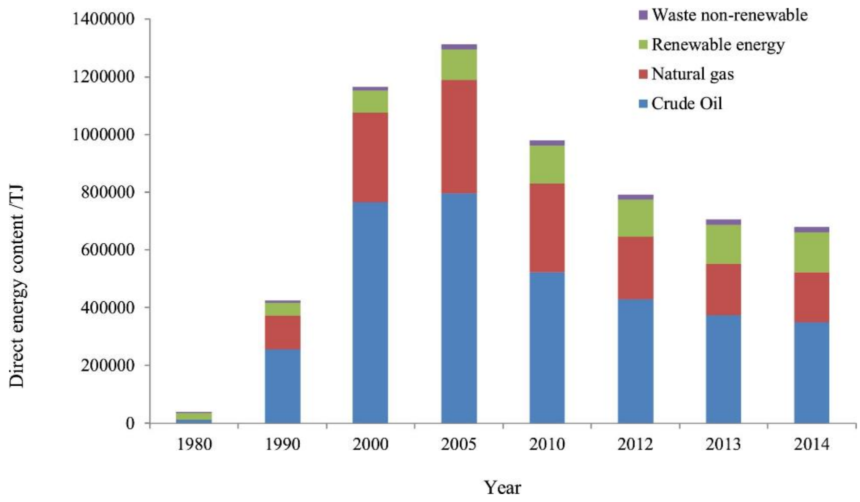

Fig. 1. Development of primary energy production in Denmark. Source: [7].

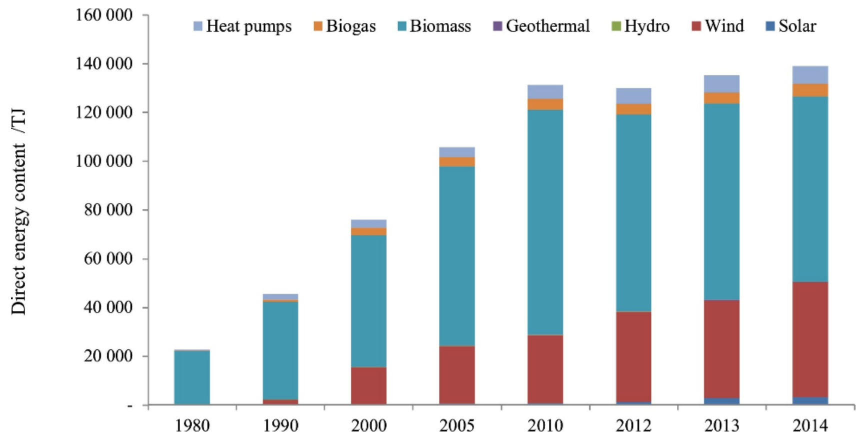

Fig. 2. Development of renewable production in Denmark. Source: [7].

The extant literature shows that consumers' environmental concerns are important for adopting environmentally friendly products such as green electricity [8–10]. In addition, consumers' attitudes are another significant factor that has an influence on their willingness to pay for green electricity [4,9,11–14]. Furthermore, norms have been found to be significant influencers on consumers' willingness to pay for green electricity [4,15,16]. The influence of norms has been examined based on what consumers' important referent group thinks about their adoption of green electricity [4,17]. Norms may function as a "moral compass" for guiding individuals to take responsible action [18–20]. However, Tversky and Kahneman [21] argued that consumers tend to reveal inverse preferences under different framings of problems, com- plications or outcomes. Usually, positive framing signals benefits while negative framing indicates risks. According to Tversky and Kahneman [21], decision makers are prone to minimize risk (i.e., being "risk averse" when contemplating benefits, but are prone to take risks (i.e., displaying "risk seeking") when contemplating losses. It is therefore logic to assume that consumers' willingness to adopt green electricity will be different under different problem framings. Put differently, our research hypothesis is that the willingness to adopt green electricity is higher under positive framing than under negative framing.

Given this, the aim of this study is to investigate consumers' will- ingness to adopt green electricity services in Denmark with positively or negatively framing information regarding the willingness to buy green electricity in the market. The current study does not only explore the factors influencing the willingness to adopt green electricity among Danish residential energy consumers but also explicitly addresses the influence of positive and negative framing on consumers' willingness to adopt green electricity. The paper is organized as follows. Section 2 provides a review of the literature and outlines the theoretical frame- work for explaining consumers' WTP for green electricity. Section 3 presents the research method and specifies the model for the analysis. Section

4 presents the results of the statistical analyses. In Section 5, we highlight the research findings, and discuss the managerial implications of the study as well as possible further research.

2. Literature review

The adoption of green electricity service is a typical "green consumerism" behavior. One of the distinguishing features of the green consumerism is that the consumers' decision marking is heavily relying on individuals' environmental consciousness and the environmental product information [8,22]. Previous studies have suggested that individuals' socio-economic factors, knowledge about the product, values, attitudes and routine consumer behavior are important factors influencing consumers' willingness to pay for environmentally friendly products [15,23–25]. Ozaki [4] categorized that the adoption of green electricity can be explained from various perspectives, an innovation diffusion perspective, a cognitive perspective, a normative perspective and from a consumption perspective. The various perspectives not only differ on several dimensions but also overlap on some important dimensions, for detail please refer to Ozaki [4]. For example, a consumer may see relative advantages in adopting an innovation (in an innovation diffusion perspective) because s/he is aware of the consequence of the innovation such as improving the environment (in a normative perspective). In addition, individual's beliefs/attitudes on their influence on the outcomes were also found to be important for adoption of ecological products [26]. Whether or not buying green electricity, theories have also suggested that consumers often use combinations of decision-marking strategies [27]. For example, Salmela and Varho [9] proposed a hybrid theoretical framework to illustrate consumers' adoption of green electricity incorporating the cognitive factor, orientational factor and the economic factor. The cognitive factor takes up issues like consumer attitudes, knowledge and perception, the eco- nomic factor relates to the costs and free-rider problem, and the orientational factor relates to consumers' old habits and consumer incentives for buying electricity [9].

Previous research has shown that socio-economic profiles are important for explaining consumers' WTP for green electricity [28–30]. In general higher income consumers are more willing to pay a higher premium for green electricity [3,11,31–37]. Moreover, numerous studies have reported a statistically significant relationship between age [3,31,34,38–40], gender [31,34,38,41–44], educational background [3,31,33,36,39,40,45],and household size [3,36,46] on the one hand, and willingness to pay for green electricity on the other. In addition to the socio-demographical variables, consumers psychographic profile also plays a role in determining willingness to buy green electricity [29]. Webster [18] suggested that individuals who have strong moral obligations for the society often consider the social impact of their buying behavior, this was identified as "green norms" by Ek and Söderholm [17]. In addition, the level of product knowledge is also found to be an important determinant for buying green electricity [47]. In addition, green electricity buyers were also found to take a proactive personal view on expansion of the sustainable energy [47]. Previous research has suggested that individuals' pro-environmental attitude has positive effect on her/his intention to perform a pro-environmental behavior in general [38,48,49]. We therefore assume that individuals' environmental behavior in general may also guide individuals' willingness to adopt green electricity service. Therefore, we decided to include individuals' knowledge about the green electricity products, personal view on expanding renewable energy and individuals' socio- economic profiles and pro-environmental behavior in general as predictors for the willingness to adopt green electricity service.

3. Methodology

Contingency valuation (CV) and choice experiments (CE) are two main stream methods for assessing consumers' willingness to buy green electricity [28]. The CV method measures a single willingness-to-pay (WTP) value (i.e., the price or the price premium) for green electricity while the CE method investigates how different attributes will influence consumers' purchase decision of green electricity. The WTP estimations vary much among different markets and research techniques used. In this study, a contingent valuation (CV) method was used to value households' willingness to adopt green electricity [50].

The CV method is a well-established method for measuring WTP and eliciting consumers' preference [27,50]. The main advantage of CV is that it addresses straightforward question to the respondents, thus it is easy for respondent to comprehend and to answer. The often used elicitation technique in CV surveys has different formats, for example, open-ended, biding, payment card, single-bounded dichotomous choice (SBDC) and double-bounded dichotomous choice (DBDC) [27]. Each format has its strengths and weaknesses [51]; the choice of the elicitation format depends on several factors such as the nature of the good being investigated, the cost of the survey and the characteristics of the respondents. Based on an evaluation of these factors, we decided to use the payment card. The main advantage of payment card is that we can use a value as close to the real market price as possible, subsequently it helps reduce the amount of outliers in the survey [51]. In addition, the range of values also prevents the starting point bias. Furthermore, it should be noted that although consumers use electricity as a power source for the daily life, the purchase of a service contract is not a routine buying for households, and many households have no clue regarding the premium to pay for green electricity, plus the fact that the price composition of electricity is already complicated enough to be understood by most consumers. The payment card elicitation can therefore help respondents evaluate the price ranges as close to the market price. CV has also its limitations. In the hypothetical market situation respondents may take the experiments less seriously than a real market, consequently it can create bias in the WTP estimation. Respondents may overstate or understate his/her bid for the good or service being investigated, which is known as strategic behavior [52]. On the one hand, some respondents may be willing to pay whatever price for green electricity to display his/her concern about the issue. On the other hand, some respondents may understate his/her real WTP for green electricity because s/he expects many others will pay for the public good (i.e., green electricity). The former bias occurs due to an over-pledging, in other words, consumers feels better about oneself, known as the "warm glow of giving" [53,54]. The latter bias occurs due to free-riding [55,56]. Mitchell and Carson [57] claimed that the strategic bias may not occur (1) when there is much information needed, (2) respondents think they have little influences on the outcome of the survey, (3) respondents are aware of their budget constraints and/or (4) respondents assume the good will not be provided. Therefore, the validity and reliability of the CV method are two major concerns, which can be improved through careful design of the questionnaire [50,58].

The study divided a sample of 1022 respondents into two nearly equal sized sub-samples chosen from an Internet Panel administrated by a commercial marketing research firm. One subsample received a positively framed version of the questionnaire regarding subscription to a green electricity contract, and the other subsample received a negatively framed version of the questionnaire. The green electricity product is a real product in the electricity retail market at the time of the survey.[2]

3.1. The survey

The sample was drawn from an Internet-panel including 7000+ Danish consumers which reflects the actual Danish population 15–65 years of age with access to the internet from home. A sample of 1022 residential electricity bill payers with usable questionnaires was used for the analysis. Table 1 presents the sample statistics. As compared to the general structure of the Danish population, the entire sample fits well in terms of the basic socio-economic descriptors such as gender, age, household size, household income and education level [59]. It can be noted that the entire survey sample is slightly skewed toward more highly educated people with a high-income level and relatively larger household size. This may probably be attributed to the fact that only respondents who have access to the Internet were recruited and that many small-sized households which do not need to consider purchasing electricity such as dormitories for students and other youths due to their leasing agreements were screened out. The structure of the sample under both the positive framing and the negative framing appears to be similar except regarding gender. There are more male respondents than female respondents in the two divided samples. This is because there are more female respondents who had bought green electricity products and thereby they were not asked about their willingness to adopt green electricity.

Table 1. Sample Description (in %)

Characteristics	**The whole sample (N = 1022)**	**Under positive framing (N = 453)**	**Under negative framing (N = 441)**
Gender			
Male	50.4	55.8	55.4
Female	49.6	44.2	44.6
Age			
Below 30 years	27.7	27.5	27.6
30–39 years	19.8	20.7	19.8
40–49 years	21.9	22.6	22.1
50–59 years	19.3	17.3	19.2
Over 60 years	11.9	11.8	11.2
Number of persons over 15 year-old in HH			
1 person	27.5	25.3	29.3
2 persons	52.6	53.5	53.4
3 persons	11.8	11.7	10.1
4 + persons	8.1	9.4	7.2

Characteristics	The whole sample (N = 1022)	Under positive framing (N = 453)	Under negative framing (N = 441)
Children/teenagers under 16 year-old in HH			
Yes	29.4	28.1	29.4
None	70.6	71.9	70.6
Education			
Grade School	9.1	9.1	9.2
High School	25.1	26.1	23.4
Short-term higher education	14.4	13.3	16.3
Medium-term higher education	30.6	30.5	29.3
Long-term higher education	17.8	16.4	19.9
Others	1.8	2.6	1.3
Undisclosed	1.3	2.1	.6
Pre-taxed annual household income			
Under 200.000DKK	8.7	8.9	8.9
200.000–299.999 DKK	10.3	8.7	12.3
300.000–399.999 DKK	12.4	12.3	13.0
400.000–499.999 DKK	9.8	12.2	7.3
500.000–599.999 DKK	9.3	8.9	9.7
600.000 DKK or more	33.6	31.2	34.7
Undisclosed	15.9	18.0	14.1

The questionnaire begins with a brief introduction that informs respondents about the green electricity market and a definition of green electricity products, and then we asked about the respondents' knowledgeability about green electricity products and the current purchasing of green electricity products. The questionnaire also included questions concerning respondents' attitudes towards green electricity, green electricity expansion and habitual environmental friendliness practice. Finally, questions concerning the respondents' socio-economic background are also included in the survey.

3.1.1. The question framing

Before the framed question, a brief introduction about the current electricity market situation, the definition of green electricity and the consequences of subscribing to a green electricity contract were presented to the respondents.

The negatively framed version:

Suppose that *only a few* Danish households have bought wind energy, how likely it is for you to buy wind energy (via subscribing to a green electricity contract)?

The positively framed version:

Suppose that *most* Danish households have bought wind energy, how likely it is for you to buy wind energy (via subscribing to a green electricity contract)?

All participants were asked to select their willingness to buy green electricity on a five point scale ranging from 1 ("Definitely no") through 5 ("Definitely yes").

3.2. Model specification

The dependent variable (willingness to adopt) is a categorical ordered variable ranging from "Definitely no" to "Definitely yes", indicating that the dependent variable has a meaningful ordering. Thus, the ordered logit model is used for the analysis [[60], [61], [62]]. Unlike linear regression, ordered logit has no restrictions regarding normally distributed errors terms and homogeneity of variance for the independent variables [62]. The ordered logit model is an extension of the binary logit model, and is built around a latent regression in the same way as binary logit [[60], [61], [62]]. The underlying theoretical framework is the random utility theory (RUT), for detail, please refer to McFadden [63] and Train [64]. The model assumes that the underlying response variable y^* is defined by the following regression relationship:

$$y^* = \sum_{k=1}^{K} \beta_k x_k + \varepsilon \tag{1}$$

where the xs are the explanatory variables. In practice, y^* is unobserved. Instead, we observed y, namely the adoption intention in this study. The general probability that the observed y falls into response category j ($j = 1, 2, 3, \ldots, J$) is the difference between two neighboring cumulative probabilities.

$$\begin{aligned}
\text{Prob}(\text{y} = \text{j}) &= \text{Prob}(\mu_{j-1} < y^* \leq \mu_j) \\
&= \text{Prob}\left(\mu_{j-1} < \sum_{k=1}^{K} \beta_k x_k + \varepsilon \leq \mu_j\right) \\
&= \text{Prob}\left(\sum_{k=1}^{K} \beta_k x_k + \varepsilon \leq \mu_j\right) - \text{Prob}\left(\sum_{k=1}^{K} \beta_k x_k + \varepsilon \leq \mu_{j-1}\right) \\
&= \text{Prob}\left(\varepsilon \leq \mu_j - \sum_{k=1}^{K} \beta_k x_k\right) - \text{Prob}\left(\varepsilon \leq \mu_{j-1} - \sum_{k=1}^{K} \beta_k x_k\right) \\
&= \text{F}\left(\mu_j - \sum_{k=1}^{K} \beta_k x_k\right) - \text{F}\left(\mu_{j-1} - \sum_{k=1}^{K} \beta_k x_k\right)
\end{aligned} \tag{2}$$

where y is observed as one of the **J** ordered categories, and the μ s are unknown threshold parameters separating the neighboring categories to be estimated with β_s, F is the cumulative distribution function. The number of μ s to estimate depends on whether or not e μ is normalized [60]. Without normalization, there would be J-1 numbers of μ s to estimate and with normalization, there would be J-2 [60]. This is be- cause the number of thresholds is always one smaller than the number of categories [60]. To get a probability value for all categories, the μ s are constrained as $0 < \mu_2 < \mu_3 < \ldots < \mu_{J1}$.

There are two exceptions for the probability of the first and the last category: $\text{Prob}(y \leq 1) = \text{Prob}(y = 1)$ and $\text{Prob}(y \leq \text{J}) = 1$ [60].

The marginal effect on the probability that the observed *y* falls into response category *j* is the partial derivative of the probability with respect to x_k:

$$\frac{\partial \text{Prob(y=j)}}{\partial x_k} = \left[f\left(\mu_{j-1} - \sum_{k=1}^{K} \beta_k x_k\right) - f\left(\mu_j - \sum_{k=1}^{K} \beta_k x_k\right)\right]\beta_k \quad (3)$$

Where *f*(.) is the probability density function typically either the standard normal or the logistic distribution.

The ordered logit model allows a sequence of logits specified with the same β s and *x*s but with different μs [60]. The probability that the observed *y* falls into the five response categories has the following forms:

$$\begin{aligned}
&\text{Prob(y = 1)} = \text{L}\left(-\sum_{k=1}^{K} \beta_k x_k\right) \\
&\text{Prob(y = 2)} = \text{L}\left(\mu_2 - \sum_{k=1}^{K} \beta_k x_k\right) - \text{L}\left(-\sum_{k=1}^{K} \beta_k x_k\right) \\
&\text{Prob(y = 3)} = \text{L}\left(\mu_3 - \sum_{k=1}^{K} \beta_k x_k\right) - \text{L}\left(\mu_2 - \sum_{k=1}^{K} \beta_k x_k\right) \\
&\text{Prob(y = 4)} = \text{L}\left(\mu_4 - \sum_{k=1}^{K} \beta_k x_k\right) - \text{L}\left(\mu_3 - \sum_{k=1}^{K} \beta_k x_k\right) \\
&\text{Prob(y = 5)} = 1 - \text{L}\left(\mu_4 - \sum_{k=1}^{K} \beta_k x_k\right)
\end{aligned} \quad (4)$$

where L is the logistic cumulative distribution function.

An important assumption for the ordinal model is that the relationship between the independent variables *x*s and the logits are the same for all the logits [60]. This means that the effects of an *x* should be constant over the choice response category *j*. Simply put, the β estimates are invariant to the thresholds. This is also called the parallel lines assumption [[60], [61], [62]].

The independent variables entered into the model include questions regarding consumers' perceptions, attitudes, moral values, daily environmental-friendly practices as well as consumers socio-demographic profiles. A test for multicollinearity for the independent variables was performed in a linear regression. All variance inflation factor values associated with the independent variables are less than five, indicating that multicollinearity is not a problem for the econometric analysis [62].

4. Empirical results

4.1. Descriptive statistics

Fig. 3 shows the distribution of potential buyers[3] of green electricity under two different framing conditions. It appeared that more consumers are likely to sign up to green electricity products when most households have bought it (namely under positive framing), and vice versa.

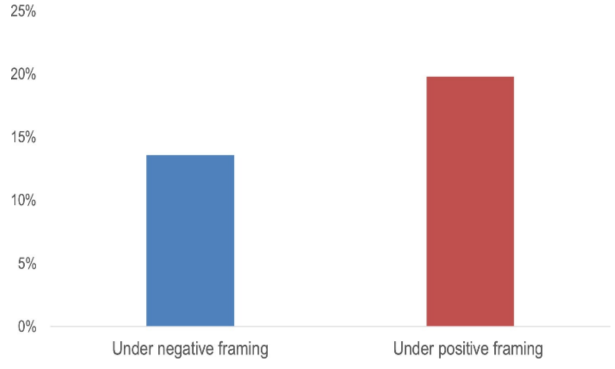

Fig. 3. Distribution of potential buyers under two framing conditions (in %).

Expanding renewable energy is important for achieving a fossil fuel independent nation. Table 2 presents the public opinion about renewable energy expansion in Denmark. Most of the respondents believe that the government has the primary responsibility for renewable energy expansion. Only a small percent of the respondents believe that the consumers have the primarily responsibility. It can be noted that there are more people who believe that either the government or the electricity suppliers has the primary responsibility under the negative framing than under the positive framing. Regarding the answer for “should the consumers have the primary responsibility?” there are more yes-sayers under positive framing than under the negative framing. This underlines also that consumers’ expectations for the role of the government and the electricity suppliers in a renewable energy expansion are great, and consumers maybe should not play a key role in it. Regarding the location for the newest built wind farms, offshore wind farms are far more preferred than wind farms on land for both samples. Nearly half of the respondents had no preferences on the location of the newly built wind farms except the non-disturbance for residents.

Table 2. Attitudes towards renewable energy expansion.

Frequency	**Positive framing (n = 453)**	**Negative framing (n = 441)**
…has the primary responsibility		
The government	55.4	58.0
The consumers	6.4	5.3
The electricity suppliers	26.3	28.6
Do not know	11.9	8.2
… you prefer most in building the newest wind farms		
On land	.3	1.2
Offshore	41.2	46.6

Frequency	Positive framing (n = 453)	Negative framing (n = 441)
Either on land or offshore, but it should keep enough distant not to disturb people	53.8	49.1
Don't know	4.4	3.1

Table 3 presents the consumer perceptions for and attitudes towards adoption of green electricity as well as their moral values. An independent sample t-test revealed that there are no significant differences on these measurements between the two samples. As shown, consumers tend to be positive about the stability of the supply of 100% renewable energy but are skeptical about the environmental quality of the green electricity. Regarding respondents' habitual pro-environmental behavior, it appears that price is an important factor in their daily practices.

Table 3. Consumer perceptions for and attitudes towards adoption of green electricity and their moral values (in %)

Measurements	Positive framing (n = 453) Mean (S.D.)	Negative framing (n = 441) Mean (S.D.)
Switching electricity suppliers is definitely necessary in order to obtain green electricity*	4.32(1.59)	4.24(1.67)
Obtaining green electricity would make me feel like I am doing something for the environment*	3.99(1.28)	3.92(1.33)
I am worried that the 100% renewable energy supply will be unstable, because wind and sun are not available at all times*	3.20(1.58)	3.26(1.60)
It is difficult to know what environmental quality standards green electricity comply with*	4.37(1.31)	4.27(1.28)
The standards for existing environmentally friendly electricity products are very unclear*	4.66(1.36)	4.64(1.33)

Measurements	Positive framing (n = 453) Mean (S.D.)	Negative framing (n = 441) Mean (S.D.)
I am obligated to use green electricity for future generations*	3.51(1.64)	3.47(1.62)
Generally, I will choose the environmentally friendly alternatives regardless of price#	2.68(.91)	2.58(.92)
Generally, I try to discover the environmental effects of products prior to purchase#	3.07(.99)	3.05(.96)

Note: Items with "*" are measured on a five-point Likert scale from "strongly disagree" to "strongly agree".

Items with "#" are measured on a five point scale from "never" to "always".

4.2. The adoption of green electricity model estimation

We estimate the model for green electricity adoption for the entire sample, for the sample under positive framing and for the sample under negative framing. Table 4 presents the definition of the explanatory variables. Table 5 presents the estimation results of the adoption of green electricity model. As shown, all three models are significant, and all significant explanatory variables entered into the models have the expected sign. The coefficient is the log-odds (i.e., logits) for the regression. The p-value of .00 indicates that at least one of the regression coefficients is not equal to zero for all models, indicating that all models are valid. The Pseudo R^2 indicates the goodness of fit of the model. As a rule of thumb, a high value of Pseudo R^2 is preferred. However, the model fit for discrete data often have a low Pseudo R^2 [65]. Thus, Greene [61] suggested that one should not over-interpret the Pseudo R^2. Overall, performances for all estimated models are acceptable. In the following, we discuss the estimates of three models.

Table 4. Definition of variables

Variables	Definition
SSUPL	Switching electricity suppliers is definitely necessary in order to obtain green electricity (1=strongly disagree, …, 5=strongly agree)
FELGD	Obtaining green electricity would make me feel like I am doing something for the environment (1=strongly disagree, …, 5=strongly agree)
WUSTA	I am worried that the 100% renewable energy supply will be unstable, because wind and sun are not available at all times (1=strongly disagree, …, 5=strongly agree)
EQLTY	It is difficult to know what environmental quality standards green electricity comply with (1=strongly disagree, …, 5=strongly agree)
STNDR	The standards for existing environmentally friendly electricity products are very unclear (1=strongly disagree, …, 5=strongly agree)
OBLIG	I am obligated to use green electricity for future generations (1=strongly disagree, …, 5=strongly agree)
CENVP	Generally, I will choose the environmentally friendly alternatives regardless of price (1=never, …, 5=always)
DENVE	Generally, I try to discover the environmental effects of products prior to purchase (1=never, …, 5=always)
FRAME	Framing (1= only a few have bought green electricity, 2= most households have bought green electricity)
GENDR	Gender (1=female, 2=male)
AGE	Age (1=below 30 years, …5=over 60 years)
INCOM	Household income (1= under 200,000 DKK, ….6 = 600.000 DKK or more)
FCHLD	Family with children (1=yes, 0=no)
EDU	Education (1= grade school, 5=long-term higher education)

Table 5. Logit models explaining willingness to buy green electricity (whole sample, negative framing and positive framing)

Independent variables		Whole sample Coef. (s.e.)	Negative framing Coef. (s.e.)	Positive framing Coef. (s.e.)
SSUPL		.11(.05)*	.02(.07)	.20(.07)*
FELGD		.27(.06)*	.22(.08)*	.34(.09)*
WUSTA		−.17(.05)*	−.18(.07)*	−.14(.07)*
EQLTY		−.16(.07)*	−.09(.10)	−.23(.10)*
STNDR		−.18(.06)*	−.15(.09)**	−.24(.09)*
OBLIG		.24(.05)*	.21(.07)*	.26(.07)*
CENVP		.39(.10)*	.30(.14)*	.50(.14)*
DENVE		.27(.09)*	.25(.14)**	.29(.13)*
FRAME		.59(.13)*		
GENDR		−.22(.14)	−.57(.20)*	.17(.20)
AGE		−.02(.06)	−.19(.08)*	.18(.08)*
INCOM		−.04(.03)**	−.05(.04)	−.03(.04)
FCHLD		−.22(.11)*	−.09(.16)	−.46(.17)*
EDU		−.12(.05)*	−.06(.07)	−.19(.07)*
Model Fit	N	894	453	441
	LL	−1014.96	−515.50	−484.45
	p-value	.00	.00	.00
	Pseudo R^2	.10	.09	.13

Note: * indicates that the parameter is significant at the 5% level,** indicates that the parameter is significant at the 10% level.

In the estimation of the model for the whole sample, the results indicate that consumers' attitudes towards green electricity have important impact on consumers' willingness to buy green electricity. Households' positive feelings from use of green electricity had a significant positive effect on willingness to buy green electricity. The more an individual feel good for the environment from use of green electricity, the higher the probability than an individual is willing to buy green electricity. Due to the negative wording in questions regarding consumers concern about the environmental quality of green electricity, the coefficients for variables “the stability of 100% renewable energy supply”, “the environmental quality standards” and “the standards are unclear” had negative sign. Therefore, the results show that the more positive an individual feel about the stability of the 100% renewable energy supply, the clearer standards complied with green electricity, the higher the likelihood that an individual is likely to buy green electricity. Self-moral obligation had positive impact on the willingness to buy green electricity. The more an individual feel that he or she has an obligation to use green electricity, the higher will be the likelihood that consumers are willing to buy green electricity. Consumer daily practice had also positive impact on consumers’ willingness to buy green electricity. It can be noted that when most people have bought green electricity that will increase the likelihood for non-buyers to adopt green electricity. Finally, the impact of some of the standard demographic and socio-economic characteristics is also detected in this research. It can be noted that education and income have a negative effect on adoption intention. This may be due to contradictory and controversial public discussions and debates about energy and climate in the media, and those respondents are often very skeptical about the “real” environmental effect of green electricity.

With respect to the estimations of the model for the sample under negative framing, supplier switching appears to be insignificant for their adoption intention. Individuals’ feelings for obtaining green electricity had positive effect on adoption intention. Again, potential adopters do not fear for the stability of a 100% renewable energy supply.

Individuals' habitual environmental practice displays also a positive effect on the adoption intention. It can be noted that younger females are more likely to adopt green electricity.

For the estimation of the model under positive framing, supplier switching and personal feeling of doing good for the environment when using green electricity had positive effect on the adoption intention. The clarification of the environmental quality and product standard are likely to influence the adoption intention positively. Individual's personal obligation and their habitual environmental practice had positive effect on the adoption intention. Finally, it can be noted that age, education level and number of children living at home had effect on the adoption intention [28].

5. Conclusion and managerial implications

The research hypothesis was that consumers will display higher adoption intention under the positive framing condition relative to the negative framing condition. Our study shows that the effect of framing was statistically significant. As expected, consumers displayed stronger intention to buy green electricity when the situation was framed in a positive manner (i.e., most Danish households have already bought it), as compared to the situation that was framed in a negative manner. The results of this study confirm that there is a tendency for risk aversion under positive framing conditions and a tendency for risk seeking under negative framing conditions. The framing effect also signals the public good side of green electricity in that there seems to be a free rider problem. The relatively low intention to buy green electricity in the negative frame (i.e., a few Danish household has bought green electricity) indicates that the free-rider incentive is particularly powerful in a large group, where an individual may perceive that her or his behavior will have only little influence on the collective outcome [66]. The results confirm the finding from Ek and Söderholm [17].

Consumers who are going to buy green electricity in general hold a positive attitude towards green energy and the environmental effect of green energy. Potential adopters seem to be confident about the stability of an energy system supplied by 100% renewable energy. In addition, consumers generally felt a kind of moral obligation to buy green energy for a sustainable future. This finding is in line with previous research that an individual may take proactive steps to behave in ways that benefit others [54,67]. When taking the framing scenarios into consideration, respondents in the positive framing situation appear to be more positive regarding the stability of the renewable energy supply and feel stronger in moral obligation to use green energy for future generations than respondents in the negative framing situation. Respondents' daily practice in the positive framing are generally more environmentally conscious than respondents in the negative framing. Finally, respondents in positive framing are generally elderly respondents whereas respondents in the negative framing are generally younger respondents. The effects of the socio-demographic variables – gender, age and education level varies across models but the results are in line with previous studies [28,29]. However, the effect of households' income differs from previous studies, namely, insignificant for the negative and positive framing model but negative effect for the whole sample model at 10% significance level. This may be due to electricity expenditure is only a small proportion of Danish household expenditure and the present market price for green electricity is only slightly above non-green electricity.

This has important implications for both policy makers and also for electricity retailers. First the percentage of potential green energy adopters remains low. An important reason seems to be the environmental effect of using green electricity and that the standards of green electricity should be clarified. Second, households appear to be willing to participate if only other households also do so. Therefore, for energy policy makers, there is a need to design clear product standards for green electricity. With respect to the environment effect of using green electricity, the policy makers may provide better information about the characteristics of green electricity e.g. greenhouse gas indicators. An important implication for the policy makers is that the current pricing method should be modified. For instance, residents who have bought green electricity should not pay as much tax as brown electricity. Otherwise, adopters will have difficulties in accepting why a less-polluted product costs the same as a polluted one and eventually adopters will lose their interests and confidence for the green electricity product. This study shows that more people will buy green electricity only when many other people buy it. Since green electricity does not have a physical presence signaling individual's social status, the intangible nature of purchasing green electricity can thus be a hurdle for potential adopters. According to Menges, Schroeder [54] and Schwartz [67], an individual will feel more stimulated to perform a pro-environmental behavior with a financial cost, when one's behavior can be observed by others. Therefore, labeling of homes that is supplied with green electricity might be a good idea for facilitating the sales of green electricity. Finally, it can be noted that the clear majority believes that the government has the primary responsibility in renewable energy expansion and very few (less than 6%) consider that consumers have the primary responsibility. Therefore, consumers should be regarded as having a supplementary role in promoting renewable energy when designing a sustainable energy strategy.

Finally, since the study is mainly based on the stated preference for the green electricity service, it is worth noting that the stated preference does not necessarily translated into action, see also Nakarado [68].

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