



forsa. Gesellschaft für
Sozialforschung und statistische Analysen mbH

**The German
Residential Energy Consumption Survey
2009-2010**

**Rheinisch-Westfälisches Institut für Wirtschaftsforschung
(RWI)**

**forsa Gesellschaft für Sozialforschung und statistische
Analysen mbH**

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Team:

RWI: Prof. Dr. Manuel Frondel (Project Leader), Dr. Mark Andor,
Dr. Nolan Ritter, Prof. Dr. Harald Tauchmann, Prof. Colin Vance,
Ph.D.

forsa: Dr. Peter Matuschek, Ute Müller

Executive Summary

The aim of this study is to estimate the energy consumption of German private households for the years 2009 to 2010. A nationwide survey among more than 7,100 households serves as a starting point to determine the consumption of various fuels for residential purposes and due to private car-usage. The households were interviewed with respect to their housing conditions, the characteristics of the respective dwelling, the consumption of fossil fuels, electricity and renewable energy sources, etc. The sample estimates were extrapolated for the corresponding years to derive consumption figures for the entire population of private households in Germany.

The results will be compared with those of the preceding study performed by the RWI and forsa (2010) in 2008. As these are based on the same interview tool and panel of households, they should be well-suited for comparison purposes. Moreover, the results will be compared to the values of AGEB.

Methodology

The current study is in many respects comparable to its predecessors, the German Residential Energy Consumption Surveys 2005 and 2006 - 2008. The households of the forsa.omninet-panel serve again as the survey sample, who are equipped with an interface that allows an easy implementation of complex questionnaires by filter techniques and visual assistance. This tool further allows for automatic consistency checks during the data input by the participant. By this means, the forsa.omninet-panel ensures that the collected data is of high quality.

The extrapolation was stratified by region and type of building, or in exceptional cases by household size. Recognizing that the ability to provide details about, for example the electricity consumption, may be correlated with the consumption behavior, econometric discrete choice models were used to derive a weighting scheme to overcome possible problems with self-selection effects in the data. Self-selection might occur if households who are hardly aware of their energy consumption are also

less diligent with keeping their energy bills, and are therefore unable to quantify their energy consumption. In consequence, the sample would systematically consist of households with a low consumption, and the “true” residential energy consumption would be underestimated. The derived weighting scheme aims at accounting for such potential data problems.

Discrete-choice models are econometric regression models in which the dependent variable is categorical. In this case a binary categorization was created that distinguished households according to whether they gave valid information. For each household a probability (based on socio-economic characteristics) is estimated that the observation falls into one of these two categories. The probabilities were used to develop a weighting scheme that systematically puts more weight on households with low response probabilities.

The survey was performed via forsa.omninet, an interview tool that allows high response rates and ensures high reliability. The tool ensures that entry errors during the data transmission can be avoided and plausibility and consistency checks can be carried out. The visualizing and filter abilities turn out to be very advantageous.

After a household has indicated its respective billing company, the survey procedure subsequently presents an exemplary bill issued by the company. The system goes step by step through the details of the exemplary bill, while highlighting the parameters of interest. By this means, both the error rate and drop-out quota of households living in multi-family houses with central heating were reduced substantially.

Like in the preceding reports of RWI and forsa (2008, 2010), the residence information provided by the households are used in order to consider the individual climatic conditions of the households.

The household-specific climate conditions were obtained by a grid of climate stations operated by *Deutscher Wetterdienst*, and geographically interpolated to the households’ places of residence. This procedure improves considerably the quality of the results for storable fuels such as heating oil.

Results

Generally all results obtained by a sample survey entail a certain degree of statistical uncertainty, having also implications for the extrapolation procedure. By definition, a sample consists of only a fraction of the population, and the sample estimates will therefore randomly deviate from the parameters in the population. Therefore, in addition to the estimated average consumption, this study provides the range of the confidence interval, which is likely to include the true, but unknown population parameter with a probability of 95%. These confidence intervals are indispensable when extrapolation results are compared to results of other data sources, for instance to the consumption figures published in the German energy balances.¹ It would be highly unlikely if the AGEB-values coincided perfectly with the extrapolation results obtained in this study. But if deviations occur, it should be assessed whether they are random or systematic. To answer such questions, the empirical literature applies the computation of standard errors and confidence intervals.

By comparing the results of this study with the consumption values of the AGEB it seems salient that the same pattern occurs, which could also be observed for the preceding studies for 2003, 2005 and 2006-2008: Compared to the AGEB values, the results for electricity and district heating of this study are lower. The consumption figures for fuel oil are not comparable due to methodological reasons. While the AGEB (2012) publishes the amount sold to the households, in this study the factual consumption is estimated.

Turning to electricity, deviations of the same magnitude as in the previous studies performed by RWI and forsa (2005, 2008 and 2010) can be found. These deviations range from 5 to 6% and can be explained primarily by conceptual differences: While this study focuses on the number of occupied housing units, the AGEB

¹ "[T]o reject a hypothesis because the data show 'large' departures from the prediction requires a quantitative criterion of what is to be considered a large departure (Jeffreys 1967, 384)", in Ziliak, McCloskey (2004:528). Interpreted in this comparison, this means: Criteria such as standard error are required to evaluate whether the extrapolation results do not deviate randomly but systematically from the AGEB values.

focuses on the number of households. The Federal Statistical Office (Statistisches Bundesamt) reported that these values differ by about 9%, which explains broadly the differences in the results.

Some of the biggest differences are salient for coal and lignite. According to the AGEBA, 54 petajoule (PJ) were used in 2010, while the current study only shows a value of 14 PJ. The differences are smaller if all energy sources are considered. For 2010 the value of this study exceeds AGEBA's value by 3%, which is primarily due to fuel oil. Our estimates indicate that about 1,300 PJ are spent for private car usage in 2010, which accounts for nearly 33% of the total energy consumption of private households.

An extensive computer-assisted telephone survey directed at the market penetration of renewables in households was conducted in fall 2006. In total more than 80,000 households were asked whether they use a heat pump, solar heating, wood pellets or a photovoltaic device. A similar survey of about 30,000 households was performed in 2012. According to this survey 8.9% of all occupied housing units were equipped with a solar heat collector. Compared to 2006, the number has almost doubled. At the beginning of 2012, 5.5% of all occupied housing units were equipped with a photovoltaic system (2006: 1.8%) and 4.2% had a heat pump (2006: 2.4%).

Summary and Conclusions

The continuation of the forsa.omninet panel of private households' energy consumption compiles information that is of high relevance to policy makers and the public at a time in which energy provision in Germany is undergoing a massive transformation. No other country is equipped with a dataset of several thousand households who are repeatedly surveyed about their energy consumption and their housing conditions. This information source will allow monitoring the implications of Germany's transition of the energy sector (Energiewende) for the household sector, an issue of high prominence in Europe's deliberations about energy supply.

Continuing the survey with a largely maintained survey design increases the experience of the participants and thereby the validity of the results. The survey also complements the infor-

mation provided by the AGEB, which provides important clues concerning the energy use of private households.

In the current study a special focus is to determine the energy cost burden of private households. A brief analysis shows that the energy costs may represent an important fraction of the net household income, in particular for households of lower income groups. The results obtained for 2010 are not representative because the number of observations is too small for the more relevant lower income groups. Nevertheless, the study is representative in terms of its central objective, the extrapolation of the energy consumption of private households.

A deeper and more representative analysis of the energy cost development and the resulting burden for households seems to be appropriate in the light of further increasing electricity prices. This holds not least in the context of the findings of this study: Instead of an annual electricity consumption of 3,500 kWh, as usually assumed in the media, the consumption of a typical three-person household now can be expected to be about 4,000 kWh and more. A typical four-person household now may have an annual electricity consumption of about 5,000 kWh.