

Evaluating soft measures: potential impacts of a web-based information tool about energy efficient products

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Keywords

appliances, web tools, survey, evaluation

Abstract

The overall objective of the web-based consumer information tool Euro-Topten is to promote the market transformation towards energy efficient products. Euro-Topten informs consumers about the most energy efficient products in various categories and thereby aims to directly influence the purchasing decisions of individuals or professional buyers.

Providers of internet-based information tools are confronted with the problem, that there is no bidirectional interaction with the users. Hence, it is difficult to evaluate if the specific needs of users are addressed, if and how the user processes this information and to what extent the information influences the user's decision making process.

To study these questions, a web-based survey was conducted in two consecutive rounds. In the first round the survey focused on the assessment of the information tool itself and the motivation for using the Euro-Topten websites. This survey was online on all active Euro-Topten partner websites from October to December 2012. In total, 1791 users completed the survey.

In the second round, a subset of the survey population was queried again. 1,043 participants agreed to take part in a more comprehensive follow up survey, 383 completed the second survey between May and July 2013. The second survey concentrated on the question how Euro-Topten has influenced the purchasing behaviour of the survey participants. This gave significant insights on how the information on the Euro-Topten websites has affected purchasing decisions of the surveyed users.

Based on a comparison of performance indicators of the most efficient products recommended on the Euro-Topten

websites with performance indicators of a base case product available on the market, avoided energy demand could be estimated for those users, who bought products from the Euro-Topten list. Based on these results, two impacts of Euro-Topten could be estimated: The influence of Euro-Topten on purchasing decision of users and the associated reductions in energy demand and CO₂-emissions.

Introduction

Energy efficiency is key to sustainable development in developing countries, economies in transition, and industrialized nations. To support that goal, the overall objective of Euro-Topten is to promote market transformation towards energy efficient products. Euro-Topten is a tool to promote Best Available Technology with producers and retailers, to raise consumer awareness, and to inform policy makers.

Topten provides consumers and professionals with credible, up-to-date information on the most efficient products available on their local markets. Since the main modes of action of the websites therefore are the dissemination of information and persuasion of consumers to buy more energy efficient products, Euro-Topten can be considered a soft measure (Bamberg et al. 2011). The first Topten websites have been launched more than 10 years ago, up to now 18 country specific national Topten websites are online. They present information on specific product categories in a consumer-friendly way, using pictures, listing functions, availability and prices, and comparing total costs (i.e. purchasing price plus energy and water costs accumulating over the product's whole life cycle) with those of a non-recommended model that is also available on the market.

Topten ratings cover energy-using products of interest to individual consumers and large buyers alike: cold appliances (refrigerators and freezers), wet appliances (dishwashers and washing machines), tumble driers, air conditioners, TVs, efficient lighting (CFL and LED), computer monitors, ink jet and laser printers, copiers and multifunction devices, cars, coffee machines, vacuum cleaners, pumps, etc.

As only the best-performing products are listed, the selection is much narrower than within existing labeling systems, making it easier for consumers to choose from among the thousands of products available. The selection is based on existing relevant national regulations and international energy measurement standards. Topten is neutral, rigorous and transparent. It is independent of and uninfluenced by manufacturers or retailers. The selection methodology is accessible online.

Euro-Topten mainly aims at directly influencing the purchasing decisions of individuals. Besides, the site also provides information to professional audiences, which use the websites and the criteria as a reference for their own activities such as energy consulting, customer service, training, awareness raising and public relations. Through these activities further indirect effects are achieved, which individual users (and our survey participants) are of course not aware of.

Consequently, this paper focuses only on the direct impact on the purchasing decisions of visitors of the Topten websites. To assess the website's impact, an online feedback survey of Euro-Topten websites was undertaken. The objective of the survey was to provide information about the typical users of Euro-Topten and to find out, how they purchase appliances in general and what Topten appliances they have purchased. In a final step, the associated reductions in energy demand and CO₂-emissions have been estimated.

Methodology and Procedure

Internet-based information tools are always confronted with the problem that there is no direct face-to-face interaction with its users. Hence, it is sometimes difficult to get a feeling of the specific needs of the user of the information, and to assess, how the user processes the information and which impact the information has on his or her decision making process. Therefore it is necessary to monitor, which user groups visit the website in order to adapt the website's content to their specific needs, to apply specific communication strategies and also to try to evaluate how the information influences purchasing decisions and which the associated benefits are.

Over the past ten years computer aided self interviews increasingly gained importance in the social sciences. This is mainly explained by the increasing number of internet users and the low costs of the survey method. In addition, data can be quickly and easily collected and processed, and in contrast to other survey forms the social desirability bias is rather low (Dillman 2009). Yet, when conducting and analysing web surveys researchers have to deal with two substantial limitations of the method, which both might significantly bias the results of the survey. The first one is the problem of under-coverage, the second one is a potential bias caused by self-selection (Bethlehem 2010). Web surveys are prone to the problem of under-coverage because internet access is not a randomly distributed variable. Instead, internet access correlates with certain socio-demographic variables like age and

level of education (Bethlehem 2010). Yet, in the present study under-coverage is not a problem. The target population of this survey is the collective of all users of the EuroTopten-websites. Since every user of the EuroTopten-websites has internet access by definition, under-coverage is not a problem. The problem of self-selection occurs because every potential respondent decides himself whether to participate in the survey or not. Biases due to self-selection are not restricted to web surveys. A multitude of different methods to correct a potential bias due to self-selection have been developed. Yet, none of these could be used in the present context due to limited information about the population. We therefore proceed with two assumptions: For the first round of the survey we do not expect self-selection to significantly alter the results. We therefore consider the sample to be representative of the population. The much smaller sample of the second round of the survey made us choose a different approach, which we will describe in detail in the paragraph "Assessment of overall savings through Euro-Topten websites".

The survey was developed in two consecutive rounds. For both rounds, LimeSurvey¹, an open source web-based survey application, was used.

THE FIRST ROUND OF THE SURVEY

The objective of the first round was to get a better impression of the different user groups, which are using the Euro-Topten websites. The main questions of this first round were:

- Which user groups visit the site with which motivation?
- How do the users evaluate certain features of the website?
- What are opportunities for improvement?

The questionnaire consisted of 17 questions that were partially closed- and partially open-ended to answer. It was translated and implemented as pop-up window on all national Euro-Topten websites. The web based feed-back survey was online on all 17 active Euro-Topten partner websites from October to December 2012 in different languages. In the following, we will mainly concentrate on the aggregated results for all 17 websites. The individual results for each national website will of course be different from these values, though we consider the aggregate results to give a valid picture of the general reception of the Euro-Topten websites.

Visitors

Over the three month period of the survey, 2,085 visitors activated the web survey and 1,791 (86 %) of them completed the whole survey. Therefore, 294 participants 'dropped out' of the survey during the answering process. For the following calculations and statistics only the participants who completed the whole survey are taken into account. In the same period about 400,000 people visited the Euro-Topten websites (based on Google Analytics²). Thus 0.5 % of these visitors took part in the web survey. The number of participants and the share of unique visitors³, which took part in the survey, varies between the different country websites (see Figure 1).

1. <http://www.limesurvey.org>

2. <http://www.google.com/analytics/>

3. Unique visitors in Google Analytics = total number of people who visited.

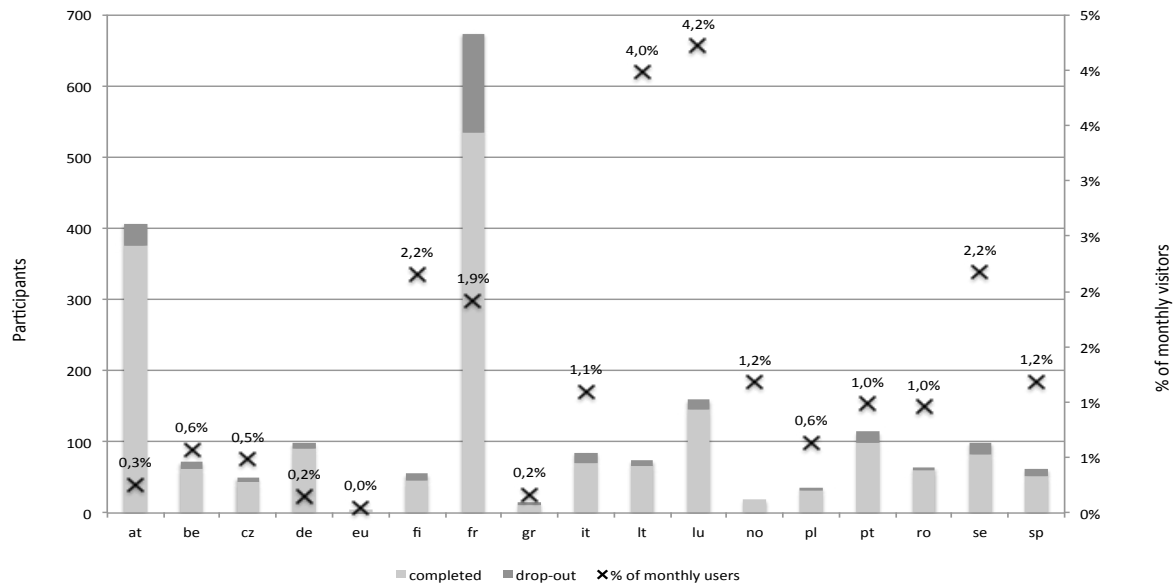


Figure 1. Number of participants per country and percentage of monthly users.

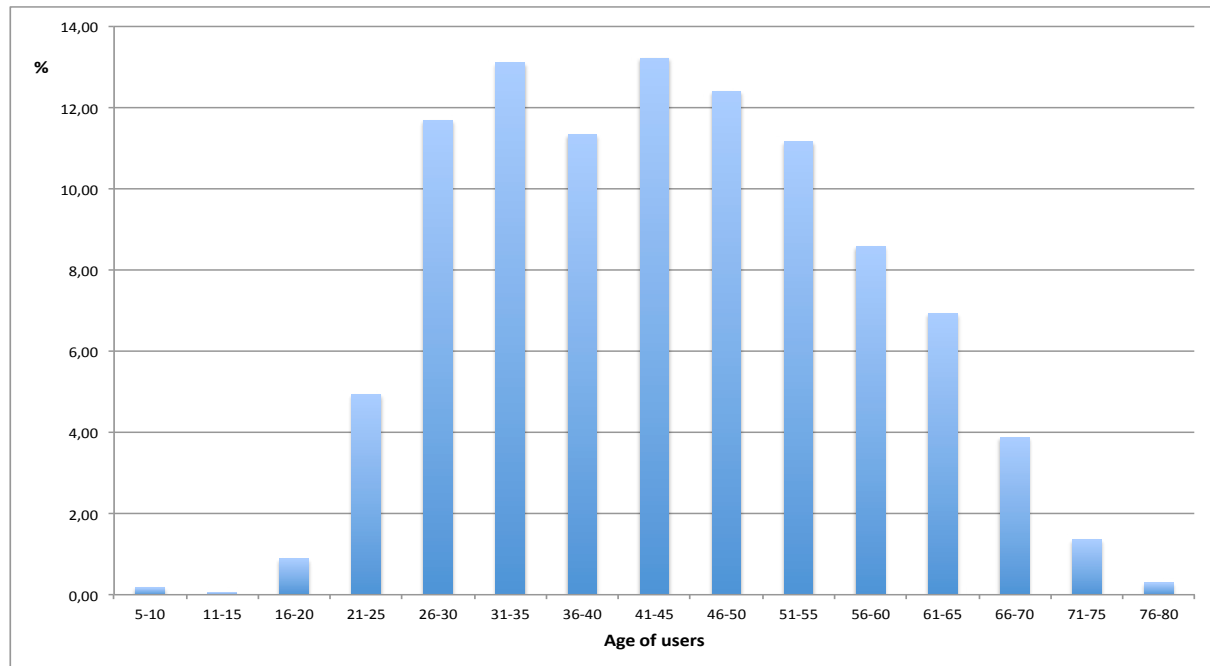


Figure 2. Frequency histogram of age of users of the Euro-Topten Websites.

Users of the website are on average 44 years old, which is a relatively high value for web-based information. A large majority of the sample (72 %) is between 30 and 60 years old (see Figure 2). This age group is usually associated with a relatively high purchasing power. As expected for internet-based information services, the share of male users is higher (58 %) than the share of female users (42 %).

Reasons for visiting of the Euro-Topten websites

Asked for their reasons for visiting the website, most participants answered that they are visiting the website for private purposes. The majority of visitors (54 %) uses the websites not

only to inform themselves but also to help with concrete purchasing decisions.

Only 10 % (183) of the survey participants use the website for professional purposes⁴. A majority of those (36 %) are

4. In a few countries, such as Austria or Germany, there are specific websites for professional users separate from the websites for private purposes. These websites do not belong to the Euro-Topten project and have not been part of the evaluation. This might slightly bias the results of the web survey insofar as professional users in these countries might use these website instead of the Euro-Topten website. In this case the share of professional users for all 17 Euro-Topten websites would be slightly higher without these websites specifically designed for a professional audience.

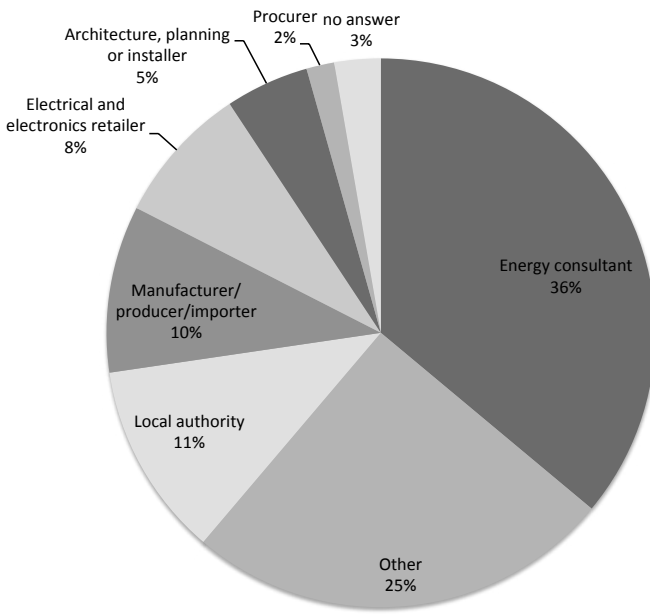


Figure 3. The use of the Euro-topten Websites by professional users.

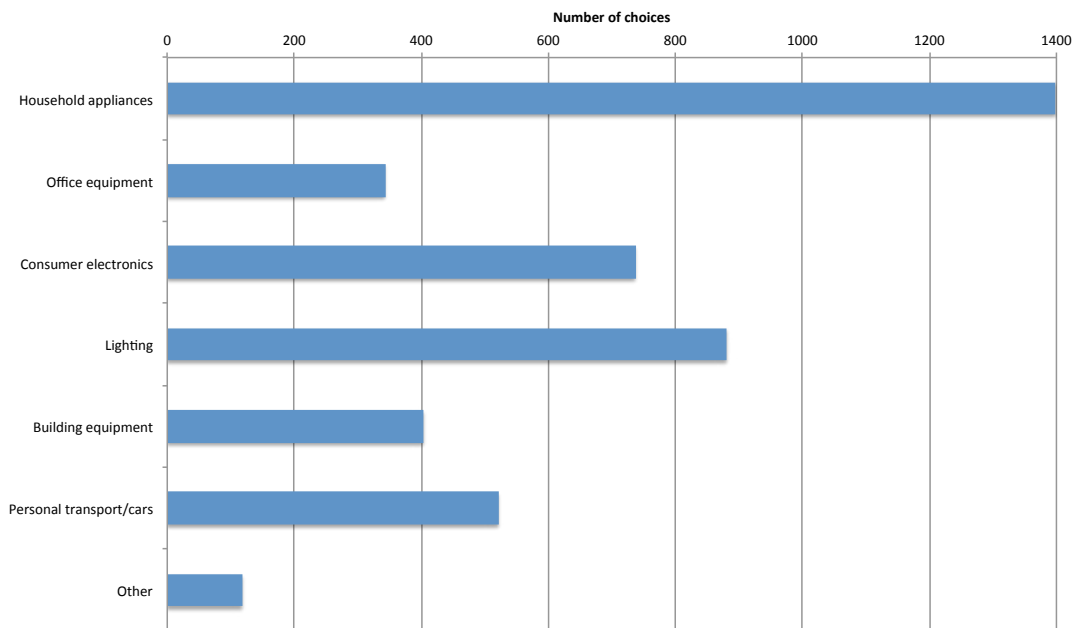


Figure 4. The categories users of the Euro-Topten Websites are most interested in (multiple responses were allowed).

working as energy consultants, as Figure 3 shows. This implies that the Euro-Topten websites also serves as a reference for appropriate energy advice and that the information are made available to a larger number of consumers due to this multiplier effect.

Household appliances, lighting and consumer electronics are the categories the participants of the survey are most interested in (see Figure 4). This is consistent with the number of page views each of the respective categories gets.

Assessment of the Euro-Topten websites

Overall, the visitors assess the website very positively (see Figure 5). Especially the easy navigation of the website, the product comparison and the transparent selection of products are rated positively. The least rated properties are the actuality of the website’s content and the range of product categories. Still, 58 % of the respondents agree with the statement, that the actuality and range of product lists are sufficient. Of course, this assessment varies between the different country specific web-

sites, because there are different ranges of product categories and update cycles. For example, for the Austrian website, with the largest variety of products and frequent updates, 73 % of the users assess the product range as sufficient and 74 % assess the actuality as good.

THE SECOND ROUND OF THE SURVEY

Building on the knowledge about user groups and the user's evaluation of Euro-Topten websites gained in the first round of the survey, the second round of the survey was designed to provide further insights into the concrete use of the information and its influence on the users' purchasing behaviour. In a final step, the reductions in energy demand and CO₂-emissions have been estimated based on information about which Topten appliances the users have purchased in the past year.

The impacts are calculated for all websites together. Country-specific evaluations could not be conducted as the number of participants per country did not allow for such an evaluation.

For the second round, a subset of the first survey's participants was surveyed again. A requirement was that they entered their e-mail address during the first round as well as their permission to contact them again for a second survey. Of the first survey's 1,791 participants, 1,043 (58 %) entered their e-mail addresses and agreed to take part in a follow up survey. Of these, 383 persons completed the questionnaire, which corresponds to a response rate of 36.7 %.

Preferred product characteristics and sources of information

The main goals of the second survey were gaining knowledge on the different sources of information consumers consider when making purchasing decisions and the influence of the

EuroTopten-websites on their purchasing behaviour. This was used to assess how and to what extent information on the Euro-Topten websites affect the users' decision-making process.

When asked which specific properties of a product are important, a majority of participants prefers quality and long-lasting products with low energy consumption or environmentally friendly operation over design or colour or a certain brand – which are less important (cf. Figure 6).

Looking at the buying behaviour, it turned out that only 9 % of the users buy their appliances exclusively on the internet, 45 % buy exclusively in retail stores and 34 % use both. Even those buying exclusively offline consider the internet an important source of information before buying a product, especially the Euro-Topten websites (cf. Figure 7).

Resulting savings by the participants of the survey by appliances purchased

Altogether, 383 survey participants purchased 399 very energy efficient products over the last year, which were listed on the Euro-Topten websites. Of those, 315 participants (82 %) bought one or more products, while 68 participants bought no product. The majority of survey participants bought either a household appliance or a lighting device.

Table 1 lists the estimated savings that are induced by these purchases. The reduction of the end energy consumption is calculated by subtracting the mean for the energy consumption of the ten most efficient products as listed on the Euro-Topten websites from the energy consumption of an average product available on the market. Over the lifetime of the products, end and primary energy savings of the products bought by survey participants are estimated to be 931,344 kWh and

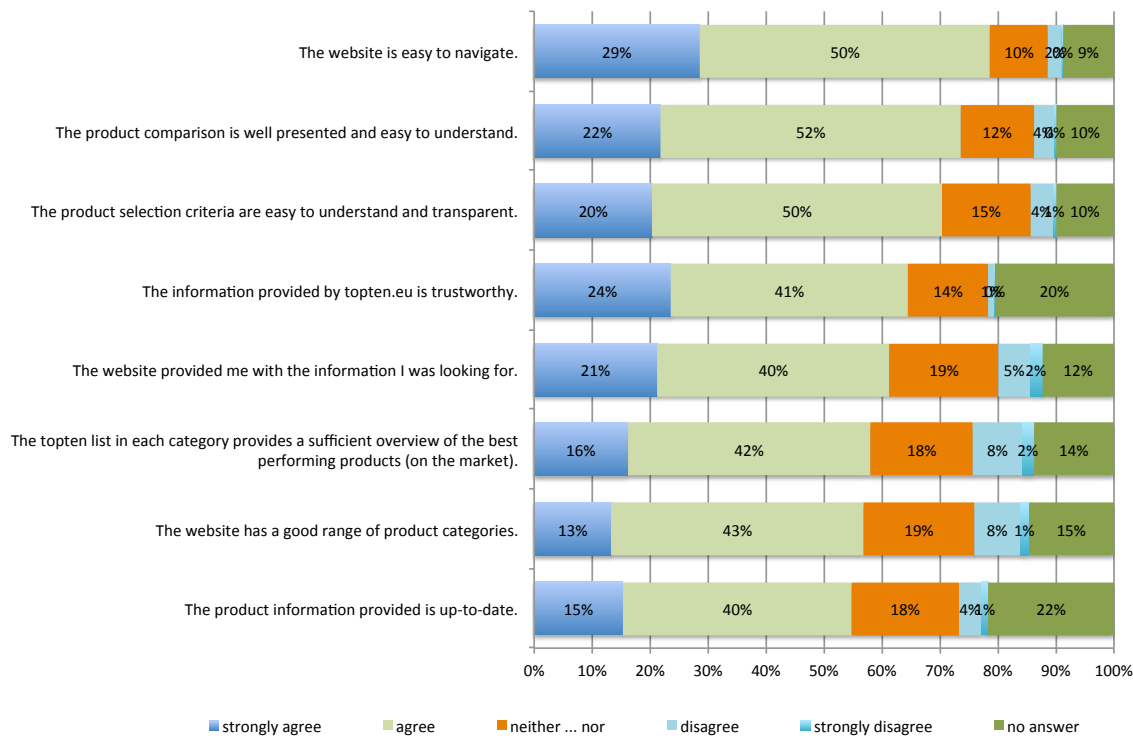


Figure 5. The assessment of the Euro-Topten websites by users is very positive.

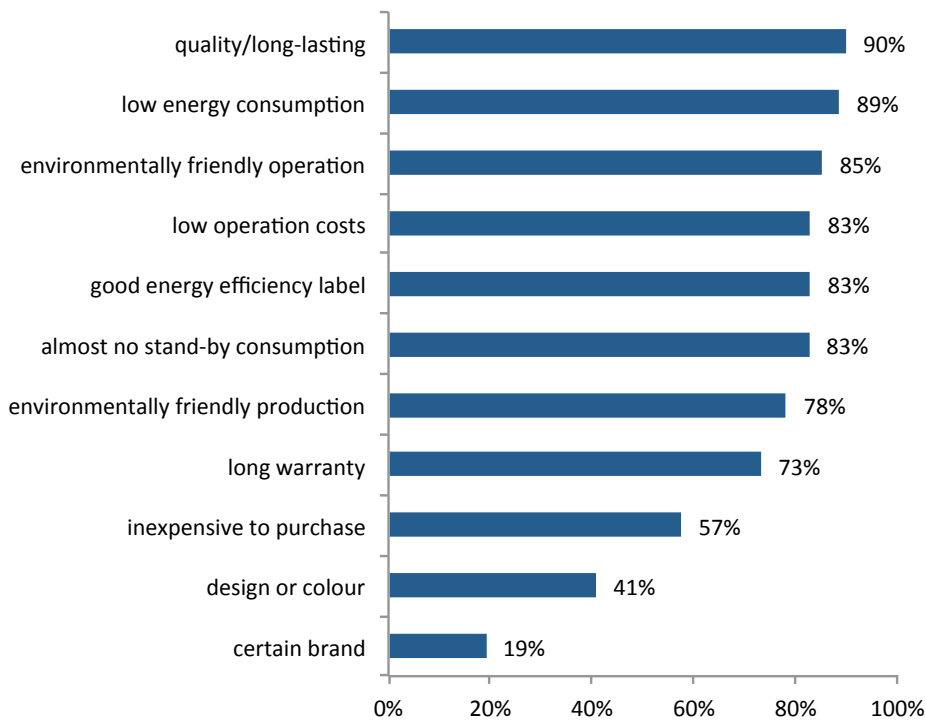


Figure 6. Most frequently considered appliances characteristics.

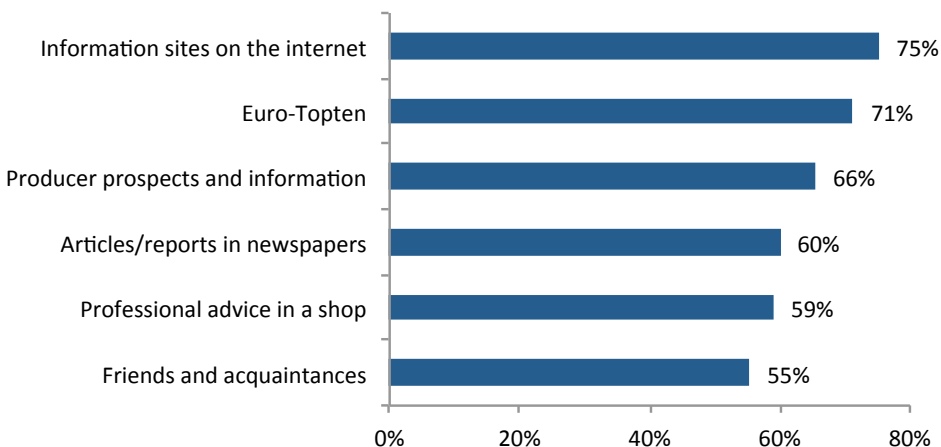


Figure 7. Sources of information for the purchase of a product.

1,727,859 kWh, respectively. A CO₂ emissions abatement⁵ of 345 t is associated with these energy savings.

Looking at the shares the different product groups contributed to the total CO₂ mitigation (see Figure 8), it should be noted that besides the high contribution of household appliances, almost one third of the total emission mitigation is induced by the survey participants' purchase of more energy efficient cars. Although only six survey respondents have purchased a car, the large relevance of car use for an individual's energy demand

means that high energy savings can be achieved if a more energy efficient car is bought. The calculations only consider the savings from the purchases of more energy efficient product recommended on the Euro-Topten websites. Considering that 71 % of the visitors stated that they use the information of the Euro-Topten websites before they purchase products, it is likely that the information leads to a more efficient product even if it is not on the Euro-Topten list.

Assessment of overall savings through Euro-Topten websites

Assessing the overall energy and CO₂ savings based on a web survey, we had to find a way to deal with the "self-selection bias" (Bethlehem 2010). This bias arises when a sample is not

5. Source for calculation www.eumayors.eu/IMG/pdf/technical_annex_en.pdf, www.topten.eu.

Table 1. End energy, primary energy and CO₂ savings caused by the participants of the survey.

Categories	Bought Topten appliances	End energy reduction for an average Topten model [kWh/a]	Lifetime of savings [a]	End energy reduction for all given purchases over lifetime [kWh]	Primary energy reduction for all given purchases over lifetime [kWh]	CO ₂ reduction for all given purchases over lifetime [t CO ₂]
Fridge/Fridge Freezer	35	150	15	78,750	196,875	36.23
Freezer	23	120	15	41,400	103,500	19.04
Dishwasher	21	50	15	15,750	39,375	7.25
Washing Machine	27	80	15	32,400	81,000	14.9
Tumble Drier	16	320	15	76,800	192,000	35.33
Vacuum Cleaner	15	80	10	12,000	30,000	5.52
Coffee Machine	6	133	10	7,980	19,950	3.67
Other Household Appliances ¹	12	100	10	12,000	30,000	5.52
Monitors – Flat Screen	3	28	5	420	1,050	0.19
Laser Printers/Multifunctional	9	400	5	18,000	45,000	8.28
Other Office Equipment ²	1	200	5	1,000	2,500	0.46
TV	23	120	10	27,600	69,000	12.7
Other Consumer Electronics ³	6	100	5	3,000	7,500	1.38
Energy saving lamp (CFL)	72	40	15	43,200	108,000	19.87
LED	111	30	15	49,950	124,875	22.98
Halogen	2	15	2	60	150	0.03
Heat Pump	3	1,850	15	83,250	208,125	38.3
Circulation Pump	5	320	15	24,000	60,000	11.04
Air Condition	2	115	15	3,450	8,625	1.59
Car	6	5,560	12	400,334	400,334	100.8
Other Mobility ⁴	1	–	12	–	–	–
Total	399	9,811		931,344	1,727,859	345,06

¹ iron, hairdryer, steamer, chest freezer, electric kettle, kitchen machine

² laptop

³ camera, stereo system, laptop

⁴ motorcycle

randomly drawn from the population, but possible respondents decide themselves whether to participate in the survey or not. This has also been the case in this survey.

Several ways to deal with a self-selection bias are discussed in the literature (Nicolini 2011). One such method is the Propensity Score Matching. Yet, to perform Propensity Score Matching in this case, we would have needed a lot more information about the population (i.e. all website users). Within this project we did not have the resources to gather the respective data.

Therefore we are only able to acknowledge that a self-selection bias likely influences the results. When interpreting our survey's results one has to take further limitations into ac-

count: Given the number of 1.4 million unique visitors of all Euro-Topten websites annually, the sample size of 383 is rather small. Furthermore, it seems reasonable to assume that the likelihood of answering the survey is higher for those users who have bought one or more products recommended on the Euro-Topten websites since taking the time to answer the survey is an indicator of a comparatively high salience of the issue of energy efficiency to the individual.

To deal with this and not overstate the savings induced by Topten, we extrapolated the total savings induced by the website based on the number of unique visitors, whose visit duration is more than only a few seconds, and not based on the total number of unique visitors. The web statistics showed a

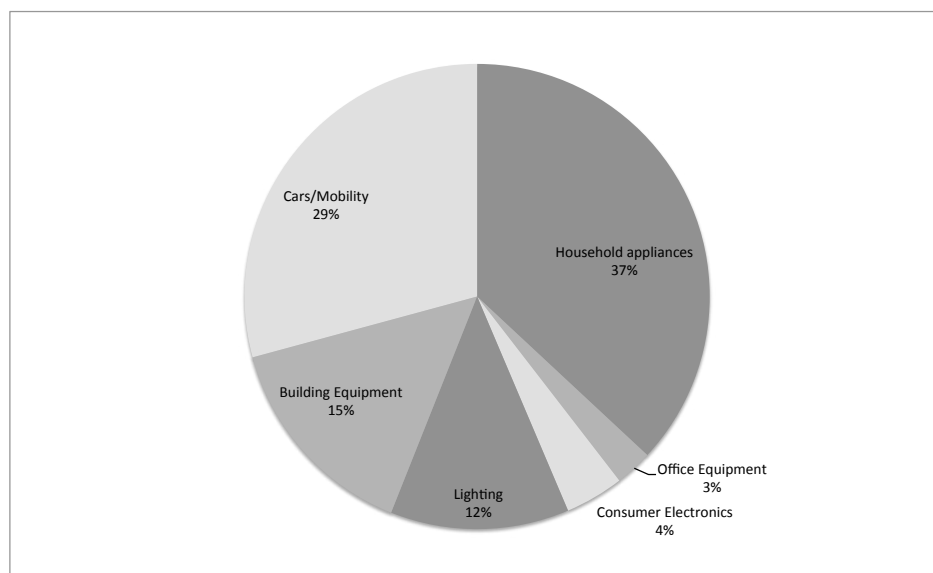


Figure 8. Shares of product categories relevant for CO₂ mitigation.

Table 2. Energy and CO₂ savings through Euro-Topten websites.

	Savings over the lifetime of products per Unique Visitor	Savings over the lifetime of products for 1 year of operation of Topten	Savings per year for 1 year of operation of Topten ¹
End energy savings	243 kWh	340 GWh	26.5 GWh/a
Primary energy savings	451 kWh	631 GWh	49.1 GWh/a
CO ₂ mitigation	90.1 kg	126,133 t	9,815 t/a

¹ The average lifetime of products is 12.85 years, the weighted arithmetic mean of the lifetimes as specified in Table 1.

bounce rate⁶ of about 50 % and an average access time of two to five minutes on all national websites. For the calculation of energy savings and mitigation of CO₂-emissions, we therefore have corrected the number of unique visitors by dividing them by two. In a further step, we have multiplied the resulting number of unique visitors by 0,2 to factor in that the users who answered the survey are assumed to have a higher likelihood of buying a product recommended by Euro-Topten (i.e. consulting the website for advice before buying a certain product). It should be noted that the factor of 0,2 is our own assumption to stay on the safe side. This assumption is backed up by the results of an online survey of the purchasing behaviour of visitors of the Swedish Topten website (Lönngrén 2014).

Based on these assumptions, the number of purchases of more energy-efficient products due to the website's information can be calculated by dividing the number of unique visitors by a factor of 10.

All European Euro-Topten websites have 1.4 million unique visitors per year. The resulting energy savings are listed in Table 2, as is the mitigation potential.

Conclusions

From October 2012 to April 2013 an online survey on all Euro-Topten websites was conducted in two consecutive rounds. In the first round 2,085 visitors activated the web survey and 1,791 of them completed the whole survey. In the second round, 1,043 participants of the first round were asked to answer additional questions. Of them, 383 participants completed the second online questionnaire.

Though web surveys have their own limitations, we did learn a lot of lessons about the users of the Euro-Topten websites, their evaluation of the respective websites and their content and on how the website's information influences consumer behaviour.

The main takeaways with respect to user demographics are the following: The share of male users of the Euro-Topten websites (58 %) is a little higher than the share of female users,

6. The bounce rate is defined as the percentage of visitors who leave the website without visiting any other of the website's pages but the entry page.

though one cannot say that the website users are predominantly male. The mean age of the website user is 44 years, which places it right in the middle of the age group with the highest expenditures for purchases of products. An overwhelming majority of website users visits the website for personal purposes. Still, ten per cent of the users need the website's information in their professional capacity. Most of the "professional" users are energy consultants. This shows that Euro-Topten also functions as a reference for information on the most energy-efficient products for consultants and implies that it also indirectly generates impacts whenever energy consultants communicate the website's information to their clients.

More than half of the visits to the Euro-Topten websites are in order to inform a specific purchasing decision. The product categories which attract the widest interest are "household appliances", "lighting" and "consumer electronics".

In general, the users of the Euro-Topten websites evaluate them as very user-friendly. More than two third (70 %) of the surveyed users consider the website to be easy or very easy to use. Other properties rated highly are the selection criteria and the product comparison. Few users criticise a lack of actuality and a low number of product categories. Consequently, 85 % of the survey participants would recommend the Euro-Topten website to a friend.

A second survey with a much smaller sample was conducted in 2013 to assess if and how the Euro-Topten websites influence the purchasing behaviour of consumers. The sample population of 383 has altogether bought 399 products recommended on the Euro-Topten websites. As could be expected, the survey participants place high regard in energy-efficient products with a long lifetime. While an environmentally friendly operation is also highly considered, design or brand is of lower importance to the survey participants. More than half of the survey participants purchased their Topten-product in a retail store. With buying a more energy-efficient product, the website's users have saved 931,344 kWh of end energy and 1,727,859 kWh of primary energy. This energy saving is associated with a mitigation potential of 345 t CO₂.

Extrapolating the results for the survey participants to all users of Euro-Topten websites under the assumptions described in section "Assessment of overall savings through Euro-Topten websites" yields savings of 340 GWh of end energy and 631 GWh of primary energy. This equates to a mitigation potential of 126,133 t CO₂.

Yet, our results are subject to the methodological limitations of web surveys. These methodological limitations are not unique to our study, but are inherently connected to web surveys. Future research should deal with methods to check and correct for biases due to self-selection. Furthermore, future

studies of the impacts of web based information tools should not only employ retrospective web surveys, which might also suffer from recall bias, but be supplemented by other methods to measure the influence of web based information on actual decision-making. This is also a task for future research, and, as always, also a question of available resources.

While we acknowledge the methodological difficulties associated with web surveys, our study has shown that websites helping consumers to make informed decisions with respect to the energy efficiency of the products they are about to buy, can have great impacts. As such they are an important part of a strategy promoting energy efficiency. Yet they depend on other policies incentivising the development of more energy efficient products. Without these, the Euro-Topten website probably had not as energy efficient products to recommend as it has with these policies. This complicates the issue of attribution, which we have neither discussed in detail nor have we quantified the share of the mitigation potential attributable to the Euro-Topten websites in absence of other policies. Nevertheless, one cannot ascribe the estimated mitigation potential to the websites alone. Without other policies, the website's impact would most certainly be different.

Still, consumer information and related soft measures should have their place in any policy mix promoting energy efficiency. They are complementary to minimum energy performance standards like those defined by the Ecodesign Directive. While the latter defines a minimum standard, websites like Euro-Topten help those consumers who want to support even more energy efficient products with their purchasing behaviour to make the right decision and save further energy costs. Therefore the potentially quite substantial additional energy savings achieved by web based information portals may not be disregarded.

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