

The Influence of Eco-Labeling on Consumer Behaviour –

Results of a Discrete Choice Analysis

Katharina Sammer and Rolf Wüstenhagen*

Institute for Economy and the Environment (IWOe-HSG), University of St. Gallen, Switzerland

Abstract

Eco-labelling is an important tool to overcome market failure due to information asymmetries for environmental products. While previous research has discussed the importance of labelling, this paper provides empirical data on the influence of eco-labels on consumer behaviour for household appliances. It reports on the results of a survey involving a total of 300 choice-based conjoint interviews conducted in Switzerland in Spring 2004. Choice-based conjoint analysis (also known as Discrete Choice) has been applied to reveal the relative importance of various product attributes for consumers. The EU Energy label is used for the two product categories in our survey, light bulbs and washing machines, and we investigate the relative importance of this eco-label compared to other product features (like brand name) in consumers' purchasing decisions. We discuss differences between the two product categories, and draw conclusions for sustainability marketing and policy.

Keywords: Information asymmetry, consumer behaviour, eco-labelling, choice-based conjoint analysis, discrete choice, household appliances, EU energy label, sustainability marketing.

* Correspondence to: Rolf Wüstenhagen, Institute for Economy and the Environment, Tigerbergstrasse 2, CH-9000 St. Gallen, Switzerland. E-mail: rolf.wuestenhagen@unisg.ch, www.iwoe.unisg.ch.

1 Introduction

Consumers are interested in goods as a bundle of different product characteristics (Lancaster, 1966) that can be distinguished by search, experience and credence characteristics. While search characteristics can be identified by consumers prior to purchase, e.g. price, colour, size, etc., experience characteristics can only be determined after purchase (Nelson, 1970). Finally, credence characteristics cannot be checked before or after purchase (Darby and Karni, 1973). Knowledge about these product characteristics is asymmetrically allocated between buyers and sellers. This information asymmetry can be overcome in different ways. Markets for products with search attributes are able to produce this information relatively easily, while goods with credence attributes need reputable information to be credible for consumers. This study focuses on intangible product characteristics which especially depend on appropriate product information (signals like brands, labels). Brands and labels fulfil two main functions for consumers: they inform them about intangible product characteristics (information function, e.g. quality) and provide a value in themselves (value function, e.g. prestige). This paper addresses the relevance of the EU Energy label as a buying decision criterion compared to other product characteristics like brands. The EU Energy label transforms the credence attribute 'energy consumption' into a search attribute by third-party certification, which guides consumers' buying decisions. Activities of firms and/or institutions to provide consumers with information about product characteristics are termed 'signalling' in new institutional economics, while the activity of consumers to search and check out the product characteristics of a product is called 'screening' (Goebel 2002). After realising that a problem exists in obtaining information about different product characteristics, the question is: In which types of product characteristics is the consumer interested, depending on different product groups? On the basis of a discrete choice analysis with 300 interviews conducted in Switzerland in Spring 2004 this research question will be analysed, focussing on two products: washing machines and light bulbs.

2 The European Energy Label

Previous literature on eco-labelling has often taken a conceptual or descriptive approach, discussing the relevance of eco-labels from marketers', consumers' and policymakers' perspectives (Gallastegui 2002, de Boer 2003, OECD 1991). Another stream of literature has attempted to assess the market impact of eco-labelling schemes (OECD 1997, Gallastegui 2002, Imug 1998, Banerjee and Solomon 2003), while others have focussed on the policy process of implementing successful eco-labelling schemes (Karl and Orwat 1999, Wiel and McMahon 2003). Finally, some authors have tried to combine the different perspectives of eco-labelling in order to explain the dynamic incentives that this relatively new environmental policy instrument provides (e.g. Wüstenhagen 2000: 264 ff., Truffer et al. 2001).

The European energy label (see Figure 1) initiated by the European Commission is a compulsory label that is applied to all white goods, home appliances and light bulbs sold within the EU. It came into effect on January 1st, 1995, based on the "Directive For Mandatory Energy Labelling of Household Appliances". Application of the label will shortly be extended to cars (Energy Efficiency 2004). Based on the EU directive, each country is responsible to establish national legislation for the program to be enforced and for aspects of implementation including compliance, label accuracy, educational and promotional activities (Harrington and Damnic 2001). Switzerland has introduced the EU Energy Label¹ on January 1st, 2002 (Energie



Figure 1: EU Energy Label

Schweiz, 2004). The purpose of this label is to allow consumers to compare appliances (comparative label). Appliances are rated on a scale of A to G, with 'A' being the most energy

¹ To avoid mentioning of the politically somewhat contentious term EU, the Swiss have invented a new name for the label, calling it "Energieetikette".

efficient and 'G' the least. The appliances that are subject to the labelling scheme account for 20 % of electricity consumption in Switzerland (S.A.F.E., 2001)

A series of studies within the EU has tried to evaluate the success of the Energy label. In their report to the European Commission on the first three years of the EU energy labelling scheme, Winward and Schiellerup and Boardman (1998) indicate that the label is used by consumers and they understand its message. They conclude that across the EU, about a third of consumer purchases of cold appliances are influenced by the Energy label. Three years after the implementation of the labelling scheme the Energy label had little effect on purchasing patterns in the southern countries and much greater influence in northern countries, where there is a longer history of concern about energy use. A limiting factor of the influence of the Energy label on the buying decision can be seen in the limited range of models in some retail outlets which reduces the consumer's choice to a few appliances or even a single model. However, the EU energy label provides both a carrot and a stick, labelling good as well as inefficient products, so manufacturers and retailers have a twofold incentive to offer more energy efficient products. Bertoldi (1999), based on the results of two market evaluations throughout the EU (Waide, 1998 and 2001), concludes that average sales figures of energy efficient home appliances within the EU have increased by 29 percent.

Alec (2002, 2003) has evaluated the implementation of the Energy label at typical points of sale on the Swiss market: About 6000 household appliances (refrigerators, washing machines, dryers, dishwashers) have been observed. About 56.5 % of the household appliances had been labelled correctly and 26.5 % were A-labelled. One year later, both the share of properly labelled appliances as well as the percentage of A-rated products had slightly increased (58.9 % and 28.9 %, respectively).

While previous literature on eco-labelling in general and on the EU Energy Label in particular has provided good insights about the aggregate effects on the market level, knowledge about the influence of the Energy Label on consumer preferences and purchasing decisions remains

an under-researched issue. Not only is previous empirical research largely supply-side and macro-level oriented, but the few consumer-focused studies that exist have used relatively unsophisticated methods of analysis. By applying discrete choice analysis and investigating consumers' purchasing decisions in a realistic setting, we contribute to closing this gap.

3 Survey design

3.1 Objectives and hypothesis

The main objective of this study is to assess the relative importance of the energy label compared to other product attributes (like brand, price, etc.) for consumers' buying decisions. The methodological approach that we chose, discrete choice analysis, is particularly powerful for this kind of analysis. Further this study attempts to analyze if the importance of the energy label differs between product groups. Finally, assuming that there will be a positive willingness to pay for energy efficient products, we aim at understanding how much of the utility of an A- or B-labelled product can be explained by the underlying willingness to pay for lower energy consumption, and how much is the residual value for the label itself.

Corresponding to these objectives, our hypotheses were the following:

H1: The energy label positively influences consumers' buying decisions for household appliances.

H2: The relative importance of the energy label as a buying criterion is higher for products that are characterized by low-involvement buying decisions.

H3: A-labelled energy efficient products cause a willingness to pay that is at least equal to the monetary value of reduced energy consumption over the lifetime of a product.

We chose two product categories which vary in their purchase attributes: light bulbs and washing machines. Light bulbs are much cheaper than washing machines (about 2 - 40 CHF for light bulbs versus 300 - 5000 CHF for washing machines) and bought more frequently. We expect that the relevance of the energy label is higher for light bulbs than for washing machines, since buying a light bulb can be characterized as a habitual or limited buying

decision (H3). Such decisions are characterized by low involvement and a focus on key information, in which case we expect an information chunk like the energy label to provide cognitive relief for the customer (Kroeber-Riel and Weinberg, 1999). The purchase of a washing machine is based on an extensive buying decision for consumers which means high information demand, long duration of decision-making and development of assessment criteria (complex buying behaviour) (ibid.).

3.2 Survey

The universe of this survey comprises Swiss consumers of washing machines and light bulbs. We used a stated preference, not a revealed preference approach, i.e. we did not observe people's actual buying decisions, but confronted respondents with fictitious choice tasks. However, we sampled consumers who were actually in the process of making a buying decision or at least seriously interested in buying washing machines (light bulbs) by conducting our survey at the point of sale, in the washing machine (light bulb) section of major Swiss retail stores (Washing machines: Fust, Media Markt; light bulbs: Coop Bau & Hobby, Lumimart). We surveyed a total of 302 customers, 151 each for both product categories. Two thirds of the interviews were conducted in the German-speaking part of Switzerland (Zurich and Lucerne regions) and one third in the French-speaking part (Lausanne). Given the size of our samples, we obviously did not aim at representativeness compared to all Swiss consumers. Looking at the socio-demographic characteristics of our sample, there may be deviations with regard to income, store location and sex. The average (self-declared) monthly net income in our sample was about 5000 CHF (3300 EUR), compared to 5601 CHF (3665 EUR) for Switzerland (BFS 2004). For reasons of research efficiency, we conducted our survey in larger stores, which were in all but one cases located in suburban shopping areas rather than downtown locations. 61.6 % of our light bulb customers, but only 37.1 % of our washing machine customers were male. The average age of respondents in both groups was about 42 years.

We used personal interviews with paper and pencil, which were done by experienced interviewers. The questionnaire was structured as follows: Introductory question about ranking the most important societal issues, questions about the buying habits for washing machines (light bulbs), 21 choice tasks (combination sets of different product alternatives), washing (lighting) behaviour, socio-demographic questions.

4 Methodological Considerations

4.1 Theoretical framework

This research study is based on two theoretical concepts: Firstly on economic theory, especially microeconomic theory (household, consumer theory), which says that humans make decisions which maximize their utility. Consumers face trade-offs, because "there is no such thing as a free lunch". Therefore making decisions (in this case a product choice) requires comparing the cost and benefits of alternative actions (Kreps, 1990). Lancaster (1966) advanced this theory for consumer theory by focussing on product characteristics rather than on products itself. For example the assessment of a washing machine comprises many attributes like wash load capacity, water and energy consumption, price, etc.

Secondly, our research builds on consumer theory based on behavioural science which accounts for the subjective influence of individual behaviour (Hawkins et al. 2001). Models based on behavioural science assume that what takes place in the "black box" of the consumer's mind during the buying decision process can be inferred from a study of observed stimuli and responses (Kroeber-Riel and Weinberg, 1999). The input factors of the black box are personal factors (demographics), marketing-mix factors (product, price, place, promotion), psychological factors (motivation, attitudes, cognition, learning), sociocultural factors (culture, subculture, class), social factors (family, reference groups, opinion leaders, social roles) and situational factors (environment, present mood, time, buying purpose, ...) (Diller, 2001). The output of the black box is the actual buying decision. Purchasing behaviour itself is characterised by problem recognition (by means of stimuli), information search (by means

of internal and/or external sources of information), evaluation of alternatives from the evoked set, purchase decision and post-purchase evaluation (Kroeber-Riel and Weinberg, 1999).

4.2 Discrete Choice Analysis as Survey Instrument

The research method chosen within this study is a discrete choice analysis. The discrete choice approach is rooted in quantitative psychology. This econometric model is based on Quandt (1968), Theil (1970) and McFadden (1974) and has evolved into a family of techniques. A specific feature of this model is the possible inclusion of dependent variables with qualitative scaling attributes (e.g. buying decision). The limited response option of a discrete choice analysis results in analyses based on random utility models, akin to dichotomous-choice contingent valuation questions and random-utility travel cost models (Roe et al. 1996). Discrete choice analyses are increasingly applied within various disciplines of the social sciences, including transportation studies (Hahn 1997), energy-related issues (Rivers and Jaccard 2005, Goett et al. 2000) and health economics (Hall et al. 2004). A detailed description of this methodology would go beyond the scope of this paper and can be found in Train (2003) and Louviere et al. (2000).

Briefly described, a stated preference discrete choice model considers a realistic buying situation, where consumers choose between one or more products from a restricted product set (evoked set). Products vary within their product attributes and are not dividable. The dependent variable that provides information about the buying decision is binary (0-1 decision). It is assumed that consumers choose the most beneficial product from the evoked set (see 4.1). Personal attributes of every respondent are included within the model which leads to individual sets of criteria. Other influencing factors of buying behaviour are taken into account by the use of a random utility function. Preferences can be directly derived from the stated buying decisions.

The utility function and decision rule can be described as (Hahn, 1997):

$$U_{jk} = U_{jk}(v_{jk}, \delta_{jk}) \rightarrow \max!$$

U_{jk} = utility of product k for consumer j

v_{jk} = vector of deterministic relevant decision attributes which subsumes feasible product attributes of product k for consumer j (z_{jk}) and known personal attributes of consumer j (s_j)

δ_{jk} = stochastic random variable which comprises unobservable product attributes z_{jk}^* , unobservable personal attributes s_j^* and measurement errors ε_{jk} .

The response probability P_{jk} , that a consumer j decides for alternative k from the evoked set X_t , is equal to the probability that utility U_{jk} of product k is at least as high as the utility of other product alternatives U_{jn} from the evoked set.

$$P_{jk} = \text{Prob}(U_{jk} \geq U_{jn}; \forall k \neq n; k, n \in X_t)$$

P_{jk} = probability that consumer j chooses product k

The implementation of the discrete choice approach asks for further provisions, such as the functional form of the deterministic utility function $v(z_{jk}, s_j)$, as well as an appropriate distribution function for the stochastic utility function δ_{jk} . We have chosen the standard multinomial logit model (MNL) (McFadden 1973). The MNL function assumes the 'independence of irrelevant alternatives' (IIA), which implies that the probability of choosing an alternative (a specific washing machine/light bulb) is independent of whether the consumer chooses among all washing machines/light bulbs or only among selected alternatives (e.g. three alternatives). The estimation of the multinomial logit (MNL) model is based on a maximum likelihood estimation (Ben-Akiva and Lerman, 1985).

4.3 Discrete Choice Design

Discrete Choice Analysis applications based on choice experiments typically involve the following steps: determination of product attributes, specification of attribute levels, experimental design, visual presentation of choice alternatives to respondents and estimation of the choice model (Verma et al. 2004). The first stage in the design of this study involved the identification of relevant product attributes and their levels for washing machines and

light bulbs. By means of marketing documents of these two product categories (e.g. catalogues, websites), a former study about washing machines (Bauer et al. 1996), and expert interviews (e.g. retailers, industry associations, energy consultants), the final set of attributes and their levels was determined (Table 1). It is very important to identify those attributes and attribute levels which are meaningful and realistic from a consumer's perspective, while keeping the number of attributes low. In the case of **washing machines** the chosen brands represent a spectrum of the Swiss market for washing machines. V-Zug is a Swiss premium brand, and Miele, too, is positioned on the high end of the market. AEG is in the medium price segment and the "no-name" brand Iberna represents a low-price product. For the attribute levels of the energy label, we chose to include only three of the seven possible rating classes (A, B, and C), which cover 96 % of the products on the market. 80% of washing machines sold in Switzerland in 2002 are A-labelled, about 10% are B labelled and 6% are C labelled (FEA, 2002).

Washing Machines		Light Bulbs	
Attribute	Attribute levels	Attribute	Attribute levels
1.Brand	AEG V-Zug Miele Iberna ("Noname")	1. Brand	Philips Osram Stella (no name)
2.Equipment Version	Simple* Medium* De Luxe*	2. Form	Bar Bulb Globe
3.Water consumption (l/wash cycle)	39l/wash cycle 47l/wash cycle 58l/wash cycle	3. Power (Wattage)	11 Watt 60 Watt
4.Energy consumption (kWh/wash cycle)	0.85 kWh/wash cycle 1.0 kWh/wash cycle 1.3 kWh/wash cycle	4. Lifetime	1'000 h 6'000 h 15'000 h
5.Energy Efficiency Rating (Energy label)	A B C	5. Energy efficiency rating (Energy label)	A C F
6.Price	980 CHF 1890 CHF 2650 CHF 3780 CHF	6. Price	1.90 CHF 9.90 CHF 18.90 CHF

*) The three different levels of the equipment version are described in more detail within the choice tasks.

Table 1: Discrete Choice Design for washing machines and light bulbs: attributes and attribute levels

The **light bulb** market is shared by two market leaders (Osram, Philips) and no-name suppliers. The market is divided into conventional light bulbs and energy saving lamps

(compact fluorescent lamps). The challenge for a discrete choice design for this product category is that product attributes and levels are in reality not independent of each other. This violates the orthogonality condition for discrete choice analysis which means that attributes should be chosen independently of other attributes so that each attribute level's effect (utility) may be measured independently of all other effects. For example conventional light bulbs are characterized by prices of 1-3 CHF, either bulb or globe form, mostly D- to F-rated energy efficiency, and a wattage of 40-100 W. On the other hand, energy saving lamps are typically in the 10-20 CHF price range, mostly bar form, A- or B-labelled, and characterized by a wattage of 7-13 W. There were two reasons for us to apply discrete choice analysis to light bulbs despite these limitations: First, the EU energy label is applied to this product category just as it is to other categories where the continuous spectrum of A- to G-efficiency ratings might be more applicable. Second, informal pretests of our discrete choice design (which inherently includes “unrealistic” bundles of attribute levels due to random combination) with lay consumers indicated that people were not aware of these facts. The same applied to the washing machine questionnaire, where specific combinations of energy efficiency rating and energy consumption could be identified as unrealistic by experts, but according to our pretest average consumers seemed to know little about energy consumption (in kWh) and the definition of the rating classes.

Having said that, we still made sure that some particularly unrealistic combinations of unrealistic attribute levels did not appear in the questionnaire (e.g. the Miele premium brand for a washing machine with the lowest price of 980 CHF). The experimental design (Choice Tasks) was calculated randomly with Sawtooth, which provides minimal overlap (each attribute level is shown as few times as possible in a single task), level balance (each level of an attribute is shown approximately an equal number of times) and orthogonality (Sawtooth, 1999). The choice tasks were presented visually (picture of the product) and verbally (see example in the appendix). The respondents had to choose between three product alternatives

(concepts) plus a "None" option in each choice task. Sawtooth provided 8 versions of the questionnaire including 21 choice tasks. Half of the choice tasks included the energy efficiency label as an attribute.²

5 Results

5.1 Descriptive results: Buying Criteria, Knowledge of Label, Relevance of Energy

When asked a prompted question, providing them with a list of product features (Table 2), 31.8 % of respondents said price was the most important criterion in buying a washing machine, followed by the machine’s configuration (extra equipment) and energy consumption. Interestingly, when they named their 2nd priority, energy consumption moved up to the top of the list, with price ranking second and water consumption third, a picture that remained unchanged for their 3rd priority.

Criteria	1. Priority	2. Priority	3. Priority
Price	31.8%	21.2%	15.9%
Equipment	19.2%	7.3%	8.6%
Energy Consumption	11.9%	25.2%	17.2%
Brand	9.3%	8.6%	8.6%
Water Consumption	7.9%	11.9%	13.9%
Wash Load Capacity	5.3%	10.6%	6.0%
Dimensions	4.6%	6.0%	4.0%
Design	1.3%	1.3%	3.3%
Short Wash Time	0.7%	3.3%	9.3%
Low Noise	0.7%	2.0%	7.3%
Dryer integrated	0.0%	0.7%	0.7%
Other	7.3%	1.3%	4.0%
Total	100.0	99.3%	98.7%
N	151	150	149

Table 2: Most important criteria in buying a washing machine

The same question for light bulbs saw lifetime, price, and power (wattage) as the three most important criteria (see Table 3). The relatively higher importance of price for washing machines comes as no surprise given the substantially higher price levels compared to light bulbs. The fact that lifetime is mentioned as the highest scoring criterion is somewhat surprising, since lifetime is not featured prominently on most light bulb packaging. However, this result is strongly confirmed by our conjoint analysis (see below).

² Our analysis in chapter 5 of this paper is based on these 11 choice tasks that included the energy label.

Criteria	1. Priority	2. Priority	3. Priority
Lifetime	22.5%	25.2%	12.7%
Price	21.9%	23.2%	24.0%
Power / Wattage	19.9%	23.8%	19.3%
Energy Efficiency Rating	15.9%	7.9%	6.0%
Design/Form	11.9%	6.0%	12.0%
Aesthetic Light	5.3%	9.9%	14.7%
Height	0.7%	1.3%	2.0%
Brand	0.7%	0.7%	3.3%
Packaging	0.0%	0.0%	5.3%
Other	1.3%	2.0%	0.7%
Total	100.0%	100.0%	100.0%
N	151	151	150

Table 3: Most important criteria in buying a light bulb

Customers have a high level of awareness of the energy label. Prompted recall rates are around 70 % among both light bulb and washing machine customers, slightly higher among the latter. To probe their knowledge, we gave them a list of products, some of which are indeed labelled while others (such as hairdryers, PCs) are not (shaded grey in Table 4 below). The label was best known on refrigerators (ca. 80 %), while it was less known for other household appliances such as dishwashers (42.9-51.8 %). The lower recall value in the case of cars (26.7-27.7 %) is likely a consequence of the recent introduction of the label for this product category. Interestingly, only 19.6 % of washing machine customers recalled the label from light bulbs. On the other end, a very large majority (correctly) said they had not seen the label on TV sets, hairdryers and PCs, highlighting a good level of knowledge.

	Light Bulb Customers	Washing Machine Customers
	N = 151	N = 151
Recall seeing the Energy Label	69.5%	74.2%
of those: Recall the Energy Label from other products, namely...	N = 105	N = 112
Refrigerator	81.0%	79.5%
Washing Machine	55.2%	N/A
Dishwasher	42.9%	51.8%
Car	26.7%	27.7%
Light Bulb	N/A	19.6%
TV Set	8.6%	3.6%
Hairdryer	1.9%	0.0%
PC	1.0%	0.9%
Other	1.9%	2.7%

Don't know any particular product that is labelled	9.5%	2.7%
--	------	------

Table 4: Prompted Recall of the Energy Label

While many people know the Energy Label, this does not necessarily mean that it plays a major role in their buying decision. To find out about the importance of the energy label, but also of a product's energy consumption, in customers' purchasing decisions, we used two approaches. First, we asked them two prompted questions: "How important is energy consumption (the energy label) when you buy a washing machine (light bulb)?" Secondly, we answered this question indirectly through our discrete choice analysis discussed below. In the prompted question, people were asked to indicate the importance of a product's energy consumption and of the label on a scale from 1 (not important) to 6 (very important). Results are shown in Figure 2.

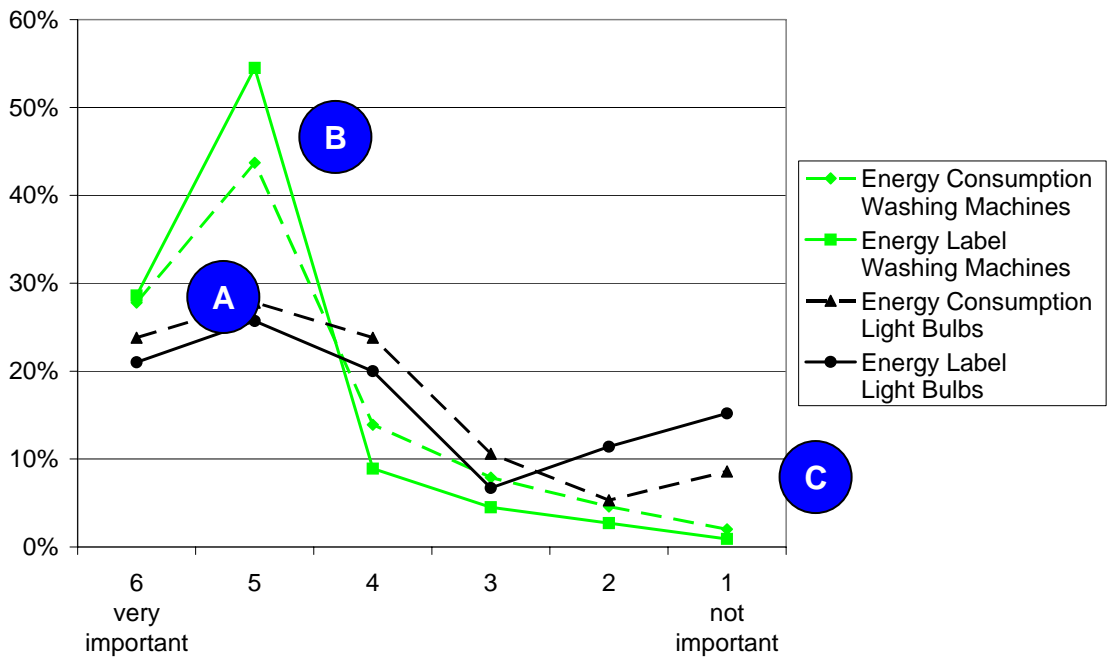


Figure 2: Importance of Energy Consumption and Energy Label for Washing Machine and Light Bulb Customers

Figure 2 provides three interesting insights: First (A), significantly more washing machine customers (about 80 %) attach a high importance to energy issues compared to light bulb customers (about 50 %). This reflects the prominent mentioning of energy among the buying

criteria for washing machines discussed above (Table 2). Second (B), in the case of washing machines, more customers state that the energy label is important in their purchasing decision than they do for energy consumption, which indicates that there is a positive effect of the label in making the energy issue meaningful for them. The fact that this effect is particularly pronounced for high, but not very high importance for energy issues, leads us to believe that the label is particularly meaningful for consumers outside the niche of highly energy-aware customers. Thirdly (C), for light bulbs, there is somewhat of an opposite effect at the lower end of the market, whereby 26.7 % of customers say that the energy label is not important for their purchasing decision, while only 14.0 % say the same about energy consumption. This indicates that the energy label provides less meaningful information to light bulb customers, especially those that attach less importance to energy issues.

With regard to different customer segments, we found at least one indication that environmentally aware consumers attach higher importance to the energy label. To operationalize environmental awareness, we asked whether respondents are holders of a rail card (half-fare card or railway pass/Generalabonnement), indicating that they are regular users of public transport. Among the 44% of those respondents knowing the label (N=105) who were holding the rail card, 30.4 % answered that the energy label is very important in buying a light bulb, compared to only 13.6 % of the non-rail card holders (Figure 3).

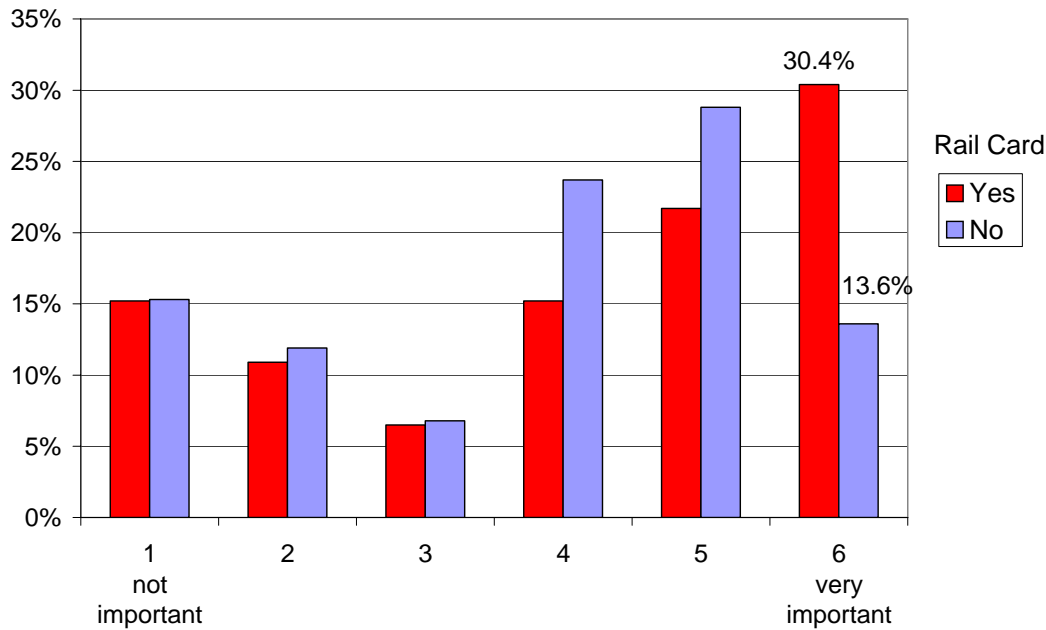


Figure 3: Higher Importance for Energy Labels (Light Bulb) for Environmentally Aware Customers

5.2 Results: Discrete Choice Analysis – washing machines

Table 5 shows the results of the discrete choice model for washing machines. It contains 1396 observations, based on the responses of 151 individuals performing 11 choice tasks each (= 1661 total choices), less 265 observations that have been skipped because the respondent decided to choose none of the three products. R-square is 0.103, predictive quality is 40 %.³ The results table includes three indicators. The coefficient (b) indicates the influence of a change of the respective variable on the customer's likelihood to buy the product. Positive values indicate that an increase of the variable results in increasing utility for the consumer, while negative values indicate decreasing utility, as in the case of energy consumption (in kWh/wash cycle) or price. For nominal or ordinal variables, such as brand or energy label, one attribute level has been set as a dummy variable (e.g. energy efficiency rating C = 0), so that the coefficient indicates the relative increase in utility of the respective attribute level over the base case (e.g. A compared to C). The following two columns provide different measures for the goodness of fit. The standard error is an indicator for the exactness of

³ Predictive quality is an indicator that shows how well the model is able to forecast whether a respondent in a specific choice task would choose alternative 1, 2 or 3.

estimating the coefficient. The ratio of coefficient to standard error (t-value) provides a standardized value for the exactness of the coefficient, enabling comparison across attributes. The higher these values, the better the estimate. Based on the respective value of the standard normal distribution, t-values greater than 2 indicate a reliable estimate (within the 95 % confidence interval) of the coefficient. In our model, most coefficients are significant at the 95 % or even 99 % levels, except for the variables “medium equipment version” and “energy consumption” which are only significant at the 80 % confidence level, indicating a higher random error. A possible explanation is that a “medium” level of equipment is less meaningful for people than the two alternative levels of this attribute (simple vs. de luxe), and that energy consumption in kWh/wash cycle is not something that people can routinely assess with high accuracy.

Variable	Coefficient (b)	Standard Error (St.Er.)	Ratio of Coefficient to Standard Error (t-value)
Constant, E0	0.1152*	0.0621	1.853
Brand: AEG (dummy), em1	0.3136***	0.0875	3.583
Brand: VZug (dummy), em2	0.8785***	0.0992	8.859
Brand: Miele (dummy), em3	0.8610***	0.1014	8.489
Brand: Iberna (no name)	0	-	-
Equipment version: Simple (dummy), ea1	-0.5308***	0.0851	-6.236
Equipment version: Middle (dummy), ea2	-0.1164*	0.0775	-1.502
Equipment version: De Luxe	0	-	-
Water Consumption: l/wash cycle, ewv	-0.0090**	0.0037	-2.410
Energy Consumption: kWh/wash cycle, eev	-0.2648*	0.1970	-1.344
Energy efficiency rating A (dummy), eeka	0.4874***	0.0918	5.306
Energy efficiency rating B (dummy), eekb	0.2434***	0.0828	2.941
Energy efficiency rating: C	0	-	-
Price: Swiss francs, e_pr	-0.0007***	-4.87E-05	-15.039

* Coefficient significant at 80 % confidence level

** Coefficient significant at 95 % confidence level

*** Coefficient significant at 99 % confidence level

Table 5: Results of the Discrete Choice (Multinomial Logit) Model for Washing Machines

A comparison of results across different attributes is facilitated by converting the utility coefficients to monetary units, which can be interpreted as the average consumer’s willingness to pay for a change from one attribute level to another. This is done by dividing

the coefficient (b) of each attribute level by the absolute value of the coefficient of price.

Figure 4 below shows the results of this analysis.

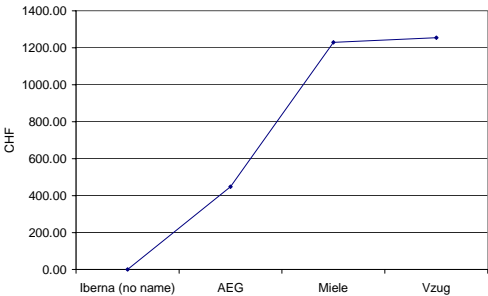


Fig. 3a: Brand

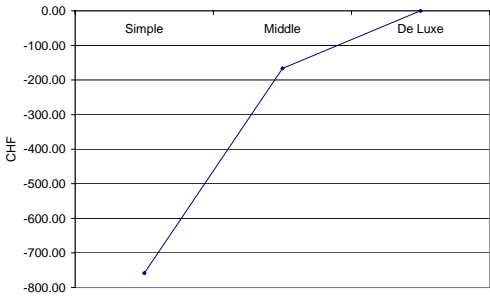


Fig. 3b: Equipment Version

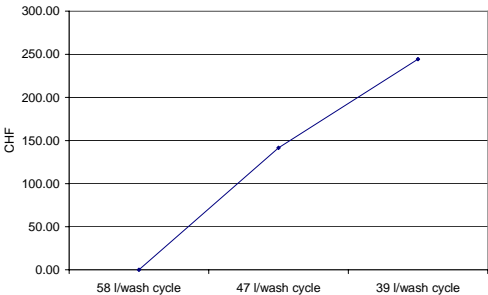


Fig. 3c: Water Consumption

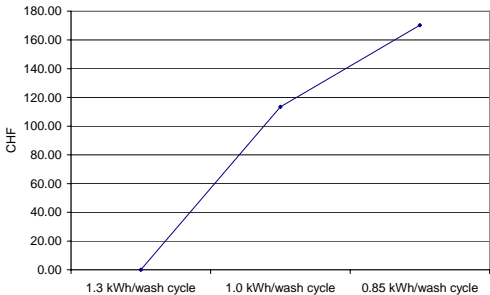


Fig. 3d: Electricity Consumption

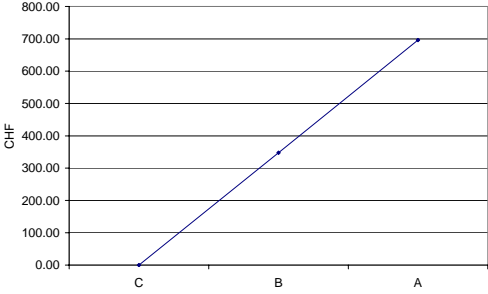


Fig. 3e: Energy Efficiency Rating

Figure 4: Willingness to pay for product attributes and attribute levels (Washing Machines)

As we can see, the value of brands is very high when it comes to buying a washing machine. For the two most popular brands, VZug and Miele, customers are willing to pay a premium of more than 1220 CHF (800 EUR) compared to a no-name product. The other interesting result is the influence of energy labels: An A-rated washing machine increases customer utility by 696.29 CHF (455.63 EUR) compared to a C-rated machine, and going from B to A increases willingness to pay by 347.41 CHF (227.33 EUR). Interestingly, this is a substantially higher amount than the willingness to pay for the underlying difference in electricity consumption.

Since the difference between categories is 0.2 kWh/wash cycle (assuming 5 kg wash load), we can easily combine figures 3d and 3e (see Figure 5 below).

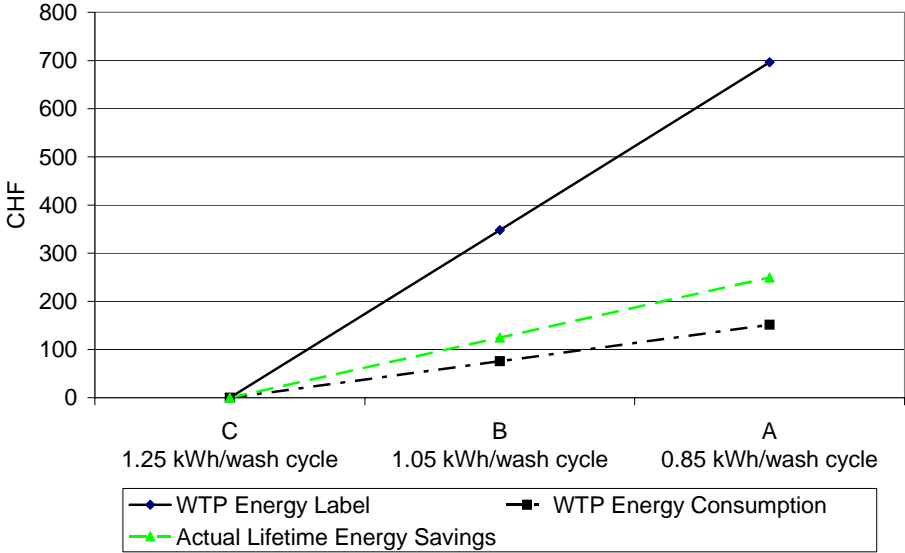


Figure 5: Willingness to pay for Energy Label exceeds underlying willingness to pay for energy efficiency
 The third line in Figure 5 represents the actual cost savings that a customer realizes over the 15-year lifetime of a washing machine.⁴ When judging their utility increase based on kWh differences, people tend to underestimate the energy cost. This is an indication that people are not well informed about the energy consumption of washing machines, and that the label plays an important role in “translating” energy efficiency into something more meaningful for them. In fact, the meaning that consumers attach to the label seems to go beyond energy efficiency. The steeper utility function for the energy label suggests that consumers perceive it as a signal for other features of a high-quality product, too, similar to other signals, such as the brand name.

5.3 Results: Discrete Choice Analysis – Light Bulbs

Table 6 shows the results of the discrete choice model for light bulbs. It contains 1582 observations, based on the responses of 151 individuals performing 11 choice tasks each, less 79 observations that have been skipped because the respondent decided to choose none of the

⁴ This has been calculated using typical Swiss retail electricity prices of 0.20 CHF/kWh (0.13 EUR/kWh), assuming 4 standard wash cycles per week (208 per year) and a discount rate of zero.

three products. R-square is 0.068, predictive quality is 38 %, both indicating a somewhat poorer fit of the model compared to the washing machines. There are several possible reasons for this poorer fit: buying decisions for light bulbs are typically low-involvement, impulse purchases, so people may have less clear preferences about product attributes and desired attribute levels; we might have picked the wrong attributes, missing out e.g. on aesthetic light (ranking 3rd as people's third priority in the descriptive part of our questionnaire); or, most likely, the almost binary nature of the product range in the lamp sector (see 4.3 above).

Variable	Coefficient (b)	Standard Error (St.Er.)	Ratio of Coefficient to Standard Error (t-value)
Constant, E0	0.7901*	0.0575	1.373
Brand: Philips (dummy), em1	0.0685	0.6536	1.047
Brand: Osram (dummy), em2	0.1073*	0.0645	1.663
Brand: Stella (no name)	0	-	-
Power: Watt, ew	0.0005	0.0022	0.239
Energy efficiency rating: A (dummy), eek1	0.4647***	0.1448	3.209
Energy efficiency rating: C (dummy), eek2	0.0501	0.0860	0.583
Energy efficiency rating: F	0	-	-
Lifetime: h, eld	6.40E-05***	5.90E-06	10.837
Form: Bar (dummy), ef1	0.0987*	0.0641	1.539
Form: Bulb (dummy), ef2	-0.0299	0.0854	-0.350
Form: Globe	0	-	-
Price: Swiss francs, epr	-0.0673***	0.0055	-12.128

* Coefficient significant at 80 % confidence level

** Coefficient significant at 95 % confidence level

*** Coefficient significant at 99 % confidence level

Table 6: Results of the Discrete Choice (Multinomial Logit) Model for Light Bulbs

Looking at the goodness of fit for individual attributes demonstrates that the coefficients for price, lifetime and energy label “A” are good estimates, while the estimates for power (wattage) show a very low ratio of coefficient to standard error (t-value), indicating a substantial influence of random error. As another insight, the values for brand are less significant than in the case of the washing machines, indicating a relatively less important influence of brand on purchasing behaviour for light bulbs. This is also reflected in a relatively lower willingness to pay for the two popular brands, Osram and Philips, compared to a no-name product. Going from no-name to Osram increases customer utility by 1.60 CHF (1.05 EUR), which is a substantial premium when it comes to conventional light bulbs, but

small compared to the additional willingness to pay for features that characterize energy saving lamps, such as lifetime and energy efficiency rating “A”. For an A-labelled lamp, respondents were willing to pay 6.16 CHF (4.03 EUR) more than for a C-lamp, reflecting a premium of 60 % to the average price of light bulbs in our sample (10.23 CHF/6.69 EUR). As an even more pronounced effect, an increase in product lifetime from 1000 hours to 15000 hours increases utility by 13.31 CHF (8.71 EUR).

6 Conclusions

Our results provide important insights for marketing and policy, as well as opportunities for further research.

6.1 Implications for sustainability marketing

With regard to sustainability marketing, the most important result of our analysis is the significant willingness to pay for A-labelled energy efficient products, confirming our first hypothesis (H1). The premium for an A- versus a C-labelled product was 696.29 CHF (455.63 EUR) for washing machines and 6.16 CHF (4.03 EUR) for light bulbs. Compared to the average price of products in our sample, this represents about a 30 % premium in the case of washing machines and a 60 % premium for light bulbs. The higher premium for light bulbs is in line with our second hypothesis that for a low-involvement product, a label as an information chunk adds more value than for a high-involvement product where people are aware of a broader set of product attributes to base their decision on (H2). Another explanation for the high willingness to pay in the case of light bulbs may be that people have become used to relatively expensive energy saving lamps, and that they are aware of their additional feature of longer lifetime, which translates into attractive cost savings. These results, the willingness to pay for a labelled product, as well as the willingness to pay directly for environmental product features like longevity in the case of lamps, are encouraging for marketers who want to differentiate themselves based on energy-efficient product attributes. We could also demonstrate that consumers’ willingness to pay for A-labelled products

exceeds the cost savings that can be expected over the lifetime of the product, confirming our third hypothesis (H3).

Finally, our analysis showed that brands are important, particularly in the case of washing machines, where the willingness to pay for a premium brand compared to a no-name product was more than 1220 CHF (800 EUR), which is about a 50 % premium and almost twice as much as the difference between A- and C-Label. These results are relevant to manufacturers of energy-efficient products since it provides them with quantitative information for comparing investments in brand value versus in research and development (R&D) for energy-efficient products. Taking AEG for example, it appears that catching up with the two most preferred brands in Switzerland, Miele and VZug, would require substantial marketing investments. On the other hand, consumers are willing to pay a premium for A-labelled energy efficient products, and AEG has a strong track record in designing such products. Therefore, the company may get a better return on investment by doing R&D to further enhance the environmental performance of their products.

For retailers, our results imply that they can increase sales and profit by offering a range of products that includes a significant share of A-labelled products. To realize these benefits, however, careful training of their sales staff is key in order to successfully communicate the added value of an energy efficient product to the consumer at the point of sale.

We should point out that we looked at the EU Energy Label which is a mandatory scheme. Many other eco-labels are voluntary schemes. In these cases, doing research along the lines that we have presented here will provide marketers with the necessary information to decide whether or not the added customer value of an eco-label exceeds the certification cost to get that label. It should be noted though that such an analysis will only provide valid results if the label is already well-known among consumers, which was the case in our study and may also

be true for some well-established labelling schemes such as the Blauer Engel in Germany or Brå Miljöval in Sweden.

6.2 Implications for policy makers

For policy makers, our analysis shows that the energy label is well-known and respected among consumers, which also led to our conclusion above that a label could be very useful for marketers to differentiate themselves. However, in a market where 80 % of the products are A-rated – as in the case of the Swiss market for washing machines – there is little left to differentiate. Therefore, policy makers should make sure that criteria provide enough incentive for continuous improvement and are therefore regularly reviewed. A currently discussed solution to include a new rating class like AA or A+ at the top end of the spectrum will probably not do an equally good job to reduce information cost for consumers.

For the light bulbs, our discrete choice model showed a relatively poorer fit than for washing machines. This may partly be caused by the binary nature of the buying decision: conventional light bulb versus energy saving lamp. We tried to bridge that in our analysis, but it seems that consumers may have some trouble making sense of the concept of the A- to G-label in a category that does not have such a continuous spectrum of products. Therefore, one option might be to consider a single-sign label (such as the EU eco-label or the German “Blauer Engel”) as an alternative for light bulbs. Alternative measures to promote energy saving lamps might also be considered.

6.3 Implications for research

Our discrete choice analysis turned out to be a very fruitful approach to investigating consumer preferences for energy labels. For the first time, we presented a comprehensive quantitative analysis of consumer behaviour with regard to eco-labels in the appliance sector. This provides much richer results than simple willingness-to-pay studies or direct inquiries of

people's environmental attitudes, since we get less socially desired answers by taking an indirect approach to revealing consumer preferences.

Therefore, applying discrete choice modelling to analyzing the influence of the EU energy label on consumer behaviour in other product categories (e.g. refrigerators, dryers) provides substantial research opportunities. Also, comparing across different European countries will be fruitful, especially given the differences in customer awareness about the EU energy label between Northern and Southern European countries described in earlier research (Winward et al. 1998). As another angle, customer segmentation should be extended. Our exploratory analysis of preferences of environmentally aware consumers versus others based on whether or not they are Rail Card holders indicated some interesting opportunities for further research.

Acknowledgement

This research was supported in part under Contract No. 150575 by the Swiss Federal Energy Agency (Bundesamt für Energie). Although support for this work is gratefully acknowledged, the ideas expressed herein are those of the authors and not necessarily endorsed by the funding agency. The authors would like to thank Andreas Herrmann, Matthias Gysler, Rolf Iten, Martin Jakob and Gerd Sammer for methodological discussions, as well as the members of the project's steering committee (Rudolf Bolliger, Conrad Brunner, Hanspeter Eicher, Felix Frey, Lorenz Frey-Eigenmann). Stephan Hammer, Maya Jegen and two anonymous reviewers provided valuable feedback and comments.

References

- Alec Alliance Energie-Konsum 2002. Marktcheck 2002. Umsetzung der Energieetikette für Haushaltsgeräte und Lampen im Schweizer Handel. Schweizerischer Agentur für Energieeffizienz: Zürich.
- Alec Alliance Energie-Konsum 2003. Marktcheck 2003. Energieetikette bei Haushaltsgeräten und Lampen, Die Ergebnisse der 2. Untersuchung. Schweizerischer Agentur für Energieeffizienz: Zürich.
- Anderson R.C., Hansen E.N. 2004. The impact of environmental certification on preferences for wood furniture: A conjoint analysis approach. *Forest Products Journal*. **54** (3), 42-51.
- Banerjee A., Solomon B.D. 2003. Eco-labeling for energy efficiency and sustainability: a meta-evaluation of US programs. *Energy Policy*, **31**, 109-123.
- Bauer H.H., Herrmann A., Homberg F. 1996. Analyse der Kundenwünsche zur Gestaltung eines Gebrauchsgutes mit Hilfe einer Conjoint Analyse. Das Beispiel einer raumsparenden Waschmaschine. Arbeitspapier Nr. 110, Institut für Marketing, Universität Mannheim.
- Ben-Akiva M., Lerman S.R. 1985. Discrete choice analysis, theory and application to travel demand. MIT Press: Cambridge, Mass.
- Bertoldi P. 1999. Energy efficient equipment within SAVE: Activities, strategies, success and barriers. *Proceedings of the SAVE Conference for an Energy Efficient Millenium*. Graz, Austria, 8-10 November 1999.
- BFS 2004. Einkommens- und Verbrauchserhebung 2002. Erste Ergebnisse. Bundesamt für Statistik (Schweiz), Neuchâtel.

- De Boer J. 2003. Sustainability Labelling Schemes: The Logic of their Claims and their Functions for Stakeholders. *Business Strategy and the Environment*, **12**, 254-264.
- Energie Schweiz 2004. Energietikette. <http://www.energieetikette.ch> [Accessed 29 September 2004].
- Energy Efficiency 2004. EU Energy Label. <http://www.saveenergy.co.uk/appliances/whatis/label.cfm> [Accessed 29 September 2004].
- FEA 2002. Statistik Elektrohaushaltgeräte. Schweizerische Treuhandgesellschaft/eae: Zürich.
- Gallastegui, I.G. 2002. The Use of Eco-Labels: A Review of the Literature, *European Environment* **12**, 316-331.
- Göbel E. 2002. Neue Institutionenökonomik, Konzeption und betriebswirtschaftliche Anwendungen. Lucius und Lucius: Stuttgart.
- Goett A., Hudson K., Train K. 2000. Customers' Choice among Retail Electricity Suppliers: The Willingness to Pay for Service Attributes. *Energy Journal*, **21**(4): 1-28.
- Hahn C. 1997. Conjoint- und Discrete Choice Analyse als Verfahren zur Abbildung von Präferenzstrukturen und Produktauswahlentscheidungen: Ein theoretischer und computergestützter empirischer Vergleich. Betriebswirtschaftliche Schriftenreihe 80. Lit Verlag: Münster.
- Hall J., Viney R., Haas M., Louviere J. 2004. Using stated preference discrete choice modeling to evaluate health care programs, *Journal of Business Research* **57**: 1026-1032.
- Harrington L., Damnic M. 2001. Energy Labelling and Standards Programs throughout the World. The National Appliance and Equipment Energy Efficiency Committee: Victoria.
- Hawkins D.J., Best R.J., Coney K.A. 2001. Consumer Behaviour - Building Marketing Strategy. 8th ed. McGraw Hill Co: New York.
- Imug 1998: *Erfolgskontrolle Umweltzeichen*, edited by the German Federal Environmental Protection Agency, Texte Nr. 61/98, Berlin.
- Karl H., Orwat C. 1999. Environmental Labelling in Europe: European and National Tasks, *European Environment* **9**, 212-220.
- Kreps D.M. 1990. A course in microeconomic theory. Harvester Wheatsheaf: New York.
- Kroeber-Riel W., Weinberg P. 1999. Konsumentenverhalten. 7th edition. Vahlen: München.
- Lancaster K. 1966. A New Approach to Consumer Theory. *Journal of Political Economy* **74**: 132-157.
- Louviere J.L., Hensher D.A., Swait J.D. 2003. Stated Choice Methods - Analysis and Applications. 2nd edition. Cambridge University Press: Cambridge.
- McFadden D. 1974. Conditional logit analysis of qualitative choice behaviour. In *Frontiers in Econometrics*, Zarembka P (Ed). Academic Press: New York.
- Nelson P. 1970. Information and Consumer Behavior. *Journal of Political Economy* **78**: 311-329.
- Quandt R.E. 1968. Estimation of Modal Splits. *Transportation Research* **2**: 41-50.
- Rivers N., Jaccard M. 2005. Combining Top-Down and Bottom-Up Approaches To Energy-Economy Modeling Using Discrete Choice Methods. *The Energy Journal* **26** (1): 83-106.
- Roe B., Boyle K.J., Teisl M.F. 1996. Using Conjoint Analysis to Derive Estimates of Compensating Variation. *Journal of Environmental Economics and Management* **31**: 145-159.
- S.A.F.E. 2001. Energieeffizienz bei Elektrogeräten, Wirkung der Instrumente und Massnahmen, S.A.F.E.: Zürich.
- Sawtooth 1999. Choice-based Conjoint (CBC). Technical Paper. Sawtooth Software: Washington.
- Theil H. 1970. On the Estimation of Relationships Involving Qualitative Variables. *American Journal Sociology* **76**: 103-154.
- Topritzhofner E. 1974. Absatzwirtschaftliche Modelle des Kaufentscheidungsprozesses unter besonderer Berücksichtigung des Markenwahlaspektes
- Train K.E. 2003. *Discrete Choice Methods with Simulation*. Cambridge University Press: Cambridge.
- Truffer B., Markard J., Wüstenhagen R. 2001. Eco-labeling of electricity - strategies and tradeoffs in the definition of environmental standards, *Energy Policy*, **29** (11), 885-897.

Verma R., Iqbal Z., Plaschka G. 2004. Understanding Customer Choices in E-Financial Services. *California Management Review* **46**, No. 4, summer: 43- 67.

Waide P. 1998. Monitoring of energy efficiency trends of European domestic refrigeration appliances. Final Report. PW Consulting for ADEME on behalf of the European Commission (SAVE). PW Consulting: Manchester.

Waide P. 2001. Monitoring of energy efficiency trends of refrigerators, freezers, washing machines and waher-driers sold in the EU. Final Report. PW Consulting for ADEME on behalf of the European Commission (SAVE). PW Consulting: Manchester.

Wiel S., McMahon J.E. 2003. Governments should implement energy-efficiency standards and labels – cautiously. *Energy Policy*, **31**, 1403-1415.

Winward J., Schiellerup P., Boardman B. 1998. Cool Labels - The first three years of the European Energy Label. Environmental Change Unit, University of Oxford: Oxford.

Wüstenhagen R. 2000. *Ökostrom – von der Nische zum Massenmarkt [Green Electricity – from Niche to Mass Market]*, vdf: Zürich.

Biographies

Katharina Sammer is a PhD candidate at the University of St. Gallen. Her current research focuses on the relative importance of brands and eco-labels in consumer behaviour for environmental products, taking a conjoint analysis (discrete choice) approach. She studied economics and environmental system sciences at the Universities of Graz (Austria) and Lund (Sweden), and has worked on several projects to analyse attitudes and behaviour with regard to energy efficiency and transport decisions.

Dr. Rolf Wüstenhagen is Vice-Director of the Institute for Economy and the Environment at the University of St. Gallen, Switzerland. He teaches corporate sustainability, green marketing and management of sustainable energy. His research focus is on venturing for sustainable energy, including aspects of entrepreneurship, venture capital, marketing for innovations, and related policy issues. Prior to his current academic position he worked for a venture capital firm dedicated to sustainable energy technologies. He is a member of the Swiss Federal Energy Research Commission (CORE) and has published extensively.

Both authors can be contacted at the Institute for Economy and the Environment, University of St. Gallen, Tigerbergstrasse 2, CH-9000 St. Gallen, Switzerland. Tel.: +41-71-224-2583 (Sammer), -2587 (Wüstenhagen), Fax: +41-71-224-2722, E-Mail:




katharina.sammer@unisg.ch,

rolf.wuestenhagen@unisg.ch.

Internet:

<http://www.iwoe.unisg.ch>.

Appendix 1: Sample for Choice Task part of the questionnaire

If you would buy a washing machine today, which product would you choose? (assuming 5 kg wash load capacity)		
Miele	V-Zug	V-Zug
Equipment Version: Simple*	Equipment Version: Middle*	Equipment Version: Middle*
Water Consumption 39 l/Wash Cycle	Water Consumption 39 l/Wash Cycle	Water Consumption 58 l/Wash Cycle
Electricity Consumption 0.85 kWh/Wash Cycle	Electricity Consumption 1.3 kWh/Wash Cycle	Electricity Consumption 1.3 kWh/Wash Cycle
'C' Class Energy Efficiency	'A' Class Energy Efficiency	'B' Class Energy Efficiency
1890 CHF	3780 CHF	2650 CHF
		
<p>* Equipment Version:</p> <ul style="list-style-type: none"> • Simple: Spin speed up to 1000 rpm, Basic wash programmes • Mittel: Spin speed up to 1400 rpm, Basic wash programmes, Energy saving programmes, 'Easy Iron' programme, Handwash programme for wool, Quickwash programme, • Luxus: Spin speed up to 1600 rpm, Basic wash programmes, Energy saving programmes, 'Easy Iron' programme, Handwash programme for wool, Quickwash programme, Prewash programme 		
<p>Which of these three models would you buy?</p> <p>Please mark with a cross!</p>		
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3