Using rewards and penalties to promote sustainability: Who chooses incentive-based electricity products and why?

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Using rewards and penalties to promote sustainability: Who chooses incentive-based electricity tariffs and why?

Abstract

Reducing electricity consumption can considerably contribute to mitigating climate change. Incentives, both rewards and punishments, are effective instruments that have been embedded in electricity tariff designs to promote electricity savings. To better understand consumer preferences for incentive-based electricity tariffs, a choice experiment using choice-based conjoint analysis was conducted among a representative sample of Swiss electricity consumers. Based on stated preferences for different tariff attributes, four consumer segments were identified. While two segments (49.6%) stated preference for incentive-based tariffs, two other segments were less accepting of incentive components (particularly of penalties). We further explain the segments' preferences using psychographic characteristics, combining measures from psychology and behavioural economics. Precisely, environmental values and emotions, energy saving intentions and motives, perceived tariff attractiveness, as well as loss and risk aversion, and comparative optimism bias best described the segments. We align our findings with previous segmentation studies and argue for a stronger integration of behavioural economics in the environmental discourse. We further discuss the usefulness of consumer segmentation to develop tailored strategies that effectively target consumers' preferences and needs.

Keywords: Market segmentation, Incentives, Electricity tariff design, Behavioural economics, Household choices

Using Rewards and Penalties to Promote Sustainability: Who Chooses Incentive-Based Electricity Tariffs and Why?

1. Introduction

Household energy consumption is one of the largest contributors to worldwide greenhouse gas emissions (IPCC, 2014). About 18% of the total U.S. energy demand is consumed by households (EPA, 2018), while households account for about 27% of the total consumption in Europe (Eurostat, 2017). Estimations project that household energy savings could fundamentally contribute to reaching the sustainable development goals, which are endorsed by a large number of countries (Rosenow et al., 2015; UNFCCC, 2015). Hence, targeting decisions and behaviours related to household consumption can considerably contribute to mitigating greenhouse gas emissions and climate change (e.g., Jackson, 2005; Lopes, Antunes, & Martins, 2012).

Incentives are popular policy instruments that receive increasing attention in environmental policy (e.g., Shogren, 2012). Incentives have been found to be effective in promoting environmentally-significant decisions and behaviours, such as recycling (e.g., Bor, Chien, & Hsu, 2004; Timlett & Williams, 2008), purchasing energy efficient appliances (e.g., de la Rue du Can, Leventis, Phadke, & Gopal, 2014; Stern, 1999), and reducing household consumption (e.g., Bertoldi, Rezessy, & Oikonomou, 2013; Ito, Ida, & Tanaka, 2018). Embedding incentives in energy tariff designs is a promising strategy to reduce energy consumption in households (Prasanna, Mahmoodi, Brosch, & Patel, 2018). Governments and utilities have a mandate to help consumers save energy and use incentives to promote renewable energy use, innovation adoption, and energy conservation (EED Directive, 2012).

In countries where consumers can freely choose electricity tariffs, as opposed to being automatically subscribed to tariffs as is the case in some regulated energy markets, it is crucial to adapt the tariff designs to the preferences and needs of consumers. Understanding consumers' preferences and needs is thus an integral part for the successful design and implementation of such tariffs. Previous research investigating consumer preferences for electricity tariff attributes found that electricity mix, costs, and location of electricity generation are most important in determining consumer choices (Burkhalter, Kaenzig, & Wüstenhagen, 2009; Kaenzig, Heinzle, & Wüstenhagen, 2013). Tabi, Hille, and Wüstenhagen (2014) extracted differing consumer segments based on their preferences for different tariff attributes and described these segments based on psychological and behavioural characteristics. Profiling and segmenting consumers based on determinants of environmentally-significant decisions and behaviours allows marketers to follow a "one size does not fit all" approach by developing tailored strategies that directly target and influence these determinants in order to promote pro-environmental decisions and behaviours (Bradley, Coke, & Leach, 2016; Egmond, Jonkers, & Kok, 2006).

In the present contribution, we expand on previous research by investigating consumers' preferences for incentive-based electricity tariffs that are designed to promote electricity savings through consumption-contingent rewards and/or penalties. Using a segmentation approach, we further aim to identify differing consumer segments based on tariff preferences revealed in a choice experiment. In our attempt to describe the determinants of tariff preferences, we rely on constructs from psychology research (e.g., values, emotions) as well as on measures commonly used in behavioural economics (e.g., loss aversion).

1.1 Incentive-based electricity tariff designs

Incentive-based electricity tariffs are designed to reward decreases and/or penalise increases in consumption (e.g., Albadi & El-Saadany, 2007), which is desirable for governments and utilities around the world in light of mandates to promote global energy conservation (EED Directive, 2012). Different incentive and pricing strategies exist. Demand-side management refers to a set of utility activities that are implemented to influence consumers' electricity use (Gellings, 2017). These include adoption of energy-efficient technologies, adopting energy-efficient behaviours such as switching off unused lights, as well as variable pricing strategies and incentives (Kim & Shcherbakova, 2011). A popular subset of demand-side management strategies are so-called demand-response tariffs that apply financial incentives, either in form of rewards (e.g., rebates) or penalties (e.g., increasing costs per kilowatt per hour [kWh]) to influence consumers' electricity use. Similar principles are implemented in progressive tariffs (PT) and energy-saving feed-in tariffs (ESFIT). PT charge consumption in different layers, where the unit price increases with consumption, hence discouraging increases in consumption (Borenstein, 2009). Such tariffs find greater implementation in highly regulated energy markets, such as China (Sun & Lin, 2013). In contrast to PT, ESFIT apply rewards for electricity savings, under which consumers do not only profit from a (financial) reward but also from overall lower electricity costs resulting from a lowered consumption. Here, either the kWh price is lowered with decreasing consumption or a reward is paid for reaching a pre-defined saving target, hence encouraging decreases in consumption (Bertoldi et al., 2013). Reward-based tariffs have been implemented primarily in Western countries, such as in the United Kingdom[1], Germany[2], or Switzerland[3].

[1] https://www.mygreenstarenergy.com/Customer-Perks
[2] http://www.strom-magazin.de/strommarkt/e-on-energiespar-tarif-strom-sparen-und-praemie-bekommen_68849.html
[3] https://ww2.sig-ge.ch/particuliers/consommer-mieux/reduire-vos-consommations/bonus-economies-energie

A review by Prasanna et al. (2018) found that both PT and ESFIT are effective in leveraging electricity savings among residential consumers. Comparing these two tariffs across a large population, PT have been found to be more effective than ESFIT in promoting electricity savings. Ito (2014) showed that electricity consumers more strongly react to average electricity costs than to variable unit prices. Consumer acceptance of incentive-based electricity tariffs have not yet been examined and compared, particularly not in cases where incentives are not expressed in unit prices (but, e.g., as lump-sum deduction from the average electricity costs).

Although research suggests greater effectiveness of electricity tariffs that apply penalties to leverage electricity savings, it can be assumed that consumers are more likely to prefer tariffs that reward, rather than penalise, consumption. This assumption is based on the concept of loss aversion. In their seminal work, Kahneman and Tversky (1979) demonstrated that people experience greater displeasure in response to losses than they experience pleasure in response to equivalent gains. As a result of the enhanced displeasure experienced from losses, people are willing to take greater risks to avoid losses than to obtain gains (e.g., Tom, Fox, Trepel, & Poldrack, 2007). Applying the concept of loss aversion to consumers' preferences for incentive-based tariffs, people should thus be less likely to voluntarily subscribe to tariffs that apply penalties than to tariffs that apply rewards. Borrowing from the literature on work contracts, results on people's voluntary subscriptions to loss-framed contracts are, however, inconclusive: Whereas some studies show that people are indeed averse towards loss-framed contracts (e.g., Luft, 1994), other studies show that people are willing to voluntarily subscribe to such contracts (e.g., Fryer, Levitt, List, & Sadoff, 2012; Imas, Sadoff, & Samek, 2017; De Quidt, 2017), potentially in anticipation of greater work performance under penalties than under rewards. Further experimental research supports people's willingness to voluntarily choose loss-framed contracts: Trope and Fischbach (2000) showed that people use self-imposed penalties, rather than rewards, to motivate themselves to perform a certain task in the near future.

In line with these findings, Mahmoodi, Prasanna, Hille, Patel, and Brosch (2018) found that consumers' tariff choices were largely influenced by the incentive components embedded in the tariff design. Overall, consumers preferred electricity tariffs that applied rewards for consumption decreases, rather than penalties for consumption increases. However, consumer acceptance of tariffs with a penalising component could be enhanced significantly when simultaneously offering a reward for decreases in consumption. These findings indicate that combinational reward-penalty tariffs are the most promising strategy to enhance consumer acceptance of penalising components embedded in electricity tariffs. This is an important finding, particularly for countries where consumers are able to freely choose their tariffs and might not otherwise voluntary subscribe to tariffs that apply penalties for overconsumption (see also Mahmoodi et al., 2018).

1.2 Psychological determinants of environmentally-significant decisions and behaviours

Careful considerations ought to be made when implementing incentive-based electricity tariffs to promote electricity conservation. Previous studies showed that financial incentives can inhibit intrinsic motivation to act altruistically or pro-socially (Titmuss, 1970; Frey & Oberholzer-Gee, 1997). The effectiveness of incentives to promote environmentally-significant decisions and behaviours is, furthermore, dependent on a number of factors, such as how the incentives are implemented or whom they are targeting (Coad, Haan, Woersdorfer, 2009; Stern et al., 1986). As different incentives appeal to different consumers, individual differences ought to be considered.

A substantial number of previous studies investigated psychological mechanisms underlying environmentally-significant decisions and behaviours. In this context, socio-demographic (e.g., education) and psychographic information (e.g., values) have been extensively examined (e.g., Gilg, Barr, & Ford, 2005). For example, several studies found that higher income and younger age correlate with willingness to pay for green electricity (e.g., Diaz-Rainey & Ashton, 2011; Ek & Söderholm, 2008; Gerpott & Mahmudova, 2010; MacPherson & Lange, 2013; Zarnikau, 2003). Female gender and higher levels of education have also been found to correlate positively with pro-environmentalism (Diamantopoulos, Schlegelmilch, Sinkovics, & Bohlen, 2003).

Despite the extensive study of socio-demographic variables, research suggests that psychographic information play a more important role in explaining environmentally-significant decisions and behaviours (e.g., Diamantopoulos et al., 2003; Faiers, Cook, & Neame, 2007; Kaiser, Hübner, & Bogner, 2005; Straughan & Roberts, 1999; Sütterlin, Brunner, & Siegrist, 2011). The potential of values to explain environmental decision and behaviours, for example, has been intensely studied (e.g., Dietz, Fitzgerald, & Shwom, 2005). Rokeach (1973) and Schwartz (1992) conceptualised values as guiding principles of human behaviour that determine which goals people choose to pursue and that are generally stable over time. The values linking to self-transcendence (e.g., altruism, biospherism) and self-enhancement (e.g., egoism) have been particularly studied and discussed in relation to environmental decisions and behaviours (e.g., Stern, Kalof, Dietz, & Guagnano, 1995; De Groot & Steg, 2007). Value-belief-norm theory initially developed by Stern and colleagues (1995) and later applied by, for example De Groot and Steg (2007), postulates that egoistic, altruistic, and biospheric values (in addition to beliefs and norms) are the most prevalent psychological determinants of pro-environmental decisions and behaviour. While egoistic values reflect protecting or increasing personal resources, altruistic values relate to concern for the welfare of others, and biospheric values reflect concern for the nature and the environment. In addition to these three central values, Steg, Perlaviciute, Van der Werff, and Lurvink (2014) suggest the significance of hedonic values for environmental decisions and behaviours. Hedonic values relate to improving one's welfare and reducing effort. Individuals endorsing hedonic and egoistic values are less likely to act environmentally-friendly than those endorsing altruistic and biospheric values (De Groot & Steg, 2007; Steg, De Groot, Dreijerink, Abrahamse, & Siero, 2011; Steg et al., 2014).

Some researchers emphasised the relevance of emotions and affect in the environmental context in addition to value theories (Hahnel & Brosch, 2018; Kollmuss & Agyeman, 2002). Emotions have multiple components (e.g., physiological and motivational) that can trigger adaptive changes. A number of studies showed that emotions have significant explanatory power in predicting environmentally-significant decisions and behaviours beyond environmental values, beliefs, and norms (Antonetti & Maklan, 2014; Carmi, Arnon, & Orion, 2015). Emotional affinity for nature as well as stronger emotional responses to environmental degradation increase the likelihood of engaging in environmental conservation (Kals, Schumacher, & Montada, 1999). People are also more likely to engage in sustainable behaviours when they can derive pleasure or satisfaction, especially in cases where the behaviour is difficult (Pelletier, Tuson, Green-Demers, Noels, & Beaton, 1998). Thus, the study of emotions in addition to the more widely researched constructs, such as environmental values, can further our understanding and prediction of environmental decisions and behaviours.

1.3 Insights from behavioural economics for environmentally-significant decisions and behaviours

In addition to psychological approaches to studying environmentally-significant decision and behaviours, behavioural economics has received increasing attention in environmental policy, as it offers an alternative framework to the study of environmental decision-making and alternative tools that are often easy to implement at large scale and at low cost (Shogren, Parkhurst, & Banerjee, 2010; Thaler & Sunstein, 2008). Behavioural economics advances economic theories and models of decision-making by providing more realistic psychological foundations of human decisions and behaviours (Camerer, Loewenstein, & Rabin, 2004). Particularly, the impact of decision biases, such as loss aversion, risk aversion, and optimism bias, on environmental decisions and behaviours has been discussed (Allcott & Mullainathan, 2010; Brekke & Johansson-Stenman, 2008; Frederiks, Stenner, & Hobman, 2015; Gillingham, Newell, & Palmer, 2009; McKenzie-Mohr, 2000).

A recent study investigated consumers' loss aversion with respect to incentive-based electricity tariff acceptance, demonstrating that loss aversion substantially explains consumers' unwillingness to switch to demand-response tariffs (Nicolson, Huebner, & Shipworth, 2017). Loss aversion, moreover, seems to explain the effectiveness of penalties in shifting peak electricity demand (Bradley et al., 2016). In line with this, a loss-framed provision of information tends to be more effective in reducing household electricity consumption (Bager & Mundaca, 2017).

Similarly, risk aversion has been linked to environmental decisions and behaviours (Gifford, 2011; Schiffman, Kanuk, & Hansen, 2012). For example, early technology adopters have been found to be less risk-averse than those less willing to adopt innovations, potentially due to the perceived uncertainties related to these technologies (Egmond et al., 2006). Applying risk-reduction strategies, such as discounts or rebates, could potentially lower perceived risks among consumers (Frederiks et al., 2015).

Furthermore, optimism bias (or comparative optimism) refers to peoples' tendency to underestimate their chances of experiencing negative events and overestimate chances of experiencing positive events (Weinstein, 1980). Optimism bias is also observed with respect to people's beliefs about their abilities to halt environmental degradation. Attari, DeKay, Davidson, and Bruine de Bruin (2010) found that those individuals most engaged in energy-conserving behaviours were also most optimistic about the effectiveness of their conservation endeavours. While the concept of optimism has been less studied in the environmental literature, optimism may link to other well-documented psychological concepts, namely behavioural control and self-efficacy, which have been found to influence environmentally-significant decisions and behaviours (Azjen, 1991). Being optimistically biased about one's abilities to save energy may link to enhanced perceptions of behavioural control and self-efficacy, which in turn have been found to positively predict environmentally-significant decisions and behaviours (Bamberg & Möser, 2007).

2. Study objectives and variable selection

The main aim of the present study was to identify consumer segments based on their preferences for electricity tariffs and to describe these segments based on a number of measures derived from psychology and behavioural economics. Despite numerous attempts to profile and segment consumers, only very few studies segmented consumers based on their preferences for different electricity tariffs, and no previous study has segmented consumers based on their preferences for penalties and rewards in this context. Furthermore, previous segmentation approaches have mainly focused on classical psychological determinants, but largely ignored relevant concepts from behavioural economics that could further describe environmentally-significant decisions and behaviours.

A prior study on tariff preferences demonstrated that consumer clusters could be identified based on their preferences for different electricity mixes, monthly electricity costs, and location of electricity generation (Tabi et al., 2014). In this previous study, the identified clusters could be further described in terms of their psychological and behavioural characteristics. While the socio-demographic information age, gender, income, and household size did not differ significantly between the consumer clusters, education levels were significantly higher in the cluster of green energy adopters than in the other clusters. In addition to socio-demographic information, sensitivity to environmental issues and price perceptions of renewable electricity partly explained cluster membership in the study by Tabi and colleagues.

Expanding on previous research, the present contribution used a choice experiment on electricity tariffs, which differed in terms of a number of attributes including electricity mix, location of electricity generation, monthly costs, and incentive components either rewarding (hereafter: Bonus) or penalising (hereafter: Malus) electricity consumption. Given the effectiveness of incentive-based electricity tariffs to reduce household consumption (Prasanna et al., 2018; Winett, Kagel, Battalio, & Winkler, 1978), a particular focus was laid on consumers' acceptance of the Bonus and Malus components embedded in the tariff designs. In addition, the present study employed a test battery consisting of psychological constructs, that is, environmental values and emotions, saving intentions and motives, tariff attractiveness perceptions, but additionally included relevant constructs from behavioural economics, that is, loss aversion, risk aversion, and optimism bias. Furthermore, relevant socio-demographic information that are often studied with respect to environmentally-significant decisions and behaviours, including age, gender, education, income, civil status, household size, and political orientation were examined.

As reviewed in the above, previous research has largely focused on socio-demographic and psychographic determinants of environmental consumer decisions and behaviours (e.g., Antonetti & Maklan, 2014; Dietz et al., 2005), but up to date, only little research has examined decision biases in this context. The biases loss aversion, risk aversion, and optimism were selected primarily due to their potential influence on the acceptance of the incentive components embedded in the electricity tariff designs.

Loss aversion may play a key role in consumer acceptance of incentive-based electricity tariffs, particularly of penalising incentive components, given that people overestimate losses as compared to gains (Kahneman & Tversky, 1979). We additionally assessed risk aversion, given the uncertainty concerning the reception of these incentives: Rewards are paid only if consumers achieve a saving target and penalties apply only if consumers increase consumption, but neither of this is known at the moment of choosing the tariff. Thus, consumers may perceive electricity tariffs that apply incentives for energy conservation as a risk. Finally, optimism bias was assessed to test consumers' perceptions about their own efficacy as compared to others to save electricity and thereby circumvent facing a penalty for increasing electricity consumption.

We hypothesise that consumer segments can be identified based on their preferences for these tariff attributes. In addition, we hypothesise that the identified segments can be described in terms of psychographic characteristics, using measures commonly used in psychology research and behavioural economics. More precisely, we hypothesise that consumer segments attributing greater importance to electricity mixes from renewable resources more strongly endorse environmental values and emotions than segments attributing importance to financial attributes, such as monthly electricity costs. Segments attributing greater importance to the incentive components Bonus and Malus, showing pronounced preference for high levels of Bonus (e.g., 20%) and low levels of Malus (e.g., No or 5% Malus), are assumed to score higher on loss and risk aversion. Additionally, consumers who are more optimistic about their abilities to save electricity in their homes are assumed to be overall more accepting of Malus attributes embedded in the tariff design.

3. Methods

3.1 Participants

The present study used a pre-existing dataset of a representative sample of Swiss electricity consumers. The averaged results over all consumers were published in Mahmoodi et al. (2018). The present dataset consists of 1,062 respondents, who were recruited via a professional market research (respondi AG). The target population of the study consisted of households in Switzerland, taking into account the distribution of the population by gender, age, and region. The Swiss-representative sample consisted of 323 (30.4%) French-speaking and 739 (69.6%) German-speaking respondents. The average age was 44.25 years (SD = 14.5), ranging from 18 – 90 years. Five hundred fifty-four (52.2%) respondents were female.

3.2 Procedures

The study was administered online, using Sawtooth software. The first part of the study explained the choice scenario and tariff structures, followed by a short comprehension test to ensure that respondents read and understood the instructions. In the second part, participants completed the choice experiment consisting of 12 choice tasks. In the last part of the study, a test battery consisting of socio-demographic and psychographic characteristics was administered. Additionally, participants were assigned to one of four experimental conditions, each rating the perceived attractiveness of one out of four different electricity tariffs, either a rewarding "Bonus tariff", a penalising "Malus tariff", a combined "Bonus-Malus tariff", or a non-incentive tariff labelled "Basic tariff".

3.3 Choice-based conjoint analysis (CBC)

Conjoint analysis is a widely used marketing research technique that allows to investigate implicit consumer preferences by identifying the relative importance consumers ascribe to different product features. Choice-based conjoint analysis (CBC) is the most popular method among conjoint analyses, using hierarchical Bayes (HB) estimation to compute part-worth utility values on individual and group level (Orme, 2010). HB estimation takes into account the individual preference structures and the preference structures of any other individual who participated in the choice experiment (see Rossi & Allenby, 2003; Huber & Train, 2001 for more detail). Post-hoc segmentation presupposes heterogeneity of consumer preference structures and clusters respondents based on their preference structures associated with a product (DeSarbo, Ramaswamy, & Cohen, 1995).

[PLACE TABLE 1 ABOUT HERE]

Electricity tariff attribute and level selection was based on the relevant literature and based on discussions with researchers in the field of environmental sciences as well as a Geneva-based utility to ensure that they are relevant and realistic for the current Swiss electricity market. The selected attributes and corresponding levels are listed in Table 1. Participants were briefed about the conditions under which the financial rewards and penalties (labelled "Bonus" and "Malus", respectively) applied. Both Bonus and Malus were designed to reflect current tariff designs that apply such incentive schemes. The Bonus applied only when a pre-defined saving target was reached (i.e., at least 10% less electricity consumption as compared to the previous year), while the Malus applied only when a pre-defined threshold of electricity consumption was exceeded (i.e., at least 10% more electricity consumption as compared to the previous year). Both Bonus and Malus were calculated as a percentage of the annual electricity bill (see Table 2 for example calculation). Consumers answered 12 consecutive and randomly generated choice tasks, each showing five attributes at a time. Consumers chose between three electricity tariffs in each choice task (see Mahmoodi et al., 2018 for further methodological detail).

[PLACE TABLE 2 ABOUT HERE]

3.4 Measures

3.4.1 Environmental values

Environmental values were assessed using the validated questionnaire by Steg et al. (2014), which consists of 16 items rated on a 9-point scale, ranging from -1 (*opposed to my values*) and 0 (*not at all important*) to 7 (*of supreme importance*). This questionnaire was employed as it was specifically designed for the study of values relating to the environment and it is easy and short to administer in empirical studies. The four subscales assessed egoistic, altruistic, biospheric, and hedonic values. Exemplary items include *"control over others, dominance"* (egoistic values), *"correcting injustice, care for the weak"* (altruistic values), *"preserving nature"* (biospheric values), and *"joy, gratification of desires"* (hedonic values).

3.4.2 Environmental emotions

Emotional responses in the environmental context were assessed using the validated Environmental Trait Affect Questionnaire (ETA-Q; Hahnel & Brosch, 2018) comprising 24 items that measure different aspects of environmental emotions. These aspects are reflected in five subscales, which measure individual dispositions to experience emotions towards environmentally-friendly (e.g., *"I am happy when I conserve or avoid wasting natural resources"*) and environmentally-unfriendly actions (e.g., *"I feel ANGRY when others act in an environmentally unfriendly manner"*), coercion towards (e.g., *"I feel ANNOYED when others try to convince me to act in a more environmentally friendly manner"*) and obstruction from (e.g., *"I feel FRUSTRATED when I would like to act in an environmentally friendly manner, but external circumstances prevent me from doing so"*) acting environmentally-friendly, as well as general emotions towards the state of nature (e.g., *"I feel GRATEFUL for our planet and its nature"*). Respondents rate these items on a 7-point Likert scale from 1 (*Totally disagree*) to 7 (*Totally agree*).

3.4.3 Saving intentions and motives

A two-item questionnaire was adapted from Sütterlin and colleagues (2011) to assess consumers' energy saving intentions and motives in households. The first item *"Do you wish to reduce your household energy use?"* assessed consumers' propensity to reduce household energy use. If this item was responded positively, the second item asked about consumers' energy saving motives in order to unravel whether environmental or financial motives are the driver of the saving intentions. Response options here were either financial (*"I can save* *money by reducing my household energy use"*) or environmental (*"I can help the environment by reducing my household energy use"*), or *"Other/None of the above"*.

3.4.4 Loss aversion

Loss aversion was measured using a task consisting of 30 binary decisions, each offering a choice between a sure and a gamble option. Despite the hypothetical nature of this task, at the end of the study, 200 respondents were randomly drawn from the total participant pool (*N* = 1'062) and for whom one actual decision was randomly determined and paid out[4]. Respondents were informed about the procedure before answering the tasks.

As in Imas et al. (2017), 30 decision tasks allowed for the estimation of the loss aversion parameter of prospect theory's value function for each respondent:

$$u(x) = \begin{cases} (x)^{\alpha} & if\ x \geq 0 \\ -\lambda(-x)^{\beta} & if\ x < 0 \end{cases}$$

where α is the risk aversion parameter in the gain domain (e.g., "If Heads then CHF 5; if Tails then CHF 0" versus "CHF 2 for sure"), β is the risk aversion parameter in the loss domain (e.g., "If Heads then CHF -5; if Tails then CHF 0" versus "CHF -2 for sure"), and λ is the loss aversion parameter (e.g., "If Heads then CHF 5; if Tails then CHF -5" versus "CHF 0 for sure"; see Imas et al., 2017 for additional detail). Exclusion criteria applied where respondents exhibited extreme behaviour by never switching in either of the three gamble domains (i.e., gain, loss, and mixed gamble domain). Where respondents switched more than once in a given gambling domain, only the first switching point was considered (see

[4] To ensure respondents' anonymity, the random lottery draw and pay-out were completed by the market research.

Andreoni & Sprenger, 2012; Imas et al., 2017 for similar exclusion criteria). On this basis, the loss aversion parameter could be estimated for 620 respondents (58.5%).

3.4.5 Risk aversion

A single item, taken from Maestas and Pollock (2010), assessed general levels risk aversion reading “*In general, people often face risks when making financial, career or other life decisions. Overall, how would you place yourself on the following scale?”*. Respondents answered this item on a 7-point scale ranging from 1 (*Extremely comfortable taking risks*) to 7 (*Extremely uncomfortable taking risks*). This one-item measure was administered due to its brevity and because it has been previously found to link to other characteristics associated with risk orientations, such as age, gender, income, and education (Maestes & Pollock, 2010). The one-item measure approach has been validated for other constructs as well (e.g., Cheung & Lucas, 2014).

3.4.6 Comparative optimism bias

Comparative optimism bias was administered using the indirect method (e.g., Harris, Middleton, & Joiner, 2000), whereby respondents estimated their likelihood of avoiding having to pay a penalty (i.e., 20% on top of the next electricity bill) in the hypothetical case of increasing their consumption (i.e., by 10%), as compared to a typical person of the same age, sex, and background. The difference score for this negative outcome (receiving a penalty) was calculated by subtracting each individual’s likelihood estimate for oneself from that given for another, typical person. The difference score is operationalised as a positive value. The larger the difference score, the more pronounced the optimism bias (Helweg-Larsen & Shepperd, 2001).

3.4.7 Experimental condition and tariff attractiveness

After the choice experiment, respondents were randomly assigned to one of four conditions. Each condition presented a different tariff and asked respondents to imagine they opted for the tariff presented to them: 1) The Bonus tariff deducted a 20% Bonus from the next annual electricity bill, if a saving target was reached (i.e., 10% less electricity consumption as compared to last year); 2) The Malus tariff applied a 20% Malus on top of the next annual electricity bill, if consumption increased (i.e., 10% more consumption as compared to last year); 3) The Bonus-Malus tariff combined the 20% Bonus for reduced and 20% Malus for increased consumption; 4) The Basic tariff was a non-incentive tariff. All respondents rated the attractiveness of the presented tariff on a 7-point Likert scale ranging from 1 (*Very unattractive*) to 7 (*Very attractive*). The attractiveness rating was administered as an explicit measure in addition to the implicit choice experiment in order to dissociate preferences for single tariff attributes and levels from preferences for the electricity tariff in its entirety.

3.4.8 Socio-demographic information

The study additionally assessed the socio-demographic information gender, age, education level, income, civil status, and household size. An exhaustive list can be found in Table 5 in Section 4.2. In addition, a single-item measure for political orientation (van Leeuwen & Park, 2009) was used, as previous research suggested the relevance of political orientation for environmentally-significant decisions and behaviours (e.g., Gromet, Kunreuther, & Larrick, 2013). The political orientation item read "*LEFT and RIGHT are two concepts that are often used to characterise political views. Where would you place yourself on a scale where 1 means very left and 7 means very right?*". Answer categories ranged from 1 (*Very left*) to 7 (*Very right*). Respondents could also answer 8 (*Other/None*).

4. Results

4.1 Cluster analysis

In a first analysis step, a Latent Class (LC) analysis was conducted in Sawtooth software to extract clusters of electricity consumers that revealed similar preference structures in the choice experiment. LC analysis was used because it allows to find groups of individuals who share an underlying (latent) construct (i.e., tariff choices). In contrast to other clustering approaches, only LC analysis incorporates such an underlying theoretical aspect to the identification of clusters.

The best model fit was determined based on the fit measures Consistent Akaike Information Criterion (CAIC), Bayes Information Criterion (BIC), and the Chi-square test (see Table 3). Looking at the relative differences between the cluster solutions for each fit measure, the differences increased considerably from the two-to-three and three-to-four cluster solution, but not from the four-to-five cluster solution. As the model fit increased considerably from three to four, but not from four to five clusters, the four-cluster solution was retained.

[PLACE TABLE 3 ABOUT HERE]

Based on the cluster membership information, the second analysis step calculated part-worth utility values and attribute importance scores for the four segments using HB estimation (Table 4). This analysis revealed differences in consumers' preferences for the tariff attributes and respective levels. Non-parametric Kruskal-Wallis tests revealed significant differences between clusters with respect to their importance scores for Bonus, $H(3) = 114.68$, $p < .001$, $\varepsilon^2 = 0.11$, Malus, $H(3) = 415.25$, $p < .001$, $\varepsilon^2 = 0.39$, electricity mix, $H(3) = 728.42$, $p < .001$, $\varepsilon^2 = 0.69$, location of electricity generation, $H(3) = 14.632$, $p = .002$, $\varepsilon^2 = 0.01$, and monthly costs, $H(3) = 168.71$, $p < .001$, $\varepsilon^2 = 0.16$.

[PLACE TABLE 4 ABOUT HERE]

4.2 Segment description and comparisons

Segment 1: The Pure Environmentalists. Consumers in the first segment ($n = 258$) had the highest attribute importance scores for *Electricity mix* (55.3%), with strong preference for electricity from renewable resources (i.e., Mix 4 and Mix 5), while the *Malus* attribute had the smallest attribute importance scores in this segment (8.4%). Pairwise comparisons between the segments showed that consumers in Segment 1 ascribed significantly more importance to the attribute *Electricity mix* and significantly less importance to *Monthly costs*, *Bonus*, and *Malus* as compared to all other segments ($p < .001$).

Pro-environmental tendencies revealed in the choice experiment were supported by the psychographic characteristics (see Table 5). Consumers in Segment 1 most strongly endorsed altruistic and biospheric values and showed an emotional response pattern strongly consistent with high environmental concern (pronounced positive emotions towards the environment and pronounced negative emotions towards environmental pollution). This segment also had the highest proportion of consumers reporting intentions to save energy in their households (92.6%), while these intentions were primarily driven by environmental motives (63.6%). Moreover, consumers in this segment were the least loss-averse and risk-averse of all and were most optimistic about their abilities to save electricity. Lastly, this segment also rated all incentive-based electricity tariffs (Bonus, Malus, Bonus-Malus tariffs) as more attractive than the other segments.

Segment 2: The Loss-averse Environmentalists. Similar to Segment 1, consumers in the second segment (n = 269) ascribed highest importance to the attribute *Electricity mix* (42.3%), with a strong preference for electricity from renewable resources (i.e., Mix 4 and Mix 5). In contrast to the first segment more importance was ascribed to the attribute *Monthly costs* (21.0%). Together, these importance scores indicate pro-environmental tendencies as well as heightened price sensitivity. In addition, the attribute importance score for *Malus* (15.8%) was significantly higher in this segment as compared to Segment 1. Pairwise comparisons showed that consumers in Segment 2 ascribed more importance to *Electricity mix* and less importance to *Monthly costs* and *Bonus* as compared to Segments 3 and 4 (p < .001). Segment 2 also ascribed significantly less importance to the tariff attribute *Malus* than Segment 4 (p < .001), which was, however, not significantly different from Segment 2 and Segment 3.

The psychographic characteristics described this segment in the following ways: Similar to consumers in Segment 1, consumers in Segment 2 endorsed altruistic and biospheric values and showed the according emotional response pattern. The majority of the consumers in this segment expressed intentions to save energy in their households (91.1%), primarily for environmental reasons (61.3%). In contrast to Segment 1, this segment was characterised by higher scores on loss aversion and risk aversion. Nonetheless, consumers in this segment were similarly optimistic about saving electricity as consumers in Segment 1. In line with this finding, this segment rated all incentive-based electricity tariffs (Bonus, Malus, Bonus-Malus) as more attractive than Segments 3 and 4.

Segment 3: The Bargainers. Consumers in the third segment (n = 315), which was also the largest, ascribed highest importance to the attribute *Monthly costs* (31.0%), followed by *Electricity mix* (24.4%). The attributes *Bonus* and *Malus* were equally important (17%) to this segment. Interestingly, consumers preferred electricity consisting of a hydro- and solar power mix (i.e., Mix 4) to electricity exclusively from solar power (i.e., Mix 5). Segments 3 and 4 did not differ significantly with respect to their preferences for the tariff attribute *Bonus*, however, the differences for *Malus* were significant ($p < .001$).

The increased importance of financial aspects revealed in the choice experiment also manifested in the psychographic characteristics. Notably, consumers in this segment were characterised by endorsement of egoistic values, more than any other segment. They also expressed lower levels of positive emotions towards the environment and lower levels of negative emotions towards environmental pollution. While the majority of the consumers in this segment reported intentions to save energy (89.9%), almost half of them expressed that these intentions were driven by financial (47.6%), rather than environmental (41.6%), motives – a significantly higher proportion than in Segments 1 and 2. Moreover, consumers in this segment showed low levels of loss aversion and risk aversion, but were also not very optimistic about their abilities to save electricity and thereby circumvent paying a potential Malus. Consistent with this, consumers in this segment rated the incentive-based tariffs Bonus and Bonus-Malus as attractive, but the Malus tariff as rather unattractive.

Segment 4: The Loss-averse Bargainers. Consumers in the fourth segment (*n* = 220) ascribed most importance to the attribute *Malus* (29.2%), followed by *Monthly costs* (27.2%). The attribute importance for *Malus* was almost twice as high as for the attribute *Bonus*, and significantly higher than in all other segments ($p < .001$).

Turning to the psychographic information, consumers in Segment 4 were further characterised by the lowest scores on altruistic and biospheric values and more strongly endorsed egoistic values. Consumers in this segment further reported the least positive emotions towards the environment and the least negative emotions towards environmental pollution. The lowest number of consumers expressed intentions to save energy in households (80.5%), while more than half of the consumers who did express intentions reported financial motives to be the driver behind these intentions (55.9%). Merely 24.5% of the consumers in this segment expressed environmental motives to drive their savings intentions. Similar to consumers in Segment 2, consumers in this segment showed high levels of loss aversion and risk aversion, but they were also the least optimistic about their abilities to save electricity. In line with this, the attractiveness ratings for incentive-based electricity tariffs were, overall, the lowest in this group of consumers. Segment 4 was the only segment to rate the Bonus-Malus tariff as rather unattractive, only the Bonus tariff was perceived as attractive by this segment.

[PLACE TABLE 5 ABOUT HERE]

5. Discussion

The findings from this choice experiment provide valuable insights into consumer preferences for electricity tariff attributes and acceptance of incentive-based electricity tariffs that reward and/or penalise electricity consumption. Using CBC, four consumer segments could be identified based on implicit preferences for different electricity tariff attributes and further described in terms of psychographic characteristics from psychology and behavioural economics.

While two of the identified consumer segments ascribed more importance to the attribute *Electricity mix*, basing their choices mainly on a preference for electricity from renewable resources, another two segments ascribed more importance to *Monthly electricity costs* and *Malus*, basing their choices mainly on a preference for lower monthly costs and lower levels of (or no) Malus. In line with these tariff preferences, the former two segments endorsed biospheric values and displayed high levels of environmental emotions, and reported greater savings intentions driven by environmental motives. The latter two segments mainly endorsed egoistic values, displayed lower levels of environmental emotions, and reported that mainly financial motives drive their (comparatively low) savings intentions. With respect to environmental values, all segments showed moderate endorsement of hedonic values and did not differ significantly from another. Hedonic values could not explain the segments beyond altruistic, biospheric, and egoistic values. With respects to consumers' saving intentions and motives, the results indicate that saving intentions are a prerequisite for the adoption of incentive-based electricity tariffs. If consumers have little or no intention to save electricity in their households, they are less likely to adopt tariffs designed to motivate electricity savings (see Segments 3 and 4). Among the segments primarily reporting financial motives for their saving intentions (i.e., Segments 3 and 4), the acceptance of incentive-based tariffs was significantly lower than in the other two segments that reported environmental motives to drive their saving intentions. It would be worthwhile to investigate whether a financial framing (i.e., the financial benefit from opting for incentive-based tariffs) could increase the acceptance of incentive-based tariffs in segments that are more concerned with financial saving motives.

Measures from behavioural economics, including loss aversion, risk aversion, and optimism bias, allowed explaining additional differences between the segments. Two segments, the *Loss-averse Environmentalists* and the *Loss-averse Bargainers*, displayed high levels of loss and risk aversion. In line with this observation, the *Loss-averse Environmentalists* also attributed significantly greater importance to the tariff attributes *Monthly costs* and *Malus* than the *Pure Environmentalists*, and the *Loss-averse Bargainers* attributed greater importance to the attributes *Monthly costs* and *Malus* than other segments. Interestingly, the *Loss-averse Environmentalists* were significantly more optimistic about their ability to save electricity than the *Loss-averse Bargainers*.

Despite differences in methodological approaches and segmentation criteria that were used in other studies, some areas of overlap can be identified with regards to the segments identified and described here and in previous work. A previous study using a clustering approach showed that consumers prioritising electricity from renewable resources were also most concerned about the environment (Tabi et al., 2014). Other segmentation and profiling studies demonstrated that different segments of consumers could be identified and described based on their endorsement of environmental values and concerns, their efficacy beliefs, their political orientation, their financial considerations, as well as their energy saving intentions and motives (e.g., Gilg et al., 2005; Roberts, 1995; Sütterlin, et al., 2011).

The additional inclusion of measures from behavioural economics in the present study was critical for gaining a better understanding of the differences between the consumer segments, facilitating a fine-grained understanding of consumers' choices. These differences would have otherwise remained unexplained. Particularly loss aversion and optimism bias, and to some extent risk aversion, explained consumers' acceptance of reward and penalty components. The more loss- and risk-averse, the less likely consumers were to accept incentive-based tariffs, particularly those penalising increases in electricity consumption. Previous research has acknowledged that perceived losses and risks associated with changing behaviour (e.g., purchasing energy-efficient appliances) might outweigh the perceived benefits resulting from this behaviour change (e.g., energy savings; Bull, 2012). Likewise, the financial losses and risks associated with tariffs applying rewards and penalties for decreases and increases in electricity consumption, respectively, could outweigh consumers' perceived benefits from subscribing to these tariffs (e.g., financial savings and electricity conservation). Similar to the findings from the present study, Nicolson and colleagues (2017) also found that loss-averse consumers were less likely to switch to demand-response tariffs that use variable kWh prices to incentivise shifts or reductions in electricity consumption. Findings from the present study, however, also suggest that comparatively more optimistic beliefs about one's own ability to save electricity enhances consumers' acceptance of incentive-based tariffs, even among consumer segments that show high levels of loss aversion (see Segment 2).

Utilities and marketers can use these insights to more effectively target consumer segments and tailor and advertise the electricity tariffs accordingly. One promising strategy that can be derived from the results of this study is to offer Malus components in combination with Bonus components, because combined Bonus-Malus tariffs reached more acceptance than tariffs applying only Malus components. In the present choice experiment, about 25% of the consumers (i.e., Segment 1) showed acceptance of rewards and penalties embedded in electricity tariffs. Another 50% (i.e., Segments 2 and 3) might be reached when marketing the tariffs according to the segments' concerns and needs (e.g., reduce uncertainty and perceptions of loss, induce optimism about energy saving abilities; see also Frederiks et al., 2015). Based on the tariff attractiveness ratings, only the *Loss-averse Bargainers* (i.e., Segment 4) rejected the combined Bonus-Malus tariff. These results together are an important first indication of the potential market size that can be reached by such combined Bonus-Malus tariffs, since prior research primarily focused on examining the effectiveness of such incentives in promoting household energy savings (e.g., Ito et al. 2018, Prasanna et al., 2018; Winett et al., 1978), rather than evaluating the consumer acceptance of such tariffs.

6. Practical relevance and policy implications

The empirical findings from this study suggest a substantial market potential for incentive-based electricity tariffs, particularly for tariffs combining rewards and penalties to promote electricity savings in households. While previous research suggests that incentive-based tariffs, in particular those applying penalties for overconsumption, are effective in promoting energy savings in households (Prasanna et al., 2018; Winett et al., 1978), a successful implementation of such tariffs in countries where consumers freely choose their tariffs relies on the compliance of consumers. Hence, understanding consumer preferences with respect to these tariffs is a crucial step towards successful implementation of incentive-based tariffs.

Based on the findings from this study valuable marketing strategies can be developed that may more effectively promote electricity conservation in households through incentive-based tariff designs by targeting consumers' psychographic characteristics (see also Egmond et al., 2006; Swim, Geiger, & Zawadzki, 2014). Incentive-based electricity tariffs seem to not only be of interest to environmentally aware and concerned consumers, but also to consumers with little or no environmental concern. Such tariff designs promoting energy efficiency and conservation offer an alternative to conventional "green" tariff designs that are often not adopted by consumers with little or no environmental concern (e.g., Diaz-Rainey & Ashton, 2011; Litvine & Wüstenhagen, 2011; MacPherson & Lange, 2013). Based on the cluster analysis reported here, two consumer segments ascribed greater importance environmental aspects when making tariff choices (i.e., electricity from renewable resources) and revealed greater concern for the environment, reporting stronger environmental values, emotions, and saving intentions (*Pure Environmentalists* and *Loss-averse Environmentalists*). To increase acceptance of penalising electricity tariffs in these consumer segments, it may be more effective to use environmental frames and appeals that match the segment's biospheric and altruistic values and environmental emotions (see also Bolderdijk, Gorsira, Keizer, & Steg, 2013; Nilsson, Hansla, Heiling, Bergstad, & Martinsson, 2016). Emphasising the benefits from reduced household consumption to nature may be a stronger motivator for consumers in these segments to voluntarily subscribe to penalising tariffs that could more effectively motivate reductions in consumption (e.g., "Save the environment by reducing your household consumption").

Consumers in segments that ascribed greater importance to monetary aspects when making tariff choices (i.e., monthly electricity costs and incentive components) and showed less concern for the environment, reporting lower saving intentions and environmental saving motives, and stronger egoistic values (*Bargainers* and *Loss-averse Bargainers*), are likely to be more responsive to financial frames and appeals. In these segments, it may be more effective to emphasise the personal and financial benefits, such as lower electricity bills and household savings (e.g., "Save up to CHF 90 on your next electricity bill"; see also De Dominicis, Schultz, & Bonaiuto, 2017).

Using empirical insights, other marketing strategies could be developed that leverage consumers' biases. Behavioural economics offers an exhaustive toolbox of strategies, so-called nudges, for this purpose, which are small changes in the choice architecture that steer people's choices towards desired outcomes without forcing or forbidding options (Thaler &

Sunstein, 2008). One major aim could be to develop strategies that help consumers to overcome loss aversion in the moment of tariff choice, which may hinder them to subscribe to incentive-based electricity tariffs, particularly those applying financial penalties. Such loss aversion-reducing strategies could include framing that emphasises the environmental and personal gains from subscribing to incentive-based tariffs (e.g., financial savings or positive environmental impact resulting from reduced consumption; De Dominicis et al., 2017). Another strategy is to pre-select tariffs as default option. Default options have been shown to significantly increase consumer choices of renewable electricity tariffs (e.g., Pichert & Katsikopoulos, 2008). The same mechanisms could be applied to nudge consumers towards incentive-based electricity tariffs. Other research suggests that loss-framed, rather than gain-framed, provision of information is more effective in reducing household electricity consumption (Bager & Mundaca, 2017). This is particularly the case when additional low-level construal information is provided, such as suggestions on how to decrease household consumption (White, MacDonnell, & Dahl, 2011). Hence, using loss-framed marketing messages emphasising consumers' potentially forfeited future savings by not subscribing to incentive-based electricity tariffs could leverage consumers' loss aversion and promote acceptance of such tariffs. This framing could be more effective when providing consumers with additional information on how to save electricity at home or by framing information in ways that leverage consumers' optimism about their ability to save electricity.

Given the potential involvement of risk aversion in tariff choices, risk-reducing strategies could also be implemented, for instance, by framing incentives in absolute (e.g., CHF 20 Malus on top of the next bill), rather than relative terms (e.g., 20% Malus on top of the next bill; see also Baron, 1997; Gigerenzer & Edwards, 2003). Such simplified incentive designs, could enhance consumers' understanding of the incentive conditions by allowing them to anticipate the exact amount of the penalty, which may reduce consumers' risk perceptions under demand uncertainties. Based on these recommendations, future research avenues could examine the effects of differently framed appeals (e.g., environmental versus financial; gains versus losses) on different consumer segments. Further interventions and nudges could also be designed and tested that can make penalising electricity tariffs more appealing to consumers and thereby increase acceptance of such tariffs.

7. Limitations

Despite the novelty of the research and its contribution to the understanding of consumer preferences with respect to electricity tariffs that apply incentives, a number of limitations need to be addressed. First of all, the present choice experiment is based on stated preferences, rather than actual choices, which is why the magnitude of the effect should be interpreted with caution. The implicit preferences revealed in this rather hypothetical choice scenario might not directly translate into actual choices in the real world. Future studies could investigate consumer preferences for incentive-based electricity tariffs in more realistic (one-shot) choice scenarios.

Second, the generalisability from this segmentation analysis to other environmentally-relevant behaviours is limited, as the present study focused on clustering consumers based only on their preferences for electricity tariffs differing with respect to environmental (e.g., *Electricity mix*) and financial (e.g., *Monthly costs*, *Malus*) tariff attributes. While this study investigated psychological mechanisms that further explain consumers' stated tariff preferences, it fell short on addressing, for instance, behavioural variables specifically related to household electricity consumption. Most consumer research focusing on sustainability covers a variety of contexts (e.g., household, transportation, waste management, support of environmental goals, etc.; Dietz, Stern, & Guagnano, 1998; Gardner & Stern, 2002; Stern,

1999) and encompasses a wide range of labels to describe sustainable decisions and behaviours (e.g., green, pro-environmental, sustainable, ecological, etc.; Jackson, 2005; Wells, Ponting, & Peattie, 2011). This variety in contexts and labels makes it difficult to generalize findings from one specific context (e.g., electricity tariff choices) to other contexts (e.g., waste management). In fact, research demonstrates that there are inconsistencies in environmental decisions and behaviours according to the context in which they are undertaken (Barr, Gilg, Shaw, 2011). The same inconsistencies may occur when trying to translate the present findings to other contexts in which sustainable decisions and actions are undertaken. Nonetheless, the segments identified and described in the present study show considerable overlap and similarity with segments identified in other research (e.g., Gilg et al., 2005; Tabi et al., 2014).

A third shortcoming concerns the conditions under which the rewards and penalties embedded in the tariff applied. The present incentive design could potentially discriminate against households that have already reduced their consumption to the possible minimum or against low-income households who may be disadvantaged by living in less energy-efficient houses thereby already being affected by higher energy costs. One way to alleviate this shortcoming is by designing incentives that rely on estimations of average electricity consumption as reference, rather than using previous consumption levels as reference, as was the case in the present incentive design.

A fourth methodological shortcoming concerns the psychographic variables assessed in this study. While these variables allowed to clearly delineate the identified consumer segments and to further describe consumers' electricity tariff preferences, some variables were more difficult to interpret. For example, although tested in previous studies (Maestes & Pollock, 2010), the risk aversion measure consisted of only one item, which generally leaves concerns surrounding internal consistency, reliability, and validity. Furthermore, consumers seem to have difficulties completing the loss aversion task in this study. Exclusion criteria disregarded respondents with extreme choice behaviour by never switching in either of the three gamble domains (i.e. gain, loss, and mixed gamble domain). By this means, the loss aversion parameter was estimated for only 620 respondents (58.4% of the sample). In previous studies, the task was administered in the laboratory and instructions were read to participants, ensuring that they followed the task's instructions (see Imas et al., 2017). Given the low number of respondents who performed the task with only one switching point, the task and instructions may pose a challenge to participants when employed online. Hence, it is possible that the loss aversion task does not mirror actual levels of loss aversion in the segments. For example, the fourth segment, the *Loss-averse Bargainers*, ascribed most importance to the tariff attribute Malus (29.2%), which was about twice as high as the score for the attribute Bonus in this segment (16.6%). However, according to the loss aversion task, the second segment, the *Loss-averse Environmentalists*, was the only segment with significantly higher levels of loss aversion than all other segments. Based on the stated preferences, however, one would assume higher levels of loss aversion in the fourth segment. As the constructs from behavioural economics were, nevertheless, crucial to the description of the consumer segments, further research is needed to better understand the role of loss aversion and other biases in predicting and explaining incentive-based tariff choices.

A last methodological limitation pertaining to conjoint analyses overall is possible fatigue among conjoint respondents (Green & Srinivasan, 1990). Some authors, however, argue that these effects may not be as severe as widely believed (e.g., Pullman, Dodson, & Moore, 1999). Further research evaluating specifically with the amount of choice tasks that can be asked in conjoint analyses suggests that respondents can reliably answer up to at least 20 choice tasks (Johnson & Orme, 1996). We countered fatigue in this study by limiting the number of choice tasks per participant to 12 choice tasks per participant. Future research using conjoint analyses should be aware of the potential of overburdening respondents with high numbers of levels, attributes, and tasks in the conjoint design and consult recommended guidelines or pre-test conjoint designs.

8. Conclusions

The present research examined differences between consumer segments with respect to their preferences for different electricity tariff designs. A particular focus was laid on incentive components – rewards and penalties for decreases and increases in consumption, respectively – embedded in the tariff designs. In a Swiss-representative choice experiment, consumers made a series of trade-off choices between electricity tariff attributes. The results from this study showed that different consumer segments prioritised different tariff attributes; where two segments (about 49.6% of this sample) attributed primary importance to electricity from renewable resources, another two segments (about 50.4% of this sample) attributed primary importance to low electricity costs and low penalty components. The identified segments could be further described using measures from psychology and behavioural economics. The findings suggest that incentive-based tariffs are not only of interest to environmentally-concerned consumers (e.g., Segment 1), but also to consumers with little environmental concern (e.g., Segment 3). The present study provides promising research and policy avenues for novel tariff designs that apply rewards and penalties to promote electricity savings in households. It further highlights the importance of considering individual differences between consumers, especially by complementing insights from psychology with behavioural economics. Using profiling and segmentation, tailored market strategies can be derived.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

Albadi, M. H., & El-Saadany, E. F. (2007, June). Demand response in electricity markets: An overview. In *IEEE Power Engineering Society General Meeting, 2007,* 1-5.

Allcott, H., & Mullainathan, S. (2010). Behavior and energy policy. *Science*, *327*(5970), 1204-1205.

Andreoni, J., & Sprenger, C. (2012). Risk preferences are not time preferences. *American Economic Review*, *102*(7), 3357-33576.

Antonetti, P., & Maklan, S. (2014). Feelings that make a difference: How guilt and pride convince consumers of the effectiveness of sustainable consumption choices. *Journal of Business Ethics*, *124*(1), 117-134.

Attari, S. Z., DeKay, M. L., Davidson, C. I., & De Bruin, W. B. (2010). Public perceptions of energy consumption and savings. *Proceedings of the National Academy of sciences*, *107*(37), 16054-16059.

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Bager, S., & Mundaca, L. (2017). Making ‘Smart Meters’ smarter? Insights from a behavioural economics pilot field experiment in Copenhagen, Denmark. *Energy Research & Social Science*, *28*, 68-76.

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour.

Journal of environmental psychology, *27*(1), 14-25.

Baron, J. (1997). Confusion of relative and absolute risk in valuation. *Journal of Risk and Uncertainty*, *14*(3), 301-309.

Barr, S., Gilg, A., & Shaw, G. (2011). 'Helping people make better choices': exploring the behaviour change agenda for environmental sustainability. *Applied Geography*, *31*(2), 712-720.

Bertoldi, P., Rezessy, S., & Oikonomou, V. (2013). Rewarding energy savings rather than energy efficiency: Exploring the concept of a feed-in tariff for energy savings. *Energy Policy*, *56*, 526-535.

Bolderdijk, J. W., Gorsira, M., Keizer, K., & Steg, L. (2013). Values determine the (in) effectiveness of informational interventions in promoting pro-environmental behavior. *PLoS One*, *8*(12), e83911.

Bor, Y. J., Chien, Y. L., & Hsu, E. (2004). The market-incentive recycling system for waste packaging containers in Taiwan. *Environmental Science & Policy*, *7*(6), 509-523.

Borenstein, S., 2009. To What Electricity Price do Consumers Respond? Residential Demand Elasticity Under Increasing-block Pricing. *University of California, Berkeley, US*.

Bradley, P., Coke, A., & Leach, M. (2016). Financial incentive approaches for reducing peak electricity demand, experience from pilot trials with a UK energy provider. *Energy Policy*, *98*, 108-120.

Brekke, K. A., & Johansson-Stenman, O. (2008). The behavioural economics of climate change. *Oxford Review of Economic Policy*, *24*(2), 280-297.

Bull, J. (2012). Loads of green washing—can behavioural economics increase willingness-to-pay for efficient washing machines in the UK?. *Energy policy*, *50*, 242-252.

Burkhalter, A., Kaenzig, J., & Wüstenhagen, R. (2009). Kundenpräferenzen für leistungsrelevante Attribute von Stromprodukten. *Zeitschrift für Energiewirtschaft*, *33*(2), 161-172.

Camerer, C., Loewenstein, G., & Rabin, M. (2004). *Advances in behavioral economics.* New York; Princeton: Russell Sage Foundation.

Carmi, N., Arnon, S., & Orion, N. (2015). Transforming environmental knowledge into behavior: The mediating role of environmental emotions. *The Journal of Environmental Education*, *46*(3), 183-201.

Cheung, F., & Lucas, R. E. (2014). Assessing the validity of single-item life satisfaction measures: Results from three large samples. *Quality of Life Research*, *23*(10), 2809–2818.

Coad, A., De Haan, P., & Woersdorfer, J. S. (2009). Consumer support for environmental policies: An application to purchases of green cars. *Ecological Economics*, *68*(7), 2078-2086.

De Dominicis, S., Schultz, P., & Bonaiuto, M. (2017). Protecting the Environment for Self-interested Reasons: Altruism Is Not the Only Pathway to Sustainability. *Frontiers in psychology*, *8*, 1065.

De Groot, J. I., & Steg, L. (2007). Value orientations and environmental beliefs in five countries: Validity of an instrument to measure egoistic, altruistic and biospheric value orientations. *Journal of Cross-Cultural Psychology*, *38*(3), 318-332.

de la Rue du Can, S., Leventis, G., Phadke, A., & Gopal, A. (2014). Design of incentive programs for accelerating penetration of energy-efficient appliances. *Energy Policy*, *72*, 56-66.

De Quidt, J. (2017). Your loss is my gain: a recruitment experiment with framed incentives. *Journal of the European Economic Association, 16*(2), 522-559.

DeSarbo, W. S., Ramaswamy, V., & Cohen, S. H. (1995). Market segmentation with choice-based conjoint analysis. *Marketing Letters*, *6*(2), 137-147.

Diamantopoulos, A., Schlegelmilch, B. B., Sinkovics, R. R., & Bohlen, G. M. (2003). Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. *Journal of Business research*, *56*(6), 465-480.

Diaz-Rainey, I., & Ashton, J. K. (2011). Profiling potential green electricity tariff adopters: green consumerism as an environmental policy tool?. *Business Strategy and the Environment*, *20*(7), 456-470.

Dietz, T., Fitzgerald, A., & Shwom, R. (2005). Environmental values. *Annual Review of Environment and Resources*, *30*, 335-372.

Dietz, T., Stern, P. C., & Guagnano, G. A. (1998). Social structural and social psychological bases of environmental concern. *Environment and behavior*, *30*(4), 450-471.

EED Directive (2012). Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32. *Official Journal, L*, *315*, 1-56.

Egmond, C., Jonkers, R., & Kok, G. (2006). One size fits all? Policy instruments should fit the segments of target groups. *Energy Policy*, *34*(18), 3464-3474.

Ek, K., & Söderholm, P. (2008). Norms and economic motivation in the Swedish green electricity market. *Ecological Economics*, *68*(1-2), 169-182.

EPA (2018). *Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2016*. Report no. EPA 430-P-18-001. Washington, DC: US Environmental Protection Agency.

Eurostat (2017). Energy consumption in households. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households [Last accessed 28 December 2019].

Faiers, A., Cook, M., & Neame, C. (2007). Towards a contemporary approach for understanding consumer behaviour in the context of domestic energy use. *Energy Policy*, *35*(8), 4381-4390.

Feather, N. T. (1995). Values, valences, and choice: The influences of values on the perceived attractiveness and choice of alternatives. *Journal of personality and social psychology*, *68*(6), 1135-1151.

Frederiks, E. R., Stenner, K., & Hobman, E. V. (2015). Household energy use: Applying behavioural economics to understand consumer decision-making and behaviour. *Renewable and Sustainable Energy Reviews, 41*, 1385-1394.

Frey, B. S., & Oberholzer-Gee, F. (1997). The cost of price incentives: An empirical analysis of motivation crowding-out. *The American Economic Review*, *87*(4), 746-755.

Fryer Jr, R. G., Levitt, S. D., List, J., & Sadoff, S. (2012). *Enhancing the efficacy of teacher incentives through loss aversion: A field experiment* (No. w18237). National Bureau of Economic Research.

Gardner, G., & Stern, P. (1996). *Environmental Problems and Human Behavior.* Needham Heights: Allyn and Bacon.

Gellings, C. W. (2017). Evolving practice of demand-side management. *Journal of Modern Power Systems and Clean Energy*, *5*(1), 1-9.

Gerpott, T. J., & Mahmudova, I. (2010). Determinants of price mark-up tolerance for green electricity–lessons for environmental marketing strategies from a study of residential electricity customers in Germany. *Business strategy and the environment*, *19*(5), 304-318.

Gifford, R. (2011). The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, *66*(4), 290.

Gigerenzer, G., & Edwards, A. (2003). Simple tools for understanding risks: from innumeracy to insight. *BMJ: British Medical Journal*, *327*(7417), 741-744.

Gilg, A., Barr, S., & Ford, N. (2005). Green consumption or sustainable lifestyles? Identifying the sustainable consumer. *Futures*, *37*(6), 481-504.

Gillingham, K., Newell, R. G., & Palmer, K. (2009). Energy efficiency economics and policy. *Annu. Rev. Resour. Econ., 1*(1), 597-620.

Green, P. E., & Srinivasan, V. (1990). Conjoint analysis in marketing: new developments with implications for research and practice. *Journal of marketing*, *54*(4), 3-19.

Gromet, D. M., Kunreuther, H., & Larrick, R. P. (2013). Political ideology affects energy-efficiency attitudes and choices. *Proceedings of the National Academy of Sciences*, *110*(23), 9314-9319.

Hahnel, U. J., & Brosch, T. (2018). Environmental trait affect. *Journal of Environmental Psychology, 59*, 94-106.

Harris, P., Middleton, W., & Joiner, R. (2000). The typical student as an in-group member: eliminating optimistic bias by reducing social distance. *European Journal of Social Psychology*, *30*(2), 235-253.

Helweg-Larsen, M., & Shepperd, J. A. (2001). Do moderators of the optimistic bias affect personal or target risk estimates? A review of the literature. *Personality and Social Psychology Review*, *5*(1), 74-95.

Huber, J., & Train, K. (2001). On the similarity of classical and Bayesian estimates of individual mean partworths. *Marketing Letters*, *12*(3), 259-269.

Imas, A., Sadoff, S., & Samek, A. (2017). Do People Anticipate Loss Aversion?. *Management Science, 63*(5), 1271-1284.

IPCC, 2014. Climate Change 2014: Synthesis Report. *Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 1-151.

Ito, K., Ida, T., & Tanaka, M. (2018). Moral suasion and economic incentives: Field experimental evidence from energy demand. *American Economic Journal: Economic Policy*, *10*(1), 240-267.

Jackson, T. (2005). *Motivating sustainable consumption: A review of evidence on consumer behaviour and behavioural change.* London: Sustainable Development Research Network.

Johnson, R. M., & Orme, B. K. (1996). *How Many Questions Should You Ask In Choice-Based Conjoint Studies?*. Sequim, WA: Sawtooth Software.

Kaenzig, J., Heinzle, S. L., & Wüstenhagen, R. (2013). Whatever the customer wants, the customer gets? Exploring the gap between consumer preferences and default electricity products in Germany. *Energy Policy*, *53*, 311-322.

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision Under Risk, *Econometrica, 47*, 263-291.

Kaiser, F. G., Hübner, G., & Bogner, F. X. (2005). Contrasting the theory of planned behavior with the value-belief-norm model in explaining conservation behavior. *Journal of applied social psychology*, *35*(10), 2150-2170.

Kals, E., Schumacher, D., & Montada, L. (1999). Emotional affinity toward nature as a motivational basis to protect nature. *Environment and behavior*, *31*(2), 178-202.

Kim, J. H., & Shcherbakova, A. (2011). Common failures of demand response. *Energy*, *36*(2), 873-880.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior?. *Environmental education research*, *8*(3), 239-260.

Litvine, D., & Wüstenhagen, R. (2011). Helping" light green" consumers walk the talk: Results of a behavioural intervention survey in the Swiss electricity market. *Ecological*

Economics, *70*(3), 462-474.

Lopes, M. A. R., Antunes, C. H., & Martins, N. (2012). Energy behaviours as promoters of energy efficiency: A 21st century review. *Renewable and Sustainable Energy Reviews*, *16*(6), 4095-4104.

Luft, J. (1994). Bonus and penalty incentives contract choice by employees. *Journal of Accounting and Economics*, *18*(2), 181-206.

MacPherson, R., & Lange, I. (2013). Determinants of green electricity tariff uptake in the UK. *Energy Policy*, *62*, 920-933.

Maestas, C. D., & Pollock, W. M. (2010). Measuring generalized risk orientation with a single survey item.

Mahmoodi, J., Prasanna, A., Hille, S., Patel, M. K., & Brosch, T. (2018). Combining “carrot and stick” to incentivize sustainability in households. *Energy Policy, 123*, 31-40.

McKenzie-Mohr, D. (2000). Fostering sustainable behavior through community-based social marketing. *American Psychologist*, *55*(5), 531-537.

Nicolson, M., Huebner, G., & Shipworth, D. (2017). Are consumers willing to switch to smart time of use electricity tariffs? The importance of loss-aversion and electric vehicle ownership. *Energy Research & Social Science*, *23*, 82-96.

Nilsson, A., Hansla, A., Heiling, J. M., Bergstad, C. J., & Martinsson, J. (2016). Public acceptability towards environmental policy measures: value-matching appeals. *Environmental Science & Policy*, *61*, 176-184.

Orme, B. K. (2010). Getting started with conjoint analysis: strategies for product design and price research (Second Edition). Research Publishers.

Pelletier, L. G., Tuson, K. M., Green-Demers, I., Noels, K., & Beaton, A. M. (1998). Why are you doing things for the environment? The motivation toward the environment scale (MTES). *Journal of applied social psychology*, *28*(5), 437-468.

Pichert, D., & Katsikopoulos, K. V. (2008). Green defaults: Information presentation and pro-environmental behaviour. *Journal of Environmental Psychology*, *28*(1), 63-73.

Pullman, M. E., Dodson, K. J., & Moore, W. L. (1999). A comparison of conjoint methods when there are many attributes. *Marketing Letters*, *10*(2), 125-138.

Prasanna, A., Mahmoodi, J., Brosch, T., & Patel, M. K. (2018). Recent experiences with tariffs for saving electricity in households. *Energy Policy*, *115*, 514-522.

Roberts, J. A. (1995). Profiling levels of socially responsible consumer behavior: a cluster analytic approach and its implications for marketing. *Journal of marketing Theory and practice*, *3*(4), 97-117.

Rokeach, M. (1973). *The nature of human values.* New York, NY: The Free Press.

Rosenow, J., Forster, D., Kampman, B., Leguijt, C., Pato, Z., Kaar, A. L., & Eyre, N. (2015). Study evaluating the national policy measures and methodologies to implement Article 7 of the Energy Efficiency Directive. Study for the European Commission, 1-106.

Rossi, P. E., & Allenby, G. M. (2003). Bayesian statistics and marketing. *Marketing Science*, *22*(3), 304-328.

Schiffman, L., Kanuk, L. and Hansen, H. (2012). *Consumer behaviour*. Harlow, UK: Pearson Financial Times/Prentice Hall.

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In *Advances in experimental social psychology, 25*, 1-65. Academic Press.

Shogren, J. (2012). Behavioural Economics and Environmental Incentives. *OECD Environment Working Papers, No. 49*, OECD Publishing, Paris. http://dx.doi.org/10.1787/5k8zwbhqs1xn-en

Shogren, J. F., Parkhurst, G. M., & Banerjee, P. (2010). Two cheers and a qualm for behavioral environmental economics. *Environmental and Resource Economics*, *46*(2), 235-247.

Steg, L., De Groot, J. I., Dreijerink, L., Abrahamse, W., & Siero, F. (2011). General antecedents of personal norms, policy acceptability, and intentions: The role of values, worldviews, and environmental concern. *Society and Natural Resources*, *24*(4), 349-367.

Steg, L., Perlaviciute, G., Van der Werff, E., & Lurvink, J. (2014). The significance of hedonic values for environmentally relevant attitudes, preferences, and actions. *Environment and behavior*, *46*(2), 163-192.

Stern, P. C. (1999). Information, incentives, and proenvironmental consumer behavior. *Journal of consumer policy*, *22*(4), 461-478.

Stern, P. C., Aronson, E., Darley, J. M., Hill, D. H., Hirst, E., Kempton, W., & Wilbanks, T. J. (1986). The effectiveness of incentives for residential energy conservation. *Evaluation Review*, *10*(2), 147-176.

Stern, P. C., Kalof, L., Dietz, T., & Guagnano, G. A. (1995). Values, beliefs, and proenvironmental action: Attitude formation toward emergent attitude objects 1. *Journal of applied social psychology*, *25*(18), 1611-1636.

Straughan, R. D., & Roberts, J. A. (1999). Environmental segmentation alternatives: a look at green consumer behavior in the new millennium. *Journal of consumer marketing*, *16*(6), 558-575.

Sun, C., & Lin, B. (2013). Reforming residential electricity tariff in China: Block tariffs pricing approach. *Energy Policy*, *60*, 741-752.

Sütterlin, B., Brunner, T. A., & Siegrist, M. (2011). Who puts the most energy into energy conservation? A segmentation of energy consumers based on energy-related behavioural characteristics. Energy Policy, 39(12), 8137–8152.

Swim, J. K., Geiger, N., & Zawadzki, S. J. (2014). Psychology and energy-use reduction policies. *Policy Insights from the Behavioral and Brain Sciences*, *1*(1), 180-188.

Tabi, A., Hille, S. L., & Wüstenhagen, R. (2014). What makes people seal the green power deal?—Customer segmentation based on choice experiment in Germany. *Ecological Economics*, *107*, 206-215.

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness.* New Haven, CT: Yale University Press.

Timlett, R. E., & Williams, I. D. (2008). Public participation and recycling performance in England: A comparison of tools for behaviour change. *Resources, Conservation and Recycling*, *52*(4), 622-634.

Titmuss, R. M. (1970). *The gift relationship*. London, UK: Allen and Unwin.

Tom, S. M., Fox, C. R., Trepel, C., & Poldrack, R. (2007). The neural basis of loss aversion in decision-making under risk. *Science, 315*, 515–518.

Trope, Y., & Fishbach, A. (2000). Counteractive self-control in overcoming temptation. *Journal of personality and social psychology, 79*(4), 493-506.

UNFCCC (2015). *Adoption of the Paris Agreement. Report No. FCCC/CP/2015/L.9/Rev.1*. Retrieved from http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf (Last accessed 28 December 2019)

Van Leeuwen, F., & Park, J. H. (2009). Perceptions of social dangers, moral foundations, and political orientation. *Personality and Individual Differences*, *47*(3), 169-173.

Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of personality and social psychology*, *39*(5), 806-820.

Wells, V. K., Ponting, C. A., & Peattie, K. (2011). Behaviour and climate change: Consumer perceptions of responsibility. *Journal of Marketing Management*, *27*, 808-833.

White, K., MacDonnell, R., & Dahl, D. W. (2011). It's the mind-set that matters: The role of construal level and message framing in influencing consumer efficacy and conservation behaviors. *Journal of Marketing Research*, *48*(3), 472-485.

Winett, R. A., Kagel, J. H., Battalio, R. C., & Winkler, R. C. (1978). Effects of monetary rebates, feedback, and information on residential electricity conservation. *Journal of Applied Psychology*, *63*(1), 73-80.

Zarnikau, J. (2003). Consumer demand for ‘green power’ and energy efficiency. *Energy Policy*, *31*(15), 1661-1672.

Appendix A

Table 6. Significance testing and post-hoc multiple comparison testing for socio-demographic and psychographic characteristics between the four consumer segments.

	Test statistics	Cluster 1-Cluster 2	Cluster 1-Cluster 3	Cluster 1-Cluster 4	Cluster 2-Cluster 3	Cluster 2-Cluster 4	Cluster 3-Cluster 4
Bonus	$H(3) = 114.68$, $p < .001$, $\varepsilon^2 = 0.11$	*U* = 28483***	*U* = 22516***	*U* = 16197***	*U* = 54882***	*U* = 21558***	*U* = 35700
Malus	$H(3) = 415.25$, $p < .001$, $\varepsilon^2 = 0.39$	*U* = 14183***	*U* = 16504***	*U* = 2015***	*U* = 43715	*U* = 10343***	*U* = 14909***
Electricity Mix	$H(3) = 728.42$, $p < .001$, $\varepsilon^2 = 0.69$	*U* = 57650***	*U* = 79570***	*U* = 56652***	*U* = 9965***	*U* = 57452***	*U* = 44753***
Location of generation	$H(3) = 14.632$, $p = .002$, $\varepsilon^2 = 0.01$	*U* = 39371**	*U* = 39067	*U* = 31544**	*U* = 48964**	*U* = 29203	*U* = 38941**
Monthly costs	$H(3) = 168.71$, $p < .001$, $\varepsilon^2 = 0.16$	*U* = 24146***	*U* = 18650***	*U* = 14661***	*U* = 58232***	*U* = 22157***	*U* = 39318**
Socio-demographics							
Mean age (years)	$F(3, 1058) = 24.54$, $p < .001$, $\eta^2 = 0.07$	*U* = 45959***	*U* = 43428	*U* = 37458***	*U* = 53308***	*U* = 29197	*U* = 43426***
Gender	$\chi 2(3, N = 1059) = 12.571$, $p = .006$, $\varphi_c = 0.11$	$\chi 2(1) = 4.003$**	$\chi 2(1) = 1.076$	$\chi 2(1) = 0.507$	$\chi 2(1) = 10.447$**	$\chi 2(1) = 7.404$**	$\chi 2(1) = 0.021$
Civil status	$\chi 2(12, N = 1062) = 35.481$, $p < .001$, $\varphi_c = 0.11$						
Single		$\chi 2(1) = 5.7226$**	$\chi 2(1) = 0.4496$	$\chi 2(1) = 9.2494$**	$\chi 2(1) = 10.96$***	$\chi 2(1) = 0.4624$	$\chi 2(1) = 15.576$***
Married or in partnership		$\chi 2(1) = 0.7868$	$\chi 2(1) = 1.729$	$\chi 2(1) = 1.7071$	$\chi 2(1) = 5.5422$**	$\chi 2(1) = 0.1494$	$\chi 2(1) = 7.3571$**
Divorced/Separated		$\chi 2(1) = 3.4466$	$\chi 2(1) = 0.2965$	$\chi 2(1) = 3.5139$	$\chi 2(1) = 1.6551$	$\chi 2(1) = 0.0000$	$\chi 2(1) = 1.7982$
Widowed		$\chi 2(1) = 0.5413$	$\chi 2(1) = 0.9557$	$\chi 2(1) = 1.7301$	$\chi 2(1) = 0.0000$	$\chi 2(1) = 0.0914$	$\chi 2(1) = 0.0218$
Political orientation	$F(3, 985 = 21.81$, $p < .001$, $\eta^2 = 0.06$	0.226	0.672***	0.934***	-0.446**	0.708***	0.262
Other/None		$\chi 2(1) = 0.3546$	$\chi 2(1) = 0.0826$	$\chi 2(1) = 1.8907$	$\chi 2(1) = 0.0318$	$\chi 2(1) = 0.4299$	$\chi 2(1) = 1.0391$
Psychographic characteristics							
Saving intentions	$\chi 2(3, N = 1062) = 19.886$, $p < .001$, $\varphi_c = 0.14$	$\chi 2(1) = 10.244$	$\chi 2(1) = 2.991$	$\chi 2(1) = 14.548$***	$\chi 2(1) = 1.1961$	$\chi 2(1) = 10.67$**	$\chi 2(1) = 5.077$**
Financial motives	$\chi 2(3, N = 947) = 80.295$, $p < .001$, $\varphi_c = 0.29$	$\chi 2(1) = 0.000$	$\chi 2(1) = 17.178$***	$\chi 2(1) = 31.082$***	$\chi 2(1) = 17.085$***	$\chi 2(1) = 31.098$***	$\chi 2(1) = 3.238$
Environmental motives		$\chi 2(1) = 0.192$	$\chi 2(1) = 26.557$***	$\chi 2(1) = 71.318$***	$\chi 2(1) = 21.862$***	$\chi 2(1) = 64.773$***	$\chi 2(1) = 15.885$***
Values							
Egoistic	$F(3, 1058) = 9.815$, $p < .001$, $\eta^2 = 0.03$	0.011	0.522***	0.389**	-0.511***	0.378**	-0.134
Altruism	$F(3, 1058) = 17.24$, $p < .001$, $\eta^2 = 0.05$	-0.270	-0.489***	-0.776***	0.219	-0.506***	-0.287**
Biospheric	$F(3, 1058) = 28.82$, $p < .001$, $\eta^2 = 0.08$	-0.458***	-0.599***	-1.134***	0.142	-0.677***	-0.535***
Hedonic	$F(3, 1058) = 0.812$, $p = .487$, $\eta^2 = 0.00$	0.1397	0.001	0.1450	0.1387	0.0053	0.1441
Environmental emotions							
Positive outcome	$F(3, 1058) = 29.39$, $p < .001$, $\eta^2 = 0.08$	-0.301**	-0.514***	-0.894**	0.213	-0.593***	-0.380***
Negative outcome	$F(3, 1058) = 14.94$, $p < .001$, $\eta^2 = 0.04$	-0.290	-0.428***	-0.815***	0.139	0.525***	-0.387**
Obstruction	$F(3, 1058) = 13.92$, $p < .001$, $\eta^2 = 0.04$	-0.149	-0.525***	-0.653***	0.376**	-0.503***	-0.128
Coercion	$F(3, 1058) = 18.28$, $p < .001$, $\eta^2 = 0.05$	0.270	0.582***	0.835***	-0.313**	0.566***	0.253
Baseline	$F(3, 1058) = 24.58$, $p < .001$, $\eta^2 = 0.07$	-0.299**	-0.344**	-0.767***	0.045	-0.469***	-0.423***
Loss aversion (λ)	$H(3) = 11.31$, $p = .010$, $\varepsilon^2 = 0.02$	-2.977**	-0.552	-1.938	-2.492**	0.875	-1.453
General risk aversion	$F(3, 1058) = 5.14$, $p = .002$, $\eta^2 = 0.01$	0.300	0.104	0.461**	0.195	0.162	0.357**
Comparative optimism bias	$F(3, 1058) = 3.246$, $p = .021$, $\eta^2 = 0.01$	-0.018	-0.237	-0.377**	0.220	-0.359	-0.140
Tariff attractiveness							
Bonus-Malus attractiveness	$F(3, 304) = 17.38$, $p < .001$, $\eta^2 = 0.17$	-0.712**	-0.300	-1.849***	-0.412	-1.137***	-1.549***

Note. Where no test statistic is reported, post-hoc Tukey HSD following ANOVA, and post-hoc Dunn tests following Kruskal-Wallis were computed. Mean differences are reported and corresponding significant p-values are indicated by asterisks.
*** p-level < .001; ** p-level < .05

Table 1.

Table 1. Electricity tariff attributes and corresponding levels used in the choice experiment.

Attributes	Levels				
Bonus	No Bonus	5% Bonus	10% Bonus	15% Bonus	20% Bonus
Malus	No Malus	5% Malus	10% Malus	15% Malus	20% Malus
Electricity mix	Mix 1: 55% Nuclear 45% Fossil	Mix 2: 60% Hydro 40% Nuclear	Mix 3: 60% Hydro 40% Fossil	Mix 4: 65% Hydro 35% Solar	Mix 5: 100% Solar
Location generation	Unknown	Europe	Switzerland	Local canton	
Monthly costs	CHF 55	CHF 65	CHF 75	CHF 85	

Table 2.

Table 2. Calculation example for reward conditions (10% Bonus) under and penalty conditions (10% Malus).

Tariff labels	Bonus conditions	Malus conditions
Calculation example:	Suppose last year's bill was CHF 900. This year, you reduced consumption by 10% and save CHF 90. Hence, this year's bill is only CHF 810. Additionally, you receive 10% off your CHF 810 bill amounting to CHF 81.	Suppose last year's bill was CHF 900. This year, you increased consumption by 10% and pay CHF 90 more. Hence, this year's bill is CHF 990. Additionally, you pay 10% on top of your CHF 990 bill amounting to CHF 99.

Table 3.

Table 3. Summary of replications.

Clusters	CAIC	BIC	Chi-Square
2	31982.16	31947.16	10917.07
3	30558.41	30505.41	12533.10
4	29929.70	29858.70	13354.07
5	29612.65	29523.65	13863.38

Table 4.

Table 4. HB estimation of average attribute importance scores (bold) and mean part-worth utilities (ZC diffs) for the four clusters (*N* = 1’062).

	Cluster 1 (*n* = 258)	Cluster 2 (*n* = 269)	Cluster 3 (*n* = 315)	Cluster 4 (*n* = 220)
Bonus	**11.66**	**13.37**	**17.44**	**16.57**
No Bonus	-30.84	-36.06	-43.08	-41.95
5% Bonus	-11.40	-10.17	-19.61	-13.74
10% Bonus	3.73	4.74	7.8	5.66
15% Bonus	14.97	15.53	20.22	16.31
20% Bonus	23.54	25.95	34.67	33.72
Malus	**8.4**	**15.81**	**17.32**	**29.23**
No Malus	5.89	37.78	33.83	80.01
5% Malus	7.50	16.81	21.27	28.23
10% Malus	5.93	0.39	2.16	-6.86
15% Malus	-4.53	-20.69	-22.90	-40.09
20% Malus	-14.80	-34.30	-34.36	-61.30
Electricity mix[a]	**55.29**	**42.34**	**24.39**	**18.6**
Mix 1 (55% N, 45% F)	-145.06	-111.90	-49.29	-30.31
Mix 2 (60% H, 40% N)	-81.28	-55.59	-8.27	-7.52
Mix 3 (60% H, 40% F)	-10.48	-6.28	0.23	3.96
Mix 4 (65% H, 35% S)	111.45	83.10	35.32	22.94
Mix 5 (100% S)	125.37	90.67	22.00	10.94
Location of electricity generation	**8.51**	**7.53**	**9.84**	**8.36**
Unknown	-20.3	-15.03	-17.02	-11.44
Europe	-8.14	-8.57	-12.90	-11.56
Swiss	11.34	11.72	12.59	13.65
Canton	17.10	11.88	17.33	9.35
Monthly costs	**16.14**	**20.95**	**31.01**	**27.24**
	-261.40	-343.78	-509.50	-450.61
None option	-39.24	91.64	-56.18	120.38

[a]N = nuclear power; F = fossil fuels; H = Hydropower; S = solar power.

Table 5.

Table 5. Comparison of descriptive statistics for the four consumer segments.

	Cluster 1 "Pure Environmentalists" *n* = 258		Cluster 2 "Loss-averse Environmentalists" *n* = 269		Cluster 3 "Bargainers" *n* = 315		Cluster 4 "Loss-averse Bargainers" *n* = 220	
Socio-demographic information								
Mean age (years)***	*M* = 48.57[a]	(*SD* = 14.64)	*M* = 40.16[b]	(*SD* = 13.64)	*M* = 46.84[a]	(*SD* = 14.55)	*M* = 40.46[b]	(*SD* = 13.16)
Gender**								
Female	132[a]	51.2%	165[b]	61.3%	150[a]	47.6%	107[a]	48.6%
Male	125	48.5%	104	38.7%	165	52.4%	111	50.5%
Refused to answer	1						2	
Highest level of education								
Required basic education	13	5.0%	4	1.5%	8	2.5%	2	0.9%
Basic apprenticeship	5	1.9%	8	3.0%	6	1.9%	3	1.4%
High school	6	2.5%	12	4.5%	11	3.5%	7	3.2%
Apprenticeship	73	28.3%	69	25.7%	110	34.9%	68	30.9%
Fulltime trade school	29	11.2%	14	5.2%	32	10.2%	25	11.4%
Gymnasium (Matura)	17	6.6%	41	15.2%	19	6.0%	23	10.5%
University/College, Higher profession training	115	44.5%	119	44.3%	127	40.3%	92	41.8%
Income								
<CHF3'000	40	15.5%	39	14.5%	46	14.6%	27	12.3%
CHF3'000-6'000	110	42.6%	112	41.6%	141	44.8%	101	45.9%
CHF6'000-10'000	83	32.2%	82	30.5%	97	30.8%	69	31.4%
>CHF10'000	25	9.7%	36	13.4%	31	9.8%	23	10.5%
Civil Status***								
Single	61[a]	23.6%	90[b]	33.5%	66[a]	21.0%	81[b]	36.8%
Married or in partnership	149[a,b]	57.7%	144[a]	53.5%	200[a,b]	63.5%	113[a]	51.4%
Divorced/Separated	42	16.3%	28	10.4%	45	14.3%	22	10.0%
Widowed	6	2.3%	3	1.1%	3	1.0%	1	0.5%
Refused to answer			4	1.5%	1	0.3%	3	1.4%
Household size								
1 person	53	20.5%	55	20.5%	68	21.6%	58	26.4%
2 persons	107	41.5%	97	36.1%	136	43.2%	73	33.2%
3 persons	45	17.4%	54	20.1%	48	15.2%	39	17.7%
4 persons	42	16.3%	48	17.8%	48	15.2%	33	15.9%
≥ 5 persons	11	4.3%	15	5.6%	15	4.8%	17	7.7%
Political orientation***	*M* = 3.83[a]	(*SD* = 1.59)	*M* = 4.06[a]	(*SD* = 1.73)	*M* = 4.50[b]	(*SD* = 1.55)	*M* = 4.76[b]	(*SD* = 1.65)
No political orientation	14	5.4%	19	7.1%	20	6.4%	20	9.1%
Psychographic characteristics								
Saving intentions***	239[a]	92.6%	245[a]	91.1%	277[a]	87.9%	177[b]	80.5%
Financial motives***	78[a]	30.2%	82[a]	30.5%	150[b]	47.6%	123[b]	55.9%
Environmental motives***	164[a]	63.6%	165[a]	61.3%	131[b]	41.6%	54[c]	24.5%
Environmental emotions	*mean*	*SD*	*mean*	*SD*	*mean*	*SD*	*mean*	*SD*
Positive outcome***	5.89[a]	(1.01)	5.59[b]	(0.98)	5.37[b]	(1.18)	4.99[c]	(1.09)
Negative outcome***	5.07[a]	(1.37)	4.78[a,b]	(1.29)	4.65[b]	(1.39)	4.26[c]	(1.34)

Obstruction ***	5.13[a]	(1.35)	4.99[a]	(1.21)	4.61[b]	(1.37)	4.48[b]	(1.30)
Coercion***	3.05[a]	(1.40)	3.31[a]	(1.30)	3.63[b]	(1.36)	3.88[b]	(1.26)
Baseline***	6.28[a]	(0.80)	5.98[b]	(0.96)	5.93[b]	(1.01)	5.51[c]	(1.12)
Values								
Egoistic***	2.04[a]		2.06[a]	(1.27)	2.57[b]	(1.56)	2.43[b]	(1.42)
Altruism***	5.29[a]	(1.16)	5.02[a,b]	(1.15)	4.8[b]	(1.33)	4.51[c]	(1.29)
Biospheric***	5.56[a]	(1.16)	5.19[b]	(1.29)	5.05[b]	(1.46)	4.51[c]	(1.43)
Hedonic	4.46	(1.51)	4.60	(1.40)	4.46	(1.52)	4.61	(1.44)
Loss aversion**	λ = 1.00[a]		λ = 1.40[b]		λ = 1.16[a]		λ = 1.29[a,b]	
General risk aversion**	4.04[a]	(1.39)	4.34[a,b]	(1.40)	4.14[a]	(1.46)	4.5[b]	(1.41)
Comparative optimism bias**	0.61[a]	(1.67)	0.59[a,b]	(1.50)	0.37[a,b]	(1.59)	0.23[b]	(1.54)
Tariff attractiveness								
Bonus	5.71	(0.89)	5.47	(1.13)	5.42	(1.25)	5.27	(1.36)
Malus	3.08	(1.45)	2.69	(1.55)	2.73	(1.54)	2.42	(1.23)
Bonus-Malus***	5.00[a]	(1.30)	4.29[b]	(1.45)	4.7[a,b]	(1.55)	3.15[c]	(1.55)
No incentives	4.17	(1.10)	4.10	(0.99)	4.16	(0.99)	4.02	(0.99)

Note. Different superscripts indicate significant differences in pairwise comparisons. Same superscripts indicate no significant differences. See Table 6 in Appendix A for pairwise comparisons test statistics.
*** p-level < .001; ** p-level < .05