

Patterns of energy use in energy-aware households

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Introduction

With rising efforts towards a transformation to more sustainable energy systems, the role and the responsibilities of individual end-users and ‘the general public’ are receiving increasing attention. It is widely recognized that the development of more energy aware lifestyles will have to constitute an important part of a shift to more sustainable energy systems.

But do people who are actively involved in energy initiatives exhibit different energy use patterns? Does their energy consumption actually differ from the average energy user? Detailed information on actual energy behaviour and consumption patterns is required in order to learn about quantitative effects of citizens’ engagement. These questions were the main focus leading to this quantitative analysis of energy use of energy-aware persons/households compared to reference households.

The analysis is part of the BENE-project, carried out by the Inter-University Research Centre for Technology, Work and Culture (IFZ) and the Sustainable Europe Research Institute (SERI) (www.bene-projekt.at), funded under the "Neue Energien 2020" programme of the Austrian climate and energy fund.

Approach

In order to gather information on the abovementioned questions 40 households, classified as “energy aware” due to their active engagement in energy related initiatives, were asked in detail about their energy use. The survey was carried out in fall 2010. The sample consisted (1) of 20 households whose members are actively engaged in the so-called “Ökoregion Kaindorf” (eco-region) as e.g. working group leaders and (2) 20 households who own a private, small scale PV-unit and take part in the initiative “Ökostrombörse”. In a previous project „Energieverbrauchsstile“ [styles of energy use; www.energisch.at] (Bohunovsky et al, 2010), more than 1000 Austrian households were asked in detail about their energy use. This representative sample served as reference data and also allowed for filtering smaller reference groups like single-family homes or households in rural regions – which proved useful in regard to energy related questions. Table 1 gives details on the number of cases.

Table 1: Overview on number of cases

Sample	N total	N households in single family houses	N households in rural areas	definition of "rural area": number of inhabitants of home community
Members of Ökostrombörse (Vorarlberg)	20	20	18	< 20.000 inhabitants
Households active in Eco-region Kaindorf (Styria)	20	19	19	< 2.000 inhabitants
Reference households				
Vorarlberg	30	7	9	< 20.000 inhabitants
Styria	148	93	27	< 2.000 inhabitants
Austria	1.014	520	148	< 2.000 inhabitants, < 20.000 inhabitants
			503	

The questionnaire consisted of two thematic parts, the first being an introductory part concerning the membership of interviewees in the respective initiative. This part aimed at gaining background information about the interviewee, to build up trust and collect feedback for our case study partners. The larger, second part covered the energy-use of the investigated households, based on the questionnaire used in the project "Energieverbrauchsstile" in order to get comparable data. The survey included items which allowed for calculating the energy demand per year in a bottom-up approach: details on quantity and quality of energy consuming units (e.g. number and quality of appliances, size and thermal quality of housing) and behavioural aspects of energy demand were combined with factors from literature. As a result the energy demand in kWh per year was calculated for various use categories such as appliances, heating, warm water, mobility, etc.

The comparison of the calculated energy demand was based on the respective per capita values which is a common approach related to the discourse on fair allocation use of resources (e.g. WBGU, 2009). Thus, differences in household size were included in the analysis. Metric data was analysed for variances (ANOVA), nominal data was analysed with cross tables and chi-square tests. Unless otherwise noted, the following numbers refer to the average values of the Ökostrombörse (ÖB), the Eco-region Kaindorf (EK), and Austria (A). A detailed, German report on the results can be found in Bohunovsky et al. (2011).

Results

The results support the hypothesis, that households which are engaged in energy initiatives differ from average households in a set of characteristics:

Renewable energies are used more often in energy-aware households than in reference households. Concerning electricity, investigated households of the eco-region Kaindorf more frequently changed to alternative electricity providers than Austrian reference households (26% vs. 5%), offering local and renewable electricity. None of the households being member in the Ökostrombörse changed their provider. This might be explained with the idea of the Ökostrombörse to directly promote alternative forms of energy and not via an

alternative electricity provider. Also for heating, investigated households use renewable energy sources more frequently than reference households (ÖB: 90%, EK: 70% vs. A: 42%).

Environmental protection is a bigger concern in energy-aware households. This concern is represented via various questions concerning the importance of the issues or reasons for decisions such as changing energy provider or the heating system.

Appliances and lighting: Energy-aware households use less appliances per capita (ÖB: 2,9; EK: 3,3 vs. A: 4,6 appliances per capita). However this could be due to bigger household sizes. Interestingly, almost no differences could be identified related to the energy efficiency of appliances used. That means that energy-aware households do not necessarily consider energy efficiency more seriously when buying electrical appliances than the average. Also, no difference can be seen concerning the frequency and duration of usage. Regarding avoidance of stand-by, there is a significant difference: 80 to 90% of the investigated energy-aware households try to avoid this unnecessary flow of energy. In comparison, Austrian reference data shows a quota of more than 20% who do not try to avoid stand-by.

Surprisingly, results in electric lighting showed that investigated energy-aware households avoided the unnecessary illumination of rooms (ÖB: 85%, EK: 100% vs. A: 42%), but they used less energy saving lamps than in the reference households (ÖB: 11.3%, EK: 12.9% vs. A: 17.9%). That adds up to a higher calculated demand of energy for lighting. The rejection of energy saving lamps was not part of the investigation, but nevertheless the respondents explained it informally with environmental reasons such as harmful substances in the lamps or lack of quality (design, quality of light emitted), hoping that new technologies like LED would lead to better products. Thus, awareness seems to be there as well. Another possible reason is that energy-aware households are more conscious about the fact that energy saving lamps only contribute to a small extent to solving the energy problem. That's why they focus more on other aspects of energy use.

Heating & thermal quality of homes: Almost all investigated energy-aware households are single family homes, which almost inevitably leads to higher demands of heating energy. No significant difference of the reference regions could be found, neither in comparison to totals nor when limiting to single family homes and small multi-family houses. Regarding behavioural aspects of heating (choice of temperature, spatial and temporary limitations of heating) and the quality of windows no difference could be found either. Energy-aware households stated that they consider energy efficiency when buying, building or renovating their house. Nevertheless, calculations of (specific) heating loads – depending on type of flat/house and thermal isolation – show that the thermal quality of their homes is rather under the average. This can be explained by the fact that most households investigated are single

family homes needing more energy for heating. That contradiction could not be further examined within the data available.

Mobility: 65 % of respondents in the ecoregion Kaindorf own two cars, among respondents in Vorarlberg (Ökostrombörse) this level is 40%. These shares are high in comparison to Austria (24%). However, when comparing the calculated per capita energy demand for cars per year, the differences are smaller and not significant. Thus, the high number of cars does not directly correspond to high mileages.

Despite living in rural areas, which show a poor connection to the public transport network, energy-aware respondents stated a more frequent use of public transport than the average. Besides school transportation also leisure activities are a frequent reason for its use. Reasons for the rare use of public transport are stated similarly to those given in reference regions: low availability and the desire to be flexible. Differently than in reference households, costs are never mentioned as reasons for non-use of public transport. Air travel is slightly less frequent in the interviewed energy-aware households. However, when calculating energy use per capita no difference could be seen any more.

Energy demand: When combining the usage patterns in different categories in order to calculate the energy demand per capita hardly any differences can be seen between the reference regions. Only the energy demand for warm water and electrical appliances proves to be significantly lower in households which are actively involved in energy initiatives. Also the sum of energy demand values in all categories does not show significant differences.

Discussion

Summing up, energy use patterns in investigated energy-aware households clearly differ from the national average. The results of the survey suggest that the interviewed households, who are engaged in one of two selected energy initiatives, are more aware and more sensitive in their decisions of energy-use. By preferring renewable energy sources as well as by following “saving” patterns of energy use like avoiding stand-by usage, reducing the annual car mileage, etc. the households try to keep the energy demand low and thus to reduce negative environmental effects like carbon dioxide emissions.

Nevertheless, calculated total energy demands for the investigated energy-aware households statistically do not differ from the national average. This might be due to the bottom-up demand calculations, which are based on a number of factors, approximations and simplifications, so that the energy demand could not be estimated with high accuracy. But also structural conditions such as living situation or the demand for mobility limit these efforts.

Living in a rural region restricts the use of public transport and single family homes need more heating energy than flats and usually have bigger floor space. The high number of cars in the eco-region Kaindorf might also be explained through the large share of households with several people over 14 years. For youth and young adults in rural regions independent mobility cannot be guaranteed other than by private car.

Even though no reduction of total energy demand could be shown, energy-aware households mainly use renewable forms of energy and top the average of reference households. The motivation for changing existing heating systems was mainly based on environmental protection. Thus, energy-aware households clearly contribute to a decarbonisation of their energy demand – although this effect could not be quantified within this study.

The results suggest that energy engagement is related to significant behavioural differences in household energy patterns. However, their endeavours seem confined by existent structural conditions. Thus, the resulting differences are mostly too small in order to lead to significant savings in energy demand.

Bibliography

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