# Choosing to save

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*Various barriers for the uptake of energy-efficiency measures in the domestic sector have been identified. Projects try to quantify the effect of individual barriers like transaction costs, information lack, access to technologies or convenience. We propose to use the 'consumer choice chain' as a wider framework to understand energy-efficiency choices by domestic consumers. This allows comparison of energy-efficiency behaviour between consumer segments, applications, and countries. Thus policy makers can target and monitor campaigns and policy measures. As the 'consumer choice chain' tracks the movement of consumer shares over time, it also allows the quantification of time lags involved in consumer responses.*

## 1. Introduction

Many governments have identified energy-efficiency as the most cost-effective way to meet targets for reducing energy-import dependency and reducing greenhouse gas (GHG) emissions. This approach has been successful to some extent, for example in the UK during the 1990s, where primary energy consumption increased by 0.7% per year, far[2] below the GDP growth of 2.5% per year.[3]

The domestic sector accounts for 31% of UK energy consumption and will be the focus of this analysis. Domestic energy consumption increased at a faster growth rate than industrial consumption, at 1.4% per year in the 90s.Without energy-efficiency measures and better

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[2] The energy intensity of the UK economy has been falling at a rate of about 1.5% per year since 1950.

[3] Cp.: Haydock (2002, p. 2 et. seqq.).

insulation, domestic consumption would have increased by an additional 2% per year (Shorrock and Utley, 2003). The dramatic impact of such small percentage growth rates are illustrated in Figure 1.

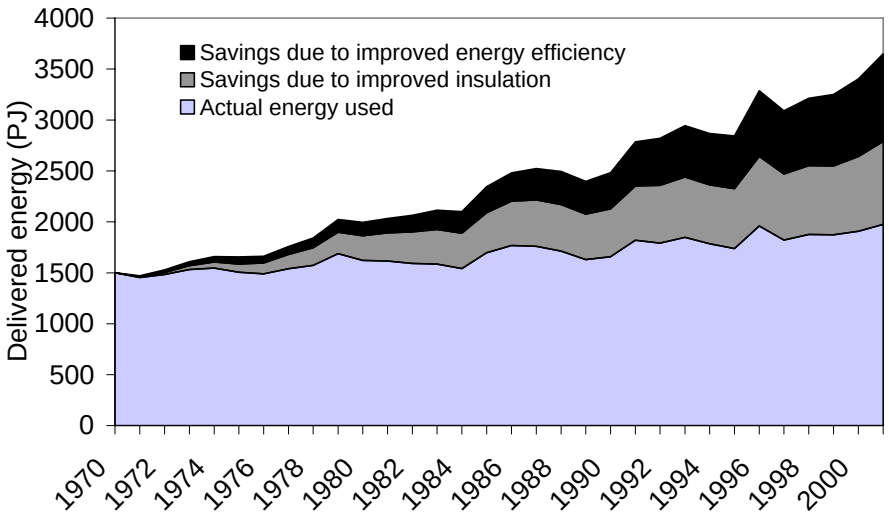


**Figure 1: The effect of energy-efficiency improvements on energy consumption of housing stocks** (Shorrock and Utley, 2003)

Again using the example of the UK, Figure 2 shows that the strongest increase of final energy consumption is in end use for light and appliances (130% from 1970 to 2001). Today's homes contain more household appliances than ever and "UK households spend around £5 billion each year on electricity to power lights and appliances, which account for around a quarter of UK electricity consumption."[4]While this accounts for only 13% of the final energy consumption, 2-3 times of the primary energy input is required to generate the needed electricity, increasing the relative share of light and appliances to almost 1/3 of total domestic energy consumption.

[4] see for example Department for Transport and Industry (2003, p. 37).

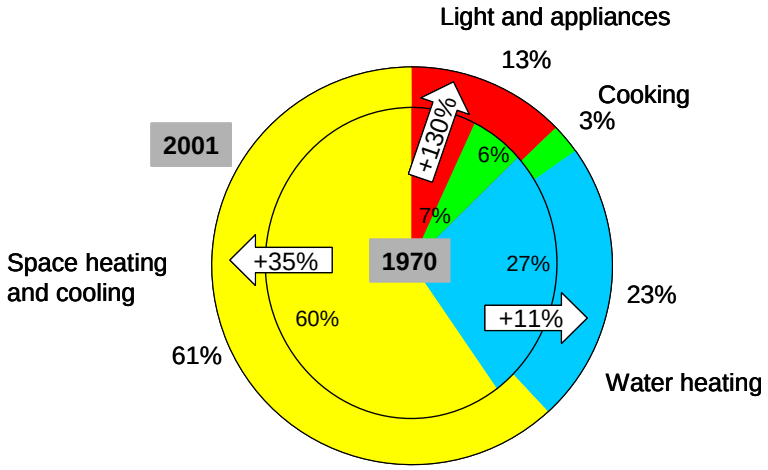


**Figure 2 Contribution to domestic energy consumption in 1970 and 2001.**

Source: Shorrock/Utley (2003, p. 75)

The International Energy Agency (2003, p. 30) identifies several items in the lighting/ appliances end use, such as the growing number of consumer electronics (television, DVD player/recorder, game consoles, computer, broadband, etc.), white appliances (especially tumble dryers), indirect lighting, etc., as the reason for the major energy consumption increase. However, policy makers are most worried about standby energy consumption by an increasing number of appliances. In the UK, video and TV devices consume ~£150 million worth of electricity while on standby.

The remainder of the paper will introduce a methodology and initial results mainly relating to light and appliances. However we think that our methodology should also support policy makers in addressing domestic energy consumption and investment decisions relating to space and water heating. Their large shares in domestic energy consumption certainly warrant effort for more effective service provision.

The European Commission estimates that overall 20% of energy-efficiency measures are cost effective. If we assume that a similar figure applies to the domestic sector, we have to ask

why domestic consumers do not chose cost effective options that induce net savings for respective households as well as benefits to society from reduced energy consumption. This is frequently referred to as the 'energy-efficiency paradox'[5] or the 'cost perception gap'[6]. Currently, various barriers for the uptake of energy-efficiency measures in the domestic sector are being discussed, and ongoing research projects are trying to quantify the impact of barriers like transaction costs, lack of information, access to technologies, access to capital markets to finance upfront costs or convenience (see also Oxera 2006 and Defra 2006). These approaches provide valuable insights into the effect of individual barriers, but, they do not provide a framework to quantify the decision-making process of domestic consumers. By developing such a framework we could reveal why consumers are not adopting energy efficient measures. We should thus be in a position to better anticipate the impact of and targeting policy choices, marketing campaigns and new product interfaces.

Assume an information deficit is identified as the main barrier for the take-up of an energy-efficiency measure. Would it imply that the provision of information results in a large uptake of the energy-efficiency measure? The authors of the EU-Green Paper[7] are not alone in believing that national programmes are not achieving lower energy consumption in the domestic sector. The overall number of programmes adopted is small and many policy activities are not assessed ex-post.

We apply the 'consumer choice chain' to understand energy-efficiency choices by domestic consumers (Finskud, 2003). Several blue chip companies have successfully applied the

[5] Cp.: Pacala/Jaccard (2004), who notice a divergence between the social optimum and the actual level of investment in energy efficiency by consumers.

[6] Cp.: Oxera (2006), who identify the key barrier that consumers have poor knowledge of the costs and benefits of measures, and tend to overestimate the costs and installation time while underestimating the savings.

[7] See EU Commission (2000) "Green Paper. Towards a European strategy for the security of energy supply".

concept to enhance the understanding and market performance of their consumer products. The ‘consumer choice chain’ identifies solid fact-based phases in the development of consumers’ attitude, opening the “black box” of individual choices and behaviour. This can be applied to the aggregate population or individual segments and reveals at each successive stage the fraction of the segment remaining in the chain in terms of the surveyed purchase choice or action. Adapting this concept to the specific requirements of energy-efficiency provides a robust quantitative framework to analyse choice behaviour by domestic energy consumers. This should allow policy makers to identify consumer segments and policy measures with high policy impact, and offers an objective approach to quantifying the performance of a policy. If a similar consumer choice chain is applied to different consumer segments or different countries, then this might help to identify whether some segments/countries have developed desired behaviour and then point to successful measures that could potentially be replicated for other segments/countries. Such comparison could then also allow for the development of ambitious and yet achievable energy-efficiency targets. Finally, the distribution of consumers in the ‘consumer choice chain’ can be used as a lead indicator to assess whether a country is on track to achieve energy-efficiency targets.

A multitude of surveys that have been commissioned can be related to domestic energy-efficiency (See Table 1). These typically concentrate on the penetration of branded products, rather than on the influence of the brand on the purchase decision. If attitudes are requested, questions are frequently rather vague. For example, in general questions would be phrased to elicit information on the overall awareness of the climate change and would not explore the link between climate change and individual choices or behaviour. We combine several of these studies to ‘fill’ the ‘consumer choice chain’. This requires matching questions asked during these surveys to the questions we would have liked to ask. Both the combination of different surveys and the use of similar but not identical questions reduces the accuracy of our empirical results. They are therefore only indicative for the type of results a ‘consumer choice

chain' allows. Further research would aim to pose these questions explicitly, for example as part of the Eurobarometer survey (Eurobarometer 2005).

## 2. The choice chain

Applying the 'consumer choice chain' to energy-efficiency decisions in the household sector aims to open the "black box" of individual choices. Figure 3 illustrates the principle of the choice chain. The first stage is defined as the total population or a socio-demographically defined segment of the population. The following stages represent successive choices, where a portion of consumers move to a further stage by making a certain choice, while the other fraction of the population separates itself out of the chain. In the end, the population of the final stage corresponds to the fraction of the initial population that uses the product or exhibits the behaviour.

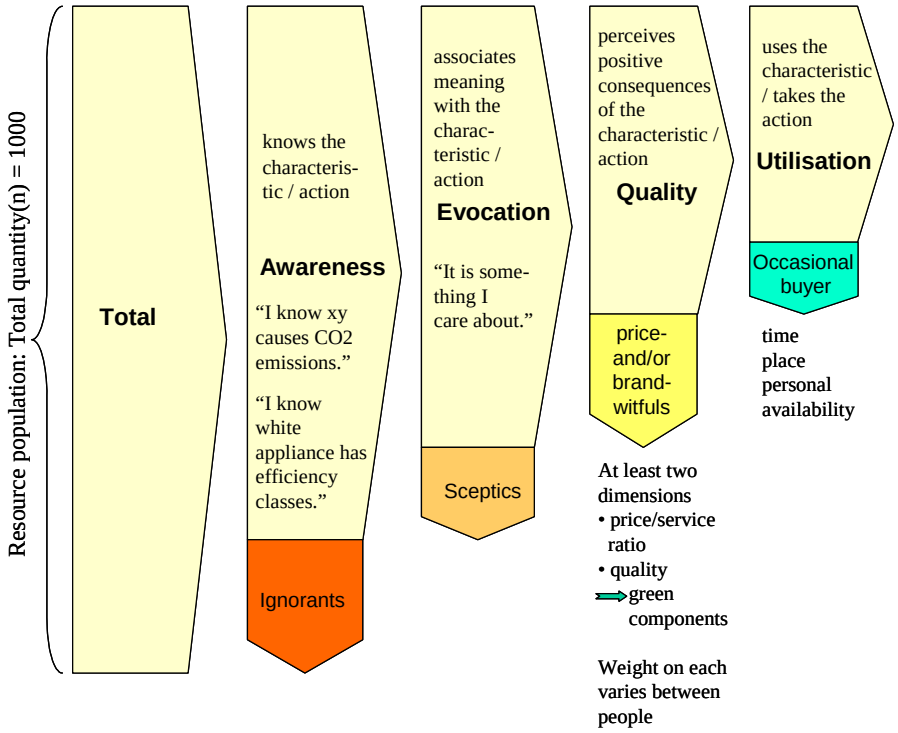


**Figure 3 The consumer choice chain**

To structure the choices for energy-efficiency, we used the following stages:

- Awareness and understanding: individuals who do know the link between their specific choice/action and the environmental impact.
- Committed: individuals for whom the specific choice/action is meaningful in terms of counteracting climate change or reducing $CO_2$ emissions.
- Disregards: individuals who know the link between their specific choice/action and the environmental impact but disregard the possible efforts.
- Quality perceivers: individuals who consider the specific energy-efficient choice/action.
- Users: consumer who have exhibited or who exhibit specific energy-efficient choices/behaviour.

The chain identifies in the first place the user group of convinced individuals who pass every stage of the chain with respect to energy-efficient consumption or action decisions. The individuals in this user group are aware of the link between their specific choice/action and the environmental impact. They choose or act according to a conviction that the specific effort makes sense in terms of counteracting climate change or reducing $CO_2$ emissions. In addition, the specific decision shows a marked 'green' quality component, which can even outweigh a higher purchase price. Some of these converts are also ambassadors by their (occasional, regular, or exclusive) environmentally conscious efforts.

The 'consumer choice chain' allows us to quantify the stock of these "converts", who receive, understand, and internalise the message of facing up to climate change through their own actions. Moreover, analysis of the consumers' residency at each of the stages also helps us to understand which phases of the take-up process are under-utilised or ignored under current conditions and/or policies. Finally, the 'consumer choice chain' clarifies that it takes different efforts or policies to influence individuals' decision process, and to move individuals along the chain from one stage to the next. For example, if information access is a dominant barrier for a product, then the choice chain will exhibit a strong decline in participation as early as the

first stage. However, higher awareness, created, for example by a advertising campaign, might not feed through to an increase in the population with evocation. This might indicate that the campaign should express issues with a stronger context of personal responsibility. Finally, if principle agent problems between landlord and tenant distort the cost allocation of domestic insulation, this might result in a drop in utilisation of despite high quality perception.

## 3. Empirical example

For the population of the following chains, data has been adopted from related studies concerning attitudes towards climate change/environment, the European labelling scheme for cold appliances or environmentally conscious efforts (Table 1). However, the interpretations must always take into account that existing and accessible surveys were not structured in accordance with the stages designated in our prototype 'consumer choice chain'. In addition, in many cases, the available data were not homogeneous across time and country. Nevertheless, the population of the prototype chain provides initial insights into the take up process of individual energy-efficient choices and actions.

| Source | Aware | Evocation | Quality | User |
|---|---|---|---|---|
| Bundesamt fuer Energie 2005 | X | X | X | X |
| International Energy Agency 2003 | | | | X |
| Energy Saving Trust 2005 | X | | | |
| Organisation for Economic Co-operation and Development 2001 | X | X | X | |
| National Consumer Council 2003 | X | | X | |
| National Consumer Council 1997 | | | | X |
| Eurobarometer, Energy 2002 | | X | X | |
| Eurobarometer, Attitudes 2003 | | | X | X |

Table 1 Surveys on energy-saving bulbs

Figure 4 shows the applicability of choice decisions to energy-efficient cold appliances in the UK, Finland, the Netherlands, and Switzerland. It illustrates a general strong decline in the first three stages for all the countries surveyed. It is apparent that the UK population has a similar level of awareness to that of the Finnish and Dutch populations, so initial improvements might be achieved by inducing informed people to be more committed. Figure 4 also illustrates a strong decline in the quality phase of the countries surveyed, which might be overcome by convincing consumers that specific energy-efficient components are a quality-increasing aspect of the product.

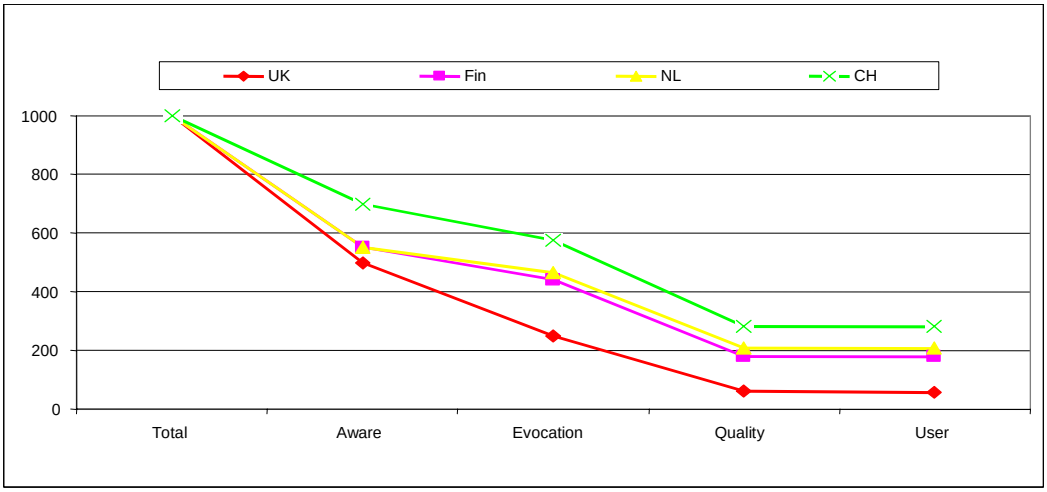


**Figure 4 Prototype 'consumer choice chain' applied to cold appliances**

Figure 5 shows the applicability of choice decisions to energy-saving bulbs in the UK and Switzerland. Compared to the purchase of cold appliances, the purchase of light bulbs does not represent an important mid-term decision, as the investment volume is lower. Nevertheless, the comparison with Figure 4 provides interesting insights. It illustrates, for example, that more UK consumers are aware of the environmental impact of non energy-efficient light bulbs than of cold appliances. Moreover, the chain for the UK remains more stable throughout the stages than Figure 3, resulting in significantly more purchases. The case of Switzerland shows the number of aware consumers at the same level as in Figure 4.

However, many more Swiss consumers leave the chain at the evocation stage, indicating that they do not perceive the use of energy-saving light bulbs as meaningful in countering climate change. Compared to the UK, more Swiss consumers assume the quality of an energy-saving bulb (lighting, energy consumption, longevity, etc.) inferior to other lightning products. In sum, the number of energy-saving bulb users is smaller in Switzerland than in the UK, indicating that a higher level of aware consumers does not necessarily lead to a higher number of users.

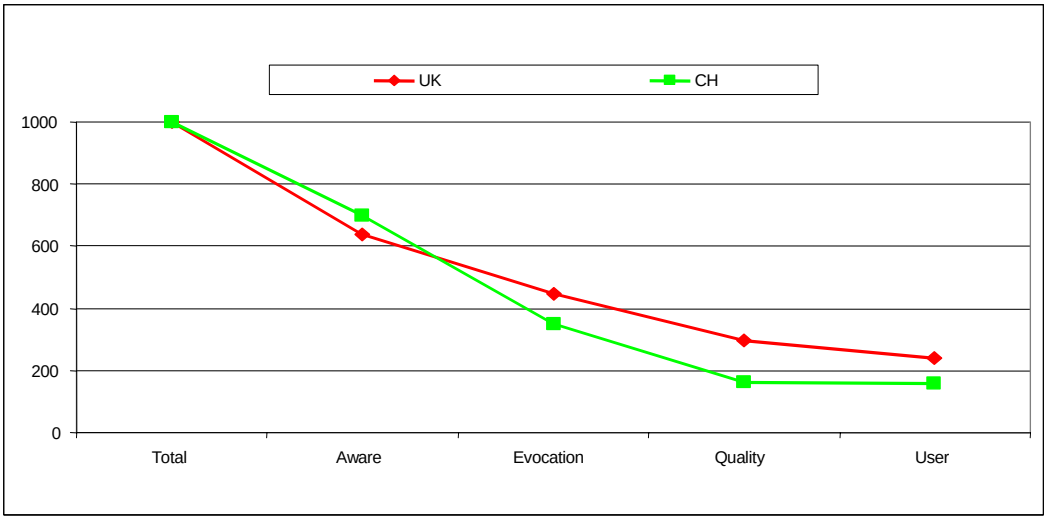


**Figure 5 Prototype 'consumer choice chain' applied to energy-saving bulbs**

Figure 6 illustrates the take-up of recycling, green purchasing, and switch-off behaviour in the UK. Each chain shows a rather similar trend for these three relatively different efforts.

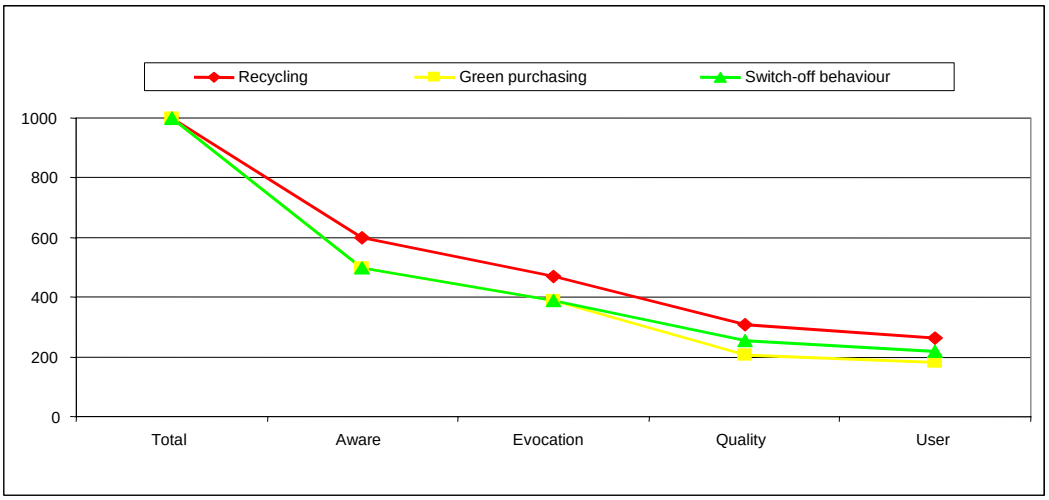


**Figure 6 Prototype 'consumer choice chain' applied to energy-saving bulbs**

Even if individuals separate out from the chain at earlier stages, it does not imply that they cannot make energy-efficient choices or actions. Choices or actions of some user groups might have an energy-efficient impact; the specific decision, however, is economically driven, with a strong focus on the price component or price-performance ratio. Specific user groups, for example, switch off the standby mode of their electronic appliances on a regular basis. The reason for this action, however, is the (quality) criteria of saving money on the electricity bill and not the reduction of $CO_2$ emissions. Economically driven energy-efficient user groups differ from i) the economical unawares who leave the chain at the first stage and ii) the economic disregards, who leave the chain at the second stage. Figure 7 illustrates a potential design of the consumer choice chain that could address this concern.

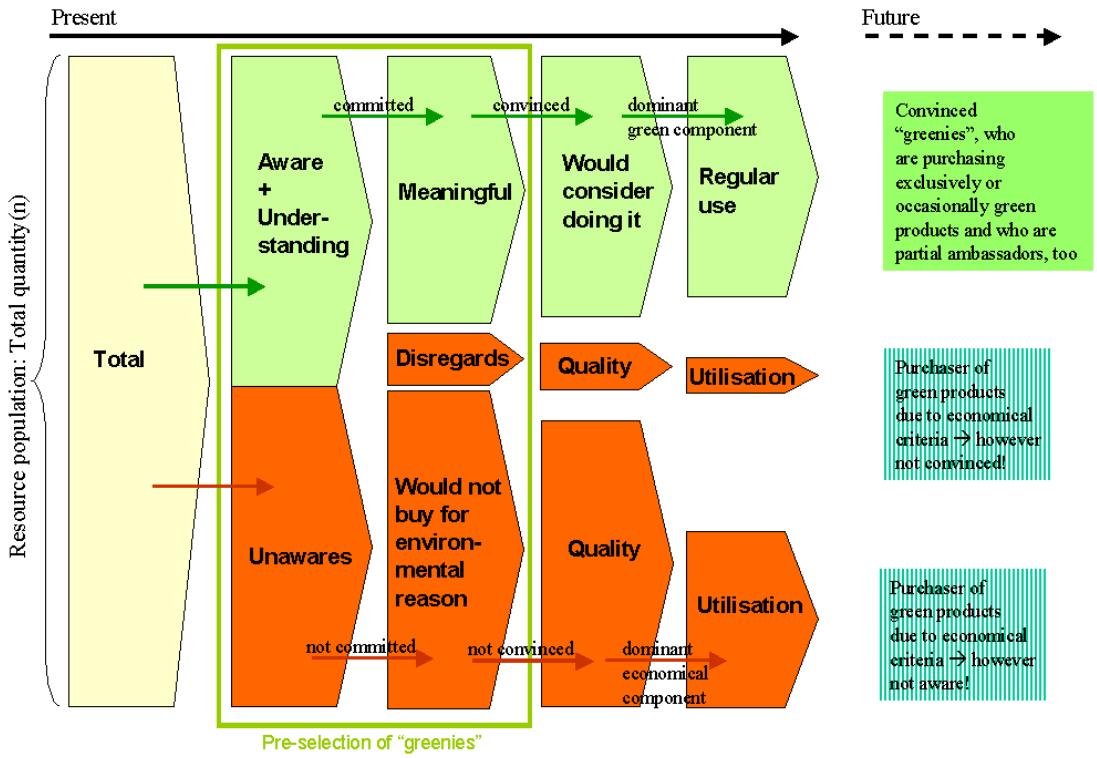


**Figure 7 The fact-based consumer choice chain**

## 4. Conclusion

Figures 3 to 5 illustrate one possible structure of the 'consumer choice chain'. Based on the trends suggested by this prototype we can infer preliminary conclusions about the quantity of energy-efficient choice and effort decisions in the domestic sector. It is apparent that a large number of consumers leave the chain as early as the first stage, indicating that knowledge about the link between individual choices or actions and their environmental impact is lower than generally estimated. The populated chains also reveal that many aware consumers disregard the possibility of efforts to counteract climate change. These consumers leave the chain at the second stage due to the conviction that their individual effort is not meaningful.

The loss of consumers from the chain also continues at the evocation stage, revealing that converts assess the green quality component of a product or effort as inferior to that of other quality components, such as price, performance, brand, etc. The last stage (user) experiences only a small decline, indicating the possibilities for energy-efficient choices and actions. The

comparison between the chain trends, moreover, demonstrates inconsistencies between energy-efficient decisions over product choices and efforts, indicating that policies must be targeted differently if they are to be effective in changing consumer behaviour.

In conclusion, each of the prototype chains reveals large untapped potentials for energy efficiency in the domestic sector for contributing to $CO_2$ emission reductions. This energy-efficiency paradox has been widely recognised by policy makers. The consumer choice chain offers an approach to quantify the different reasons why domestic consumers do not make choices for energy efficiency measures that would be economically rational from their individual perspective.

Adopted as a survey activity, it identifies consumer segments and the best starting point of policy measures to achieve a high impact on energy-efficient choices or action decisions in the household. Conducted on a regular basis, a consumer choice chain can provide an objective approach to quantify the performance of a policy.

As shown in Figures 4 and 5, the ‘consumer choice chain’ can also be used for cross-country comparisons. This practice will support the development of energy-efficiency targets and provide lead indicators to benchmark whether a country is on track to meet its target or not. Consequently, the ‘consumer choice chain’ approach can have various benefits towards delivering energy policy objectives, as it centres on viewpoint of consumers.

## References


Bundesamt fuer Energie – BFE (2005). “Evaluation der energieEtikette fuer Haushaltsgeraete und Lampen”.

DECADE (1997). “Transforming the UK cold market”.

Department for Environment, Food, and Rural Affairs (2006): Review and development of carbon dioxide abatement curves for available technologies as part of the Energy Efficiency Innovation Review

Department for Environment, Food, and Rural Affairs (2004): Energy Efficiency: the Government’s Plan to Action.

Department for Transport and Industry (2003): Energy White Paper. Our Energy Future – Creating a Low Carbon Economy.

Energy Saving Trust. “UK homes exposed as serious environmental hazards” Source: http://www.est.org.uk

Eurobarometer (2005). “The attitudes of European citizens towards the environment”.

Eurobarometer (2002). “The attitudes of Europeans towards the environment”.

Eurobarometer (2002). “Energy: Issues, options and technologies”.

Eurobarometer (2002). “Smoking and the environment: actions and attitudes”.

European Union Commission (2000): Green Paper. Towards a European strategy for the security of energy supply.

Finskud, L. (2003) Competing for Choice.

Haydock, H. (2002) Energy Efficiency in the UK (1990-2000).

GfK / Fraunhofer (2001). “Evaluating the Implementation of the Energy Consumption Labelling Ordinance”.

International Energy Agency (2003). “Cool Appliances – Policy Strategies for Energy Efficient Homes”.

International Energy Agency (2003): “Cool appliance – Policy Strategies for Energy Efficient Homes”.

MORI. “Citizens Want Tough Environmental Action Now “ Source: http://www.mori.com/polls/1998/iem_01.shtml.

MORI (2004). “The Day After Tomorrow – Public Opinion on Climate Change”.

National Consumer Council – NCC (2003). “Green choice: what choice?”.

National Consumer Council – NCC (1997). “Consumers and the Environment”.

Odyssee. “Energy Efficiency Indicators in Europe – Household Sector June 2004” Source: http://www.odyssee-indicators.org/index.html.

OECD (2001). “Are you doing your bit? Development of the UK’s Campaign to Stimulation Public Action to Protect the Environment”.

Oxera (2006). "Policies for energy efficiency in the UK household sector", Report prepared for DEFRA, www.defra.gov.uk.

Schiellerup, P. / Winward, J. (1999). “The European labelling scheme for cold appliances”.

Shorrock, L. D. and Utley, J. I. (2003): Domestic energy fact file 2003.

Timonen, L. “Increasingly technological homes bring new challenges in energy saving”. in: TEHO 06/2003.

Appendix 1 - Draft questions that match the framework of the choice chain for the Energy Saving Light Bulbs:

1. What do you associate with energy saving?
a. Saving money
b. Saving the environment

2. Relative to ordinary light bulbs – do you think energy-saving light bulbs
a. are cheaper? (yes/no/indifferent)
b. are of better design? (yes/no/indifferent)
c. have a better environmental performance? (yes/no/indifferent)
d. last longer? (no, once, twice, five, ten times longer)
e. are of better quality? (yes/no/indifferent)

3. How important are the above criteria to you – rank them
a. top priority
b. second priority
what aspect do you not care about

4. How many energy-saving light bulbs do you have?
none
one
some of my/our light bulbs
most of my/our light bulbs

How many of your light bulbs are standard light bulbs?
a. none
b. one
c. some
d. most

How many will you replace with energy-saving light bulbs in the next year?
a. none
b. one
c. some
d. most

The same questions could be asked for various technologies. One possible choice could be insulation.[8] Criteria to chose the technology could be:

- Actionable, something that the EU wants to promote / program.
- High value of additional data and insights, e.g. cold appliances already have strong programs, and lots of data.
- Reality check with final market share is possible in various countries.

[8] Possible questions relating to awareness: Do people know where they lose the energy; do people know how much they lose; do people know about the costs of insulation; do people know about support programmes for insulation; do people know about small, initial steps (insulating windows, for example)? Effort vs perceived benefit. Segmentation might consider buyers versus renting.