Generating customized sets of transport energy-saving measures for private households

Project background

The energy use of private households is one central topic of the project “Stadt mit Energie-Effizienz Stuttgart SEE” (City with Energy Efficiency), funded by the German Federal Ministry of Education and Research. Within the project’s framework measures for private households lowering the direct energy consumption (domestic heating, electricity, transport) are examined. Both findings on the theoretical potential of energy-saving measures and on their acceptance under different boundary conditions (e.g. higher energy prices) are studied.

About 700 households take part in the study. In a comprehensive survey the household data is collected.

The survey data is processed automatically in the next steps. The household´s energy consumption of the as-is state as well as a customized set of energy-saving measures are computed and presented in an individually designed folder to the household. Figure 1 shows an example of the information given about one certain measure.

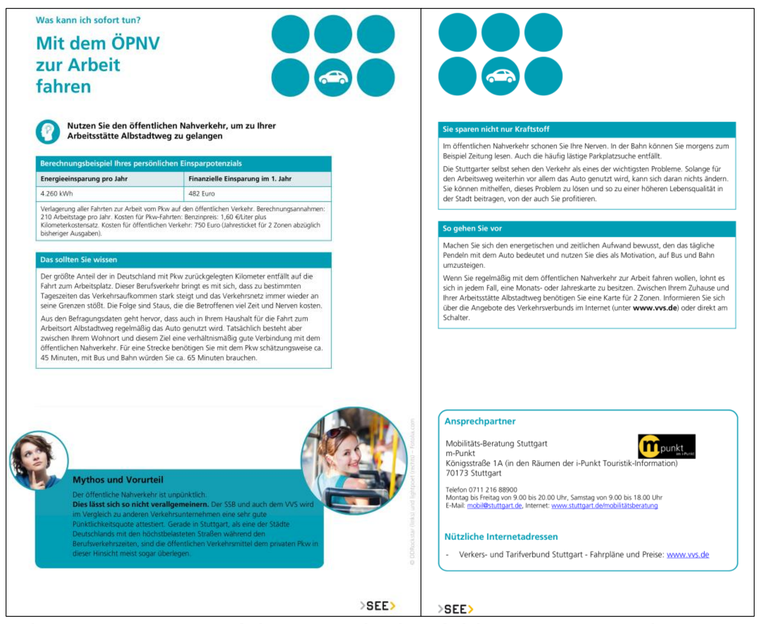

Figure 1: Content of the consultation folder: Energy-saving measure description (Source: Stadt Stuttgart)

In a second on-side interview the measures are evaluated and ranked by the household under two hypothetical situations (stated preference method). A web-based, individually adapted questionnaire is applied allowing a live-update of the displayed values and graphics (Figure 2).

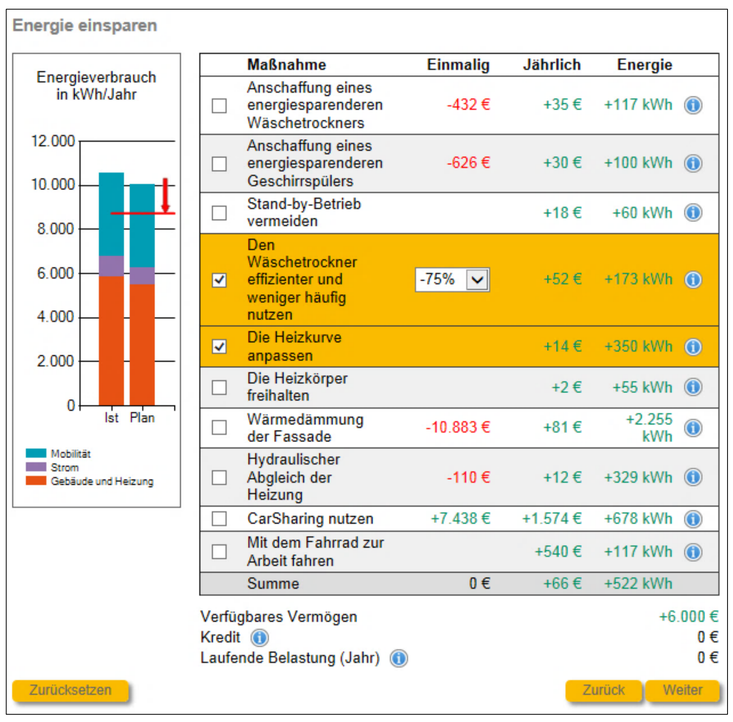

Figure 2: Web-based stated preference questionnaire (Source: Stadt Stuttgart)

The aim and the stages of the study require that the measures fulfil several conditions:

- The impacts of the measures on energy consumption and financial expenses must be quantifiable and assessable.
- The implementation of measures must be in the responsibility of the households.
- The impacts of the measures must be transparent and easy to understand (adequate level of abstraction).

Energy-saving measures

Up to four transport energy-saving measures are presented to each household. They are selected out of a pool of measures which can be subdivided into four groups of measures:

a) Investment measures: Each measure of this group refers to a certain vehicle of the household. Possible is to replace a vehicle by a fuel-efficient model, to sell the own car and use car sharing instead or to equip a vehicle with low-viscosity engine oil and low-rolling resistance tyres.

b) Measures referring to long distance trips: Proposed measures are to choose closer destinations in case of air travel or to substitute flights and car trips on journeys to destinations closer than 750 km by train rides.

c) Measures referring to car use: Objective of these measures is a energy-efficient car use or a reduction of vehicle kilometres in general. There are three important measures to mention: Energy-efficient driving style, reduction of everyday car trips by using public transport, cycling or walking and the use of ride sharing offers.

d) Measures referring to trips from or to work or education: This group of measures is focused on the possibility of using means of transport with a lower energy consumption per kilometre travelled (car/motorcycle → public transport → cycling) on the way from or to work.

Data collection

The information needed for the computation of a energy-saving potential, which is the criteria for the selection of measures, is basically the distance travelled and the energy consumption per kilometre travelled, both before and after the implementation of the measure. These two key figures have to be available on different levels of aggregation for different measures.

The systematization of data collection concerning mode choice and kilometres travelled is shown in Table 1.

A trip diary following the approach used in [1] has to be kept for one week. Extrapolating this data to the annual kilometres travelled on household level carries a substantial risk of a statistical error. Therefore, other methods are used beside.

Recording the occupation of the household members (→ frequency of work trips per week), the geographic coordinates of the workplace (→ distance per trip) and the main mode of transport on work trips enables the estimation of the annual distance travelled from or to work or education.

Long distance trips occur very infrequent but are highly relevant in terms of energy use. For that reason the household is asked to record all journeys with a distance > 100 km retrospectively for one year.

Concerning the households vehicles it is asked to estimate the vehicle kilometres travelled per year for private trips and business trips.

Methodology / collected data	Private motorized transport			Public Transport including flights			Non motorized transport		
	Everyday trips	Work or Education	Long distance trips	Everyday trips	Work or Education	Long distance trips	Everyday trips	Work or Education	Long distance trips
Trip diary over one week of every household member > 9 years of age	○	○	○	○	○	○	○	○	○
Occupation of person, distance and mode choice from or to work/education		per household member			per household member			per household member	
Long distance trips in the last year			○			○			○
Vehicles of the household including estimated annual vehicle kilometres travelled	per household vehicle								
Estimated distance travelled per week				per household member					

○ trips on personal level ○ trips on household level ▭ aggregated data

Table 1: Classification scheme of acquisition of kilometres travelled in household survey (Source: author’s illustration)

The energy consumption per kilometre travelled of each mode of transport is taken from other sources. To determine the fuel consumption of the vehicles of a household, the surveyed vehicle data allows an allocation either in a vehicle database [2] or to a certain fleet segment.

Selection of measures

Each measure has to meet specific preconditions. On the one hand the measure must match the household (logical precondition), e.g. using public transport instead of the car for the journey from or to work requires a sufficient public transport service on the considered connection. On the other hand the energy-saving potential and the financial impact of a measure must be computable (technical precondition).

For generating the set of measures presented to the household as decisive criterion is used which combination of measures adds up to the maximum sum of energy saved. It is taken into account that the energy-saving potentials of different measures possibly affect each other (e.g. purchasing a more efficient car and reducing the kilometres travelled per year).

Outlook

So far, studies on household energy use are often limited either to transport or residential energy use. Involving the whole spectrum of direct energy use is one advantage of the present project. To confront households with specifically arranged energy-saving measures allows the promising prospect of reviewing studies already carried out (e.g. [3]) and new findings on households’ preferences and their possible contribution reaching the objective of saving energy.

References

[1] INFAS, DLR (2010), *Mobilität in Deutschland 2008.* In order of Bundesministeriums für Verkehr, Bau und Stadtentwicklung under the support code 70.801/2006.

[2] ALLGEMEINER DEUTSCHER AUTOMOBIL-CLUB E.V. (2013), *ADAC Fahrzeug-/Kosten-Daten*. www.adac.de/autodatenbank. Effective Mar 2013.

[3] POORTINGA, W., STEG, L., VLEK, C. (2003), *Values, environmental concern, and environmental behavior – a study into household energy use.* In: Environment and Behaviour, Vol. 36, Jan 2004. pp 70-93.

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