Paper ID 8-039-15 Stieß

Power efficiency classes for households – a comparative feedback approach for speeding up energy efficiency on a household level

Dr. Immanuel Stieß
ISOE – Institute for Social-ecological Research
Hamburger Allee 45,
D-60486 Frankfurt am Main, Germany
E-Mail: stiess@isoe.de

Dr. Corinna Fischer
Oeko-Institute e.V.
Merzhauser Straße 173,
D-79100 Freiburg, Germany
E-Mail: c.fischer@oeko.de

Michael Kunkis (M.A.)
ISOE – Institute for Social-ecological Research
Hamburger Allee 45,
D-60486 Frankfurt am Main, Germany
E-Mail: kunkis@isoe.de

Abstract

Reducing power consumption is a vital building block for transforming the energy system. In the contribution, we will present insights from an ongoing research project “Power efficiency classes for households” studying how power consumption in households can be sustainably reduced and stabilized over the long term.

The approach uses the concept of efficiency classes to provide a comparative feedback on households’ total power consumption. The power efficiency classes of households are developed as an indicator for households to more easily estimate their total power consumption and better implement specific goals for saving power. The efficiency classes range from 1-7 – like the power label of the European Union –, with 1 being the best possible class, i.e. the lowest power consumption.

On this basis the power efficiency label pools the total power consumption of a household and assigns it a consumption class. A labelling process for particularly frugal households or households achieving a significant reduction in power use that is harmonized with this procedure makes things simple and transparent and thus increases the motivation to attain a better power efficiency class. An energy audit and corresponding power saving packages help households identify saving potentials in order to improve their power efficiency class. This approach is implemented in 100 selected households in cooperation with power companies and manufacturers of appliances in a field test. The aim of this test is to evaluate the households’ sensitization for their own power consumption and the suitability of the various power saving packages.

In the contribution, we will present the power efficiency classes for households and report results from the field test in the participating households. Against this background, we will discuss some implications for implementing and scaling-up sustainable consumption and production (SCP) practices in relation to sustainable energy use, to improve efficiency on a household level and to raise awareness for rebound effects.

Introduction

The saving of electricity is an essential requirement for the transformation of the energy system and the abandonment of nuclear energy (SRU 2011: 349). The German Federal Government has set a target to reduce power consumption by 10% by 2020 and by 25% by 2050. The lower the power consumption is, the easier the transition to a low-cost and sustainable energy supply will be. Even small reductions or increases in yearly electricity consumption have a strong impact on scenarios for the energy transition (Janzing 2012: 45). It should be noted that the household-oriented approach, even though it is useful, has to be seen as one of the most difficult starting points.

Despite many attempts to push the individual consumption and investment behaviour of households to more power efficiency, very little was actually achieved. Moreover, from 1996 to 2011 the total power consumption of private households has risen. Furthermore, a notable change in the power consumption of private households in relation to different spheres of activity can be identified (see Figure 1). Recently, the consumption of household energy (adjusted for temperature effects) rose by almost 4% in 2013 as compared to 2012 (cf. Destatis 2014). This was the first significant rise since the year 2005. It is likely to remain on a high level in the next few years. High electricity prices and the first measures of the Ecodesign Directive (e.g. relating to electronics in standby mode or limitation of refrigerators, freezers and light bulbs) are expected to decrease power consumption. On the other hand, new product groups or electricity consumers are introduced into households (e.g. Blu-ray recorder). The new generation of larger televisions also increases the power consumption. Furthermore, the appliance stock per household and per person increases (e.g. two or more TV sets, two or more computers/printers per household). However, if the investment and consumption behaviour of households does not reduce their share of total electricity demand, the energy transition will be more difficult and most likely more expensive.

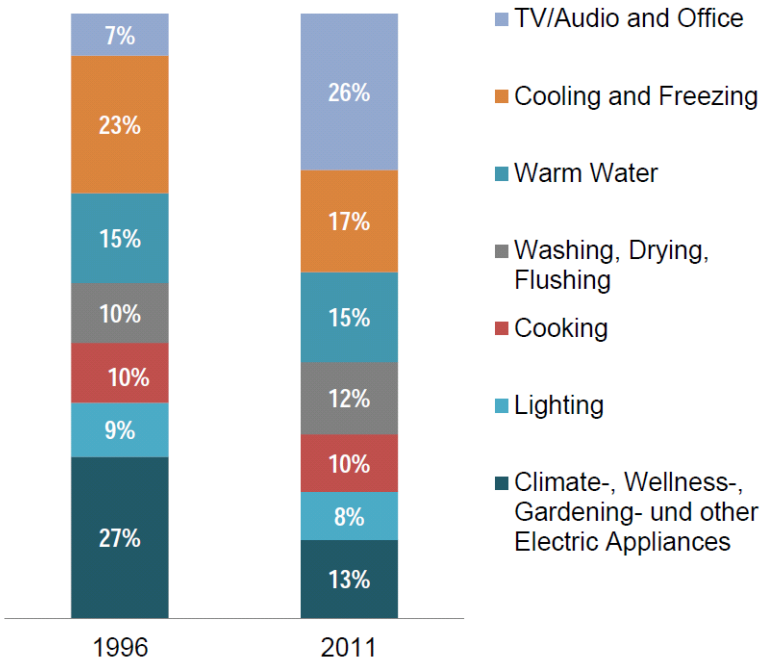

Figure 1: Annual energy consumption of private households in Germany, subdivided in spheres of activity (1996 and 2011). Overall power consumption of private households 1996: 134.151 TWh; 2011: 136.600 TWh *(Source: BDEW 2013: 9).*

Private households account for about 25% of total electricity consumption in Germany. The theoretical potential for savings, with the technologies and products available on the market today, lies at approximately 65%. The power consumption of a two-person average household in 2013 was 3,449 kWh /year (Destatis 2015). An ideal household – equipped with the power-efficient products available today – consumes only around 1,150 kWh, with equal comfort and significant cost savings (Grießhammer 2011). Calculations show that an average household can reduce its power consumption by means of low-cost measures even in a short timeframe by about 1,000 kWh (Schleicher 2011). And in the next ten years it could further reduce its power consumption by successively replacing outdated appliances by energy efficient appliances. Despite considerable efforts by consumer and energy consultancies, as well as education campaigns this potential has so far not even been realized in a rudimental sense.

There are several reasons for this gap between the potential savings and what is actually realized. At the very basis lies the problem that private households are often disinterested or experience a certain inhibition towards thinking about the issue of power saving. A related problem is that relevant saving measures are often little known. Frequently advice is given about low power saving measures (e.g. whipping cream with an electric mixer), while more effective measures (e.g. water saving shower heads or automatic power strips) are less well-known. Even if they have the information, consumers still find it difficult to relate the power saving advice and savings due to purchase of energy efficient appliances to their total power consumption. This makes such changes seem less relevant. 'Innovation management' is often missing on a household level, as they lack the routines for long-term investment planning. As a result the cost advantages provided by the early replacement of (outdated) electricity intensive home appliances are seldom explored. Furthermore the implementation of advice is often seen as lacking practicality because of being too time and cost intensive. Middleclass households, a group with large power saving potential, are often not reached. This applies mainly the households in the segment which are not eco-pioneers and are not willing to constantly engage with the matter of sustainability. Another reason for the lack of motivation in the power saving issue is that energy savings mainly show in the private area and therefore do not have a prestige function. Positive achievements are just as invisible as "energy wasting" behaviour is. The project on power efficiency classes for households aims at overcoming some of these barriers to full exploitation of their power saving potential.

Billing routines in Germany give consumers only a poor and late feedback about the amount of their power consumption. Electricity bills usually cover a full year and they are provided apart from the consumption of other energy sources, like gas. Monthly prepayment rates are based on the power consumption of the last metering period and they are adjusted at the end of the actual period. Most consumers choose to pay their power bill automatically, and hence do take notice of the amount of power registered in their electricity bill.

State-of-the-art

It has been established that the transformation of the energy system requires saving power (SRU 2011: 349, WBGU 2011: 353). Due to their large share of total power consumption, private households have an important role to play in reducing the demand for electricity. In various research contexts, intervention measures aiming at reducing household power consumption have been explored in Germany and other countries (cf. Abrahamse et al. 2005; Duscha et al. 2006; Osbaldistion/Schott 2012; Scharp 2011).

Intervention measures

Abrahamse et al. classify the interventions into two main groups. The first group contains interventions that aim at reducing power consumption in households ex ante, the second group consists of measures aiming at changing the behaviour of individual households by reflecting the consequences of their prior energy behaviour (Abrahamse et al. 2005). Measures belonging to the first group are, next to information provision, also commitments, goal-setting and social modelling (Abrahamse et al. 2005: 275ff; Scharp 2011: 40). Measures falling into the second group are for example feedback measures as well as rewards or incentives and investment grants (cf. Abrahamse et al. 2005: 278; Scharp 2011).

Information provision can refer to large general media campaigns as well as a personal in-situ energy audit. Research showed that general information campaigns have only little impact. While they might raise awareness about certain topics, little is actually put into practice due to the generalised approach (Abrahamse et al. 2005; Duscha et al. 2006).

Commitments are often applied in combination with goal-setting strategies. Commitment of a household to save power does not necessarily lead to savings by itself.

Goal-setting helps to target the effort and if combined with further measures, especially feedback, this can be an effective strategy (Scharp 2011).

Economic incentives, like for example investment grants or replacement bonuses for the purchase of energy efficient appliances, are generally positively evaluated. However, on their own these measures cannot achieve long term savings (Scharp 2011; Abrahamse et al. 2005). Their success is strongly dependent on a combination with information provision measures (Duscha et al. 2006).

Social modelling refers to creating role models that engage in power saving behaviour, thereby compelling others to follow suit. Scharp criticised a lack of proof regarding the impact of this measure (Scharp 2011). Others evaluate social modelling positively, seeing them as an effective means for the reduction of power consumption by changing the social norms. The credibility of the social model is vital for success in this approach (Osbaldistion/Schott 2012).

Feedback measures give households information on their consumption. There are different feedback types: historical feedback, comparative feedback, feedback by usage domains and real time feedback. As feedback is the most relevant intervention measure in the context this project, it is described in more detail below (see Table 1).

Information	Commitments	Goal-setting	Incentives	Social modelling	Feedback
Media campaigns Personalized information (e.g. energy audit)	Private or public commitment to behaviour change	Setting targets for reducing power consumption	Investment grants Replacement bonuses Non-monetary incentives	Role model Community or neighbourhood as model	Historical feedback Comparative feedback Feedback by usage domains Real time feedback

Table 1: Overview of intervention measures.

Feedback

As mentioned above, there are four categories of feedback interventions in relation to power consumption. Often households are given historical feedback, which informs them of their own consumption over time (cf. Duscha et al. 2006: 114). This allows consumers to trace increases or decreases in their power consumption.

Another frequently used form of feedback is comparative feedback (cf. Abrahamse et al. 2005:279; Duscha et al. 2006: 115; RAND 2012: 6). This type of feedback shows the household consumption in comparison to other households (see Figure 2). The aim of this intervention is to push households with above average consumption to start saving power (Roberts/Baker 2003:11). This is also where the power efficiency classes for households come in, by providing a means of comparing power consumption even between households with different characteristics.

Less frequently used is feedback provided for different end-uses within households. Usually this form of disaggregated consumption information is presented as statistical averages for consumption per usage domain in form of a pie-chart (cf. Duscha et al. 2006: 116; Roberts/Baker 2003: 11). Duscha et al. describe this form of feedback as useful for introducing consumers to the topic of household power consumption, but see it as insufficient to understand the household's own consumption. A personalized version of this pie chart would require in-depth knowledge of the equipment and the appliances in household (Duscha et al. 2006: 122).

The last category is real-time feedback which becomes more and more relevant with the increased installation of smart meters. These allow consumers to follow their power consumption live on screen (Roberts/Baker 2003: 11).

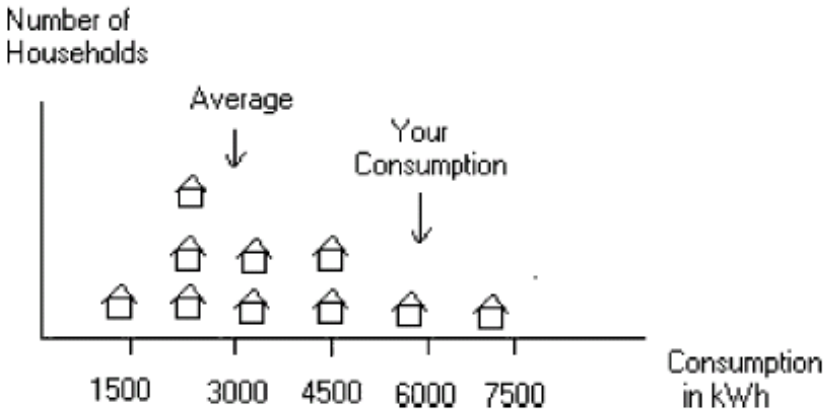

Figure 2: Example for comparing power consumption. *Source: Fischer 2008: 101.*

The effectiveness of feedback interventions depends on various circumstances, which makes drawing conclusions based different studies and projects difficult. Most studies consider historical or comparative feedback. In general they have shown power savings from 4 or 5 up to 12% (cf. Fischer 2007: 6; Scharp 2011: 41). There are no apparent differences in effectiveness between historical or comparative feedback (Abrahamse et al. 2005: 280; Fischer 2007: 8). Research carried out by ISOE resulted in lower power savings. The project Intelliekon tested the acceptance by households as well as power savings of smart meter technology in combination with different feedback systems. With 3.7% the power savings turned out lower than expected, but they were constant over time (Schleich et al. 2011: 12; Intelliekon 2011)

Combinations of measures

Research shows that the mixture of interventions is the most important factor for success (cf. Scharp 2011: 41; Fischer 2008). In a meta-study about the effects of intervention measures in the area of energy savings, Darby concluded, that combinations of interventions achieve better results than isolated interventions (cf. Darby 2010:3).

This is especially the case for feedback interventions. On their own feedbacks have been found to achieve small power savings, but they are generally very effective in combination with other measures, especially in-situ energy audits and goal-setting (Scharp 2011). Own findings point towards a similar direction. Intelliekon (2011) showed that households use feedback technology for a while after its installation, but do not keep doing so permanently (cf. Schleich et al. 2011). The insights from Intelliekon project led to the conclusion that feedback should be combined with further consultations or immediate measures. This also includes incentives to buy

efficient household appliances, which replace the need for continuous behavioural change with one-time installation of technical measures (e.g. automatic power strips).

Basic concept of “Power efficiency classes”

The main objective of the research project “Power efficiency classes for households” is to develop an integrated approach helping households to more easily estimate their total power consumption and better implement specific goals for saving power. The core elements are: a. the classification system “power efficiency classes for households”, b. the communication campaign “Klasse Strom Sparen” (“Saving power with class”) as symbolic certification and awarding procedure, and c. modularly retrievable and attractively offered packages for optimization based on power advice and power-saving recommendations.

a. The classification system “power efficiency classes of households” pools the total power consumption of a household and assigns it a consumption class. The classification is based on the annual power consumption of a household, extended by attributes like household size. In this way the new classification system is different from established energy efficiency labels as it shows not only the power efficiency of a single appliance. Rather, the calculated power consumption resulting from all technical appliances in the household and the usage behaviour connected to these appliances is illustrated. As a result the extent of the power consumption becomes much clearer for the household. The comparative feedback makes an appraisal with the power consumption of similar households possible (e.g. “I am using much more power than my neighbour” or “I am using much more than necessary”).

b. The classification system is linked to the campaign “Klasse Strom Sparen” (see Figure 3), communicating the power use of the entire household in a simple and symbolically attractive way. Part of the campaign is a booklet and an awarding procedure for particularly frugal households or households achieving a significant reduction in power use. The awarding procedure is harmonized with the classification system, making things simple and transparent and thus increasing the motivation to attain a better power efficiency class.

c. A power audit and corresponding power saving packages help households identify saving potentials in order to improve their power efficiency class. The audit provides a detailed analysis of the present power consumption and provides recommendations for potential power saving measures.

Figure 3: Label “Klasse Strom Sparen” („Saving power with class“). *Source: Own illustration.*

The core elements of the concept are explained in greater detail in the following sections.

Power efficiency classes

Households differ in their energy use simply due to base factors of the household itself which are not influenced by usage behaviour or appliance efficiency. It is vital to take these factors into account when establishing which power efficiency class a household falls into to make households with different base factors comparable. In order to establish which socio-structural and structural factors are the most relevant influences on power consumption available studies as well as own investigations were analysed (see Table 2). Three factors were identified as being the most important: the type of building (multifamily building or detached/semi-detached house), the type of hot water generation (with or without electricity) and the amount of people living in the household (1-5). The factor “apartment size” is not considered separately as the building type factor is easier to assess and is sufficient to cover the higher power consumption of larger apartments.

Type of Building	Water heating	Persons	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Average
1-2 Family house	With power	1	1,700	2,200	2,700	3,100	3,700	4,500	> 4,500	**3,150**
		2	2,500	3,000	3,500	4,000	4,400	5,000	> 5,000	**4,215**
		3	3,300	4,000	4,300	5,000	5,500	6,500	> 6,500	**5,161**
		4	3,600	4,300	5,000	5,600	6,200	7,300	> 7,300	**5,949**
		5	4,500	5,400	6,000	7,000	8,000	9,700	> 9,700	**7,350**
	Without power	1	1,400	1,900	2,200	2,600	3,100	3,700	> 3,000	**2,500**
		2	2,200	2,500	3,000	3,200	3,600	4,000	> 4,000	**3,443**
		3	2,700	3,200	3,500	4,000	4,200	4,800	> 5,400	**4,093**
		4	3,000	3,600	4,000	4,400	4,900	5,500	> 6,500	**4,582**
		5	3,500	4,200	4,800	5,300	6,000	7,000	> 8,000	**5,700**
Apartment multi-family house	With power	1	1,200	1,500	1,800	2,000	2,400	3,000	> 3,700	**2,384**
		2	2,000	2,500	2,900	3,200	3,500	4,000	> 4,000	**3,441**
		3	2,800	3,500	3,900	4,200	4,800	5,400	> 4,800	**4,485**
		4	3,200	4,000	4,500	5,000	5,500	6,500	> 5,500	**5,545**
		5	3,800	4,600	5,600	6,100	7,000	8,000	> 7,000	**7,031**
	Without power	1	800	1,000	1,200	1,500	1,700	2,000	> 2,000	**1,666**
		2	1,400	1,700	2,000	2,200	2,500	2,900	> 2,900	**2,396**
		3	1,800	2,200	2,500	3,000	3,300	3,700	> 3,700	**3,083**
		4	2,000	2,400	2,800	3,300	3,700	4,000	> 4,000	**3,335**
		5	2,300	3,000	3,500	4,200	4,600	5,300	> 5,300	**4,233**

Table 2: Power efficiency classes (kWh/year upper limits)

Based on the 20 possible combinations of the above factors a household typology was established. For each of these household types 7 power efficiency classes were defined on the basis of data about power consumption in households obtained from CO_2Online (www.co2online.com). From this data the classes were defined descriptively, with a specific quantile of the distribution corresponding to a specific power efficiency class. The highest consumption in each class (in kWh/year) defines the upper limit of that class. When defining the classes it was considered important to make moving up a class actually possible. Households can determine their own efficiency class in four steps based on their household type and their power consumption in kWh/year (see Figure 4). The label aims at making household power consumption transparent and thereby increasing motivation for saving power, for instance in order to improve to a power efficiency class better than their neighbour's.

Figure 4: Self-analysis tool for households to determine power efficiency class. *Source: Own illustration. Step 1: Type of house, Step 2: Hot water generation, Step 3: Number of persons in the household, Step 4: Power consumption in kWh/year.*

Power saving audit

The classification into power efficiency classes as explained above can be done by households themselves. This self-classification can then be augmented by an energy assessment done on-site by a qualified power consultant. While the consulting method is based on existing offers for power consultation, it expands these in order to meet the requirements of the project. The audit is tuned to the requirements of the different power efficiency classes. As a first step the consultant analyses the household's power consumption using standardized questionnaires, also establishing the power efficiency class the household currently achieves. Based on the findings from this assessment and the individual goal set by the households themselves (e.g. achieving improvement of at least one class or setting a percentage goal) the consultants develop personalized recommendations for the reduction of power consumption in the household. Corresponding to the recommendations power-saving-packages for households are developed. These can help households identifying the areas where improvement can be made and directly implement the required measures, thereby possibly achieving a better power efficiency class. Both recommendations and packages are designed depending on the prevailing circumstances in the household, as pre-designing such packages for different household types does not appear expedient. Instead, generalized instruments and measures were developed which can then be combined on the individual household level.

The power saving audit consisted of six main topics:

- Survey of household data, e.g. number of persons in the household, building type.
- Survey of the current power consumption, e.g. survey of all home appliances and their individual power consumption read from the labels.
- Analysis and evaluation of the current state, e.g. analysis of potential, comparing the current power consumption with a potential state.
- Recommendations for measures and evaluation of these measures, e.g. power saving measures, potential savings in kwh and Euro.
- Processing the data of the analysis, e.g. on-site consulting, summary.
- On-site installation, e.g. energy efficient light bulbs.

Campaign and certificate "Klasse Strom Sparen" ("Saving power with class")

The campaign for the power efficiency class project has been designed by a professional marketing agency that was selected by means of a competition. Several agencies were asked to design a label and name for the project as well as a graphic design for presentation of the power efficiency classes. In focus groups, the selected campaign was tested for its effect on participants with a strong interest in saving power and average to low consumption as well as on those who have a comparatively low interest and high consumption. Based on the results of these focus groups it was decided to create a sober and factual campaign without the strongly moral appeal related to protection of climate and environment. The selected slogan for the campaign – "Klasse Strom Sparen" – could be translated to "Saving power with class", whereby 'Klasse' in German can mean 'great' as well as 'category. As further part of the campaign an informative guide was created informing the households about what the power efficiency classes are and why it is interesting for them to participate in the project. In addition to the potential economic advantages deriving from power savings, the households are also attracted to the campaign by the prospect of certificates showing their achievements (see Figure 5). Instead of only seeing abstract changes on their electricity bills, households are issued a certificate on a yearly basis. These certificates give information on the achieved power efficiency class, the power efficiency class of last year, the total annual power consumption and the change in power consumption as compared to the previous year. The certificates can then help households to visualize their achievements and compare these to previous certificates or to the class achieved by other households.

Figure 5: Certificate "Saving power with class". *Source: Own illustration.*

Field test "Klasse Strom Sparen" ("Saving power with class")

In the project, researchers from ISOE- Institute for Social-Ecological Research and the German Oeko-Institute e.V. developed a new approach to reduce power consumption in households. As explained above, the new "power efficiency classes" label records the power consumption in households and assigns an efficiency class. The power efficiency classes and corresponding power saving packages in selected households were tested in cooperation with the participating power companies. In the field test, the households' sensitisation to their own power consumption as a result of the label and the suitability of the various power saving packages for everyday use were evaluated.

The following research questions were investigated:

- What elements of the classification system (name, function, feedback, information and counselling, etc.) were well received? Where have there been difficulties?
- What is the perceived relevance and impact of the symbolic name and award procedure on electricity saving / innovation behaviour?
- What optimization packages have been implemented by the households? Which optimization measures fit well, which not? Why? What were the difficulties in everyday practice?
- Which changes have been realised in the management of the households, e.g. concerning the acquisition planning, routines, chronological and functional processes?

In addition to the scientific project partners ISOE and Oeko-Institute, further cooperation partners participated in the field test. Firstly, the cooperation partners BSH-Bosch, Siemens Homeappliance GmbH, and OSRAM GmbH supported the field test by sponsoring the replacement of outdated appliances and providing energy efficient light bulbs. Secondly, the Badenova AG (Freiburg) and Entega GmbH, local representatives of regional utility companies, arranged the power audits by energy consultants. Lastly, the Consumer Organisation North Rhine-Westphalia collaborated in developing the methodology and analysis tool for the power saving audit.

Design of the field test

The conducted field test is meant as exemplified implementation of the campaign "Saving power with class". The field test consists of several interconnected measures:

- Website "Saving power with class".
- Power saving audits: For the field test a power saving advice on-site is needed at the home of the participants, since consumption data from appliances and usage patterns are estimated, and the subsequent recommendations are based on the actual situation in the household.
- Offline log: Historical feedback of the individual household energy consumption; Self-monitoring.
- Energy saving account ("Energiesparkonto") in cooperation with CO_2-online: Historical feedback of the individual energy consumption; Self-monitoring.
- Replacement of outdated household appliances in cooperation with BSH.
- Replacement of outdated light bulbs in cooperation with OSRAM.
- Certificate: Symbolic display of the implemented power and cost saving reductions.
- Final survey.

Sample of field test

The field test was conducted with 98 participating households in Freiburg and Darmstadt. In each city approx. 50 households were recruited according to specific criteria. Main criteria have been inter alia the socio-demographics data of the household, especially age and level of education, and the level of power consumption (see Table 3). The current efficiency classes are represented as follows: low (1-2) 20%, medium (3-5) (40%), and high (6-7) 40%. Furthermore, a differentiation was made between households which use electric hot water generation and those that do not. A further differentiation was made between detached/semi-detached houses and apartments in blocks of flats. Each type of building is represented with 50% in the final sample. By means of a project website as well as press releases interested participants for the field test were found. Following the above mentioned sampling strategy, 100 households were selected for participation (during the field test some participants dropped out). The main motivation of those households was the reduction of their individual energy consumption as well as receiving information and suggestions from experts. The chosen households gained the opportunity to receive an individual power saving audit. Next to the participation in the field test, the participating households also had the possibility to receive a financial bonus (up to €150) for the replacement of outdated appliances, e.g. refrigerators and freezers. All households were provided with power saving advice

	Young adults		**Avarage: Establishment phase**		**Avarage: Consolidation phase**		**Elder: Post job**		
Age and household size	Up to 30	Up to 30	31 to 45	31 to 45	46 to 60	46 to 60	61 and older	61 and older	
Power efficiency class	1-2 persons	3 + persons	1-2 persons	3 + persons	1-2 persons	3 + persons	1-2 persons	3 + persons	
Low power efficiency class	**2**	**0**	**3**	**8**	**2**	**5**	**2**	**0**	**22**
Medium power efficiency class	**2**	**0**	**5**	**11**	**6**	**7**	**7**	**1**	**39**
High power efficiency class	**1**	**1**	**4**	**7**	**6**	**9**	**8**	**1**	**38**
Total amount	**5**	**1**	**12**	**26**	**14**	**21**	**18**	**2**	**98**

Table 3: Sampling criteria. Basic mix of social structure.

Time schedule

These power-saving recommendations are ideally implemented and adopted by the households within a six months term (October 2014-March 2015; see Figure 6). Historical consumption feedback is used as a means to self-monitoring through monthly recordings of the electricity meter readings by the participating households themselves. The households use an online platform as well as an offline logbook to record their energy consumption and specific events. One main component of the field test is the realization of a power saving audit for each participating household, conducted in the beginning of the field test by an experienced energy consultant. The consultants were acquainted with the contents of the field test in advance by the scientific partners ISOE and Oeko-Institute e.V. For personal advice in the field test, the explanation of a consultancy report by an experienced energy consultant is needed to keep time (60 min.) and costs (€150) low. For the field test the independence of the consultants is an important criterion. The consultation was supplemented by a introductory telephone interview, where basic information was covered in advance. The energy consultants made appointments with the individual households for an inspection. Thereby household appliances as well as the individual energy consumption behavior were documented. Based on these inspections the participating households were provided with information about their present power consumption, and were given suggestions for improvement.

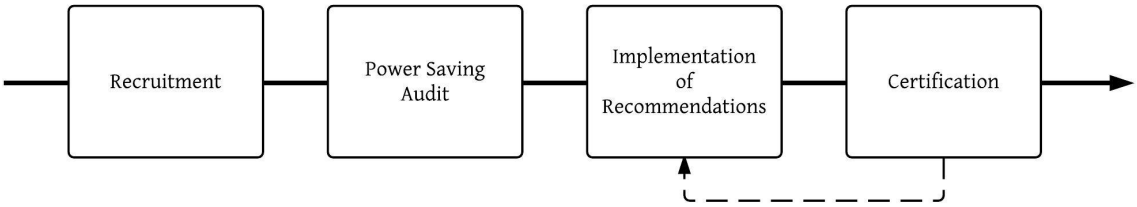

Figure 6: Time schedule of the field test. *Source: Own illustration.*

The implementation of the suggestions provided by the power consultant will be recorded by means of a final survey at the end of the field test. It is expected that the results from the field test will show new ways of attaining a better power efficiency class, adapted to different target groups. Corresponding consultation offerings will be developed. The assumption is that young households – that have just been founded – for example, have other opportunities and limitations than established households with a very low income. At the same time, and in close cooperation with the corporate partners, the research collaboration is setting up integrated technical solutions and possible new offers geared towards the needs of the target groups.

At the end of the field test the participating households received a certificate showing their present energy consumption. The certificate shows the current "power efficiency class" of the participating households, the power that can be saved through the recommended power saving packages, and further detailed information. The results of the power saving audits have been documented and evaluated. From the results of the field test, an optimised version of the total approach to the power efficiency class project will be developed the acceptance of which will be tested with the help of a representative survey (n=2,000) with an integrated conjoint-analysis. Furthermore, the power saving potential and transformation effects that can be attained across Germany will be extrapolated.

Perception of the campaign "Saving power with class"

To evaluate the perception of the campaign "Saving power with class" two focus groups were conducted before the campaign was implemented. Each focus group consisted of eight to ten participants and had a duration of two hours. The focus groups were carried out in May/June 2014. The participants of the focus groups were selected by pre-defined quota:

- Group 1: high interest in saving electricity / low to moderate electricity consumption.
- Group 2: little interest in saving electricity / medium to high electricity consumption.

The participants of each group (50% female, 50% male) were the persons responsible for the household energy use and purchasing decision of household devices. Also, the groups represented a broad socio-demographic mix:

- Age: each with one-third: under 35 years / 35 to 50 years / 50 to 65 years.
- Household-size: each with one-third: one-person / two-person / three and more person-households.
- Income: each with one-third: low-income / medium-income / high-income.

It became clear that the campaign should be kept down-to-earth and objective; in no way should it use commercial- and marketing-style communication. Following this, there should be no competitions, no giveaways, no raffle etc. These measures are considered as too close to commercial and dubious promotions. The connection of saving power to reducing costs for the households was evaluated positively, as opposed to a strong moral imperative on climate and environmental protection. However, the initially proposed name "StromStar" or "StromChamp" and also the first proposed campaign logo were criticized, since they were negatively connoted (e.g. "Pop Idol", "American Idol") by the participants. The idea of an enhanced visibility to promote participation in the campaign was also criticised by the participants. Therefore, the name and several elements of the campaign had to be adjusted, which resulted in the sober campaign slogan "Saving power with class".

Overall, the campaign was well-received and considered interesting and motivating. The power efficiency classes were perceived as an incentive to save power and achieve a better class. Therefore, the campaign is likely to succeed in raising awareness. Furthermore, continuity was considered an important factor. The participants of the focus groups emphasized the positive effects of the feedback and impetus over the duration of the field test; they ensure a longer term action. Saving electricity was recognized as an intrinsic motivation, which should not be used for public demonstration.

The campaign's elements were also evaluated positively. The power efficiency table was seen as self-explanatory and well-accepted. It immediately dissolves any inhibitions. Some participants were motivated to save even more energy ("You're doing it quite right, but there is even more"). Most of the participants were stimulated by the campaign to reach a better class ("Incentive, 500 kWh less to consume and I'm in a better class"). Overall, the campaign was considered as a way to receive useful information about one's individual power consumption and ways to improve it ("Helping you to see where you stand"). Finally, the free power advice provided by the power saving audit were recognised as very attractive. Especially as they provide tailored solutions for the individual situation and help to identify "power guzzlers" in the households.

Conclusions and outlook

The "power efficiency classes for households" provide an integrated approach to power efficiency and power saving, combining comparative feedback and the provision of specified information with symbolic and monetary incentives. The first empirical findings of the focus groups suggest that the basic idea of the classification system as a tool for the households to better assess their own level of power consumption fits well to the needs of private households. In particular, the application of the classification system was judged as helpful and motivating. Nevertheless, a sound assessment of the acceptance and the impacts on energy related behavior is only possible when the analysis of the field test and the empirical survey among the participating households have been finalized.

The transfer of the power efficiency classes approach and its broader implementation provides a further challenge. The classification system can be adopted by energy suppliers in order to improve their customers' communication and to create new and attractive services for them. It might also be integrated into new business models. Moreover, the power efficiency classes can be implemented to comply with the legal prerequisite of the German Energy Act ("Gesetz über die Elektrizitäts- und Gasversorgung – Energiewirtschaftsgesetz – EnWG"), compelling energy companies to provide a comparative feedback to their customers together with the electricity bill. In this regard, the power efficiency classes can be can be linked to other ongoing activities, like the German "Stromspiegel". Furthermore, the overall approach as well as some of the elements can be used by multipliers in the field of power efficiency. In particular, consumer associations and environmental organizations can integrate the classification system or the power audit into their communication portfolio.

Acknowledgements

The authors like to thank the German Federal Ministry of Education and Research (BMBF) for funding the project "Power efficiency classes for households" within the social-ecological research funding priority (funding code: 01UN1215; duration: 04/2013-03/2016).

Literature

Abrahamse, W./ Steg, L./ Vlek, C./ Rothengather, T. (2005): A review of intervention studies at household energy conservation, in: Journal of Environmental Psychology, Vol. 25, Issue 3: 273-291.

BDEW 2013: Stromverbrauch im Haushalt, in https://www.bdew.de/internet.nsf/id/6FE5E98B43647E00C1257C0F003314E5/$file/708-2_Beiblatt_zu%20BDEW-Charts%20Stromverbrauch%20im%20Haushalt_2013-10-23.pdf. [2015-03-16].

Darby, S. (2010): Literature review fort he Energy Demand Research Project, Office of Gas and Electricity Markets, London.

Destatis (2014): Household energy consumption up for the first time since 2005, in: https://www.destatis.de/EN/FactsFigures/NationalEconomyEnvironment/Environment/EnvironmentalEconomicAccounting/EnergyRawMaterialsEmissions/Current.html [2015-03-16].

Destatis (2015): Energieverbrauch. Stromverbrauch der privaten Haushalte nach Stromverbrauchsgrößenklassen, in www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/Umwelt/UmweltoekonomischeGesamtrechnungen/MaterialEnergiefluesse/Tabellen/StromverbrauchHaushalte.html [2015-03-16].

Duscha, M./ Dünnhoff, E./ Martin, I./ Wegener, S. (2006): Effiziente Beratungsbausteine zur Verminderung des Stromverbrauchs in privaten Haushalten. Zwischenbericht, Ifeu, Heidelberg.

Fischer, C. (2007): Influencing Electricity Consumption via Consumer Feedback. A Review of Experience. TIPS Discussion Paper 8. Berlin.

Fischer, C. (2008): Feedback on household electricity consumption: A tool for saving energy? In: Energy Efficiency, Vol. 1, No. 1: 79-104.

Grießhammer, R. (2011): Produktpolitik für stromsparende Produkte, Presentation at the congress "Stromeinsparung in Haushalten". Berlin, 02.12.2011.

Intelliekon (2011): Nachhaltiger Energiekonsum von Haushalten durch Intelligente Zähler-, Kommunikations- und Tarifsysteme, in: http://www.isoe.de/en/publications/downloads/energy-efficiency [2015-01-19].

Janzing, B. (2012): Ein Tortenstück namens Erneuerbare, in: Politische Ökologie, 2011 (126): 44-50.

Osbaldiston, R./ Schott, J. P. (2012): Environmental Sustainability and Behavioral Science: Meta-Analysis of Proenvironmental Behavior Experiments, in: Environment and Behavior, 44 (2): 257-299.

RAND (2012): What Works in Changing Energy-Using Behaviours in the Home? A Rapid Evidence Assessment. Final Report, London.

Roberts, S./ Baker, W. (2003): Towards effective energy information. Improving consumer feedback on energy consumption. A report to Ofgem by the Centre for Sustainable Energy, Bristol.

Scharp, M. (2011): Energiedienstleistungen zur Unterstützung von Endverbrauchern, in: Ökologisches Wirtschaften, 1/2011: 39-42.

Schleich, J./ Klobasa, M./ Brunner, M./ Gölz, S./ Götz, K./ Sunderer, G. (2011): Smart metering in Germany and Austria – Results of providing feedback information in a field trial, in: Working Paper Sustainability and Innovation, No. S6/2011.

Schleicher, T. (2011): Stromsparen in Haushalten. Presentation at the congress "Stromeinsparung in Haushalten". Berlin, 02.12.2011.

SRU (2011): Wege zur 100 % erneuerbaren Stromversorgung. Sondergutachten, Berlin.

WBGU (2011): Welt im Wandel Gesellschaftsvertrag für eine große Transformation, Berlin.