Karlsruhe Institute of Technology

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No. 65 | OCTOBER 2022

WORKING PAPER SERIES IN PRODUCTION AND ENERGY

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Abstract

Climate change mitigation is one of the greatest human challenges. The associated transformation of energy supply and demand to low-carbon energy sources requires not only technical solutions, but also involves consumers and as such, represents a holistic societal process. To date, however, the energy-related behavior of consumers is poorly understood. Against this backdrop, energy panels may be a viable solution to monitor behavior and collect adequate data over long periods. Yet, consumer panels are often established at the local level, raising questions about whether a sample is representative of the population of interest. We take a first step into answering this question by comparing a local sample of household consumers from the Karlsruhe area in Southwest Germany with a sample from Germany. Our analyses are based on a sample of more than 1,000 respondents surveyed via computer-assisted telephone interviews (CATI) in summer 2021. Overall, the results show strong similarities between Karlsruhe and Germany, both in terms of sociodemographics and energy consumption behavior. Nonetheless, there are also differences between the two samples, for example, in terms of political orientation or climate concern. Future research should examine whether and to what extent these differences are relevant to subsequent analyses and how a panel can still be used to approximate the population under investigation.

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ABSTRACT

Climate change mitigation is one of the greatest human challenges. The associated transformation of energy supply and demand to low-carbon energy sources requires not only technical solutions, but also involves consumers and as such, represents a holistic societal process. To date, however, the energy-related behavior of consumers is poorly understood. Against this backdrop, energy panels may be a viable solution to monitor behavior and collect adequate data over long periods. Yet, consumer panels are often established at the local level, raising questions about whether a sample is representative of the population of interest. We take a first step into answering this question by comparing a local sample of household consumers from the Karlsruhe area in Southwest Germany with a sample from Germany. Our analyses are based on a sample of more than 1,000 respondents surveyed via computer-assisted telephone interviews (CATI) in summer 2021. Overall, the results show strong similarities between Karlsruhe and Germany, both in terms of sociodemographics and energy consumption behavior. Nonetheless, there are also differences between the two samples, for example, in terms of political orientation or climate concern. Future research should examine whether and to what extent these differences are relevant to subsequent analyses and how a panel can still be used to approximate the population under investigation.

Keywords:

Energy consumption

Citizen attitudes

Energy panel

Consumer behavior

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1 Introduction

In response to climate change, numerous countries around the world have decided to fundamentally change their energy systems. These changes involve both the generation and consumption sides of energy. While on the generation side, this process is characterized by an expansion of generation plants using renewable energies, on the consumption side, energy efficiency and energy flexibility are key. In Germany, for example, an increasing number of households are installing PV systems (see Federal Network Agency 2022), thus becoming prosumers that simultaneously generate and consume energy. Similarly, the number of electric vehicles and heat pumps has increased significantly in recent years (see BDEW and Statistisches Landesamt 2022; KBA 2022). These developments also entail a number of drawbacks, such as increasing the risk of local grid congestions if feed-in, charging, or usage go uncontrolled, or local resistance caused by a lack of acceptance. Against the backdrop of these developments, consumers of energy – in particular households – will (have to) play a much more active role in future energy systems.

To date, however, the energy behavior of households and the factors influencing or preceding that behavior, such as their political views (e.g., Costa and Kahn 2013) or the effectiveness of information provision (e.g., Asmare et al. 2021), are poorly understood. This is especially true for household energy behavior over time, which has rarely been tracked in practice, but may be the result of prolonged decision-making processes and, in particular, may be non-constant (see, e.g, Song et al. 2022), thus limiting the explanatory and predictive power of cross-sectional studies. By contrast, in the retail sector, for example, companies such as *Payback* are tracking consumers' product choices by offering small discounts or credits in exchange for their data for many years already. To gain better insights into the energy behavior of households, it may also be valuable to collect such data. However, collecting longitudinal data on energy behavior, for example, by establishing a consumer panel, comes with numerous challenges, especially with regard to participation, data tracking, and costs: (i) First, for inferences to be statistically reliable, a certain number of panelists must be reached that are representative of the respective population. (ii) Second, the infrastructure to measure behavior is usually located in a consumer's personal environment (e.g., the electricity meter in the basement), which is difficult to access. (iii) Third, even if the first two challenges can be overcome, they are often accompanied by significant costs that, in practice, must be kept in check. To address these challenges, a viable approach may be to limit an energy panel to a particular geographical area, such as a municipality or the supply area of an energy provider, making it easier to provide incentives, access the local infrastructure, and limit costs. However, limiting a panel to a particular geographical area poses the risk of biased samples, as the consumers of an area may differ significantly from the population of interest. This almost inevitably leads to the question of whether the use of data on the energy behavior of consumers in a particular geographic area allows for conclusions about the entire population of interest.

This is the starting point for our research. In the long run, we plan to establish an energy panel for the district of Karlsruhe, which is located in the southwest of Germany. To ensure generalizability for Germany, we compare a sample of household consumers from Karlsruhe with a sample from Germany with regard to energy-related behavior, sociodemographics, and further consumer characteristics. Our analyses are based on data from a multistage, stratified sample of more than 1,000 respondents collected with the help of a market research company via computer-assisted telephone interviews (CATI) in August and September 2021.

The remainder of this paper is structured as follows: The subsequent Section 2 provides some conceptual background, followed by in-depth information on the telephone survey conducted and its results. Section 3 summarizes the main findings, discusses their implications, outlines the limitations of the study at hand, and concludes with potential future research.

2 Telephone survey

2.1 Method

Sample

In cooperation with the Ipsos Group, a multinational market research company, we conducted a total of n = 1,000 Computer Aided Telephone Interviews (CATI) in Germany in the period from August 5 to September 9, 2021. Although conducting CATI involves significant costs, it comes with multiple benefits. Exemplary advantages are high response rates, spontaneous answers, and the ability to reach target groups that are difficult to access (Matzke 2004, p. 425).[1] Half of the interviews addressed households of the city and county of Karlsruhe ($n_{Karlsruhe}$ = 500), while the other half was conducted nationwide to the exclusion of Karlsruhe ($n_{Germany}$ = 500). The average duration of the interviews was 10.6 minutes across both sub-samples (Ipsos Group 2021). Participants were German-speaking persons aged at least 18, who hold a landline or mobile phone connection ("dual frame" telephone survey) and who live in private households, making the population 67.566 million for the sample Germany (Ipsos Group 2021, p. 2). Because mobile phone numbers lack a local identifier (ADM e.V. 2021), only fixed-network lines were taken into account for the sample Karlsruhe, resulting in a population of .622 million people accordingly (Ipsos Group 2021). However, "mobil-onlys" or "mostly-mobiles" (persons that can be reached exclusively or mostly via mobile connection) are characterized by significantly lower average age compared to landline contacts (Ipsos Group 2021). Taking this in account, the sample Karlsruhe was surveyed using an age quota according to the target distribution of the city and district of Karlsruhe (Ipsos Group 2021). If, during the field phase, a quota stored in the CATI system was reached for the underlying age group, the respective cell was closed (Ipsos Group 2021).

A multistage stratified random sample was drawn from each of the two populations based on the telephone sampling system of the “Arbeitskreis Deutscher Markt- und Sozialforschungsinstitute e.V.” (ADM). Notably, ADM´s sampling system allows for randomized samples of private households as well as unique persons living inside them (Tausendpfund 2018, p. 225). For that reason, ADM´s design is generally considered "good practice" (Häder and Häder 2014, p. 290). The multistage drawing process for landline connections was carried out in three stages:

(i) Random selection of “sample points” within the target region, with the Federal Republic of Germany divided into approximately 53,000 sample points. Further on, one sample point comprises an average of 750 households (Heckel and Hofmann 2014, p. 96; Ipsos Group 2021).

(ii) Random selection of a household within the selected sample point via random walk procedure (Ipsos Group 2021; Heckel and Hofmann 2014, p. 107).

(iii) Random selection of a person living in the selected household drawing on the next-birthday method (Ipsos Group 2021; Heckel and Hofmann 2014, p. 107). To conduct an interview

[1] Further disadvantages of online panels include, for example, the risk of professional respondents (see, e.g., Sandorf et al. 2020) and self-selection bias (see, e.g., Bethlehem 2010).

with the household member whose birthday is next, the selected household was contacted up to ten times. If no one picked up the phone, another contact attempt was made after thirty minutes, and, if the line was busy, again after ten minutes (Ipsos Group 2021).

For mobile contacts the selection process was also based on the ADM sampling system (ADM e.V. 2021). Due to the absence of local identifiers, we assigned mobile contacts to the correct federal state based on information provided during the interview.

Design

The survey was subdivided into four sections. In the introduction, participants received a brief portrayal of the Karlsruhe Institute of Technology (KIT) and the Ipsos Group (see Appendix A.1 for the questionnaire). After participants agreed to take part in a ten-minute survey about the energy behavior of German households, they were instructed about the possibility to always answer with "Don't know" or "Don't specify". Moreover, participants were encouraged to give an estimate in case of uncertainty. In the second part, questions were asked on the household level about energy consumption behavior, consumer behavior, and demographics. In the subsequent third part, data for the same three categories were collected on the individual level. In the last part of the survey, questions were asked about the availability of a smart meter and the household´s willingness to participate in an energy panel, in which long-term consumption data would be collected via smart meters provided free of charge.

We measured items on five-point Likert scales (e.g., engagement in electricity saving measures), nominal scales (e.g., building type), or asked directly for numerical values (e.g., estimated monthly electricity costs). The original questionnaire in German language can be found in Appendix A.1.

The goals of analysis and result processing are twofold. First, we examine the degree of external validity for the sample Germany. In doing so, we compare results on household and individual level data of the sample Germany with results of prior surveys by research institutes or government institutions (with much larger sample sizes). Second, we investigate similarities and differences between the samples of Germany and Karlsruhe to determine whether the city and district of Karlsruhe have the potential to serve as an energy panel representative for German households in terms of energy consumption behavior, consumer behavior and demographics.

2.2 Analysis: External validity

We test the external validity of the surveyed Germany sample by comparison with extant research. We do so by employing hypotheses tests depending on the specific scales of measurement where applicable. In the case of nominally scaled variables, we conduct a χ^2-test for homogeneity, while an analysis of variance (ANOVA) is performed for ordinally, metrically, or quasi-metrically scaled variables.

2.2.1 Household level

Energy consumption behavior

The surveyed average living space of private households (with at least one member) in Germany approximates results of comparable extant research ($M_{GER,\ CATI}$ = 110.73 m², $M_{GER,\ Comp}$ = 112.5 m²) by (BMWI et al. 2012, p. 135). Likewise, the average monthly payment for electricity by German households is at the level of those surveyed in 2021 by BDEW ($M_{GER,\ CATI}$ = 92,14 Euro, $M_{GER,\ Comp}$ = 93,17 Euro). However, results regarding electricity usage differs from results of prior research (Dünnhoff and Palm 2016) concerning participants´ use of electricity for heating water ($\chi^2(2) = 53.586$, $p = .001$) and for heating premises ($\chi^2(5) = 33.123$, $p = .001$). Specifically, our sample demonstrates a smaller relative frequency (*RF*) of households utilizing electricity for heating water only “sometimes” ($RF_{GER,\ CATI}$ = 4.19%, $RF_{GER,\ Comp}$ = 8.94%). Moreover, we exhibit a slightly higher proportion of

participants who partially (vs. not vs. completely) heat premises by means of electricity compared to extant research ($P_{GER,\ CATI} = 16.74\%$, $P_{GER,\ Comp} = 6.18\%$).

Demography

Regarding demographics at the household level in Germany, comparison of our collected data with those of the European Social Survey (2018) demonstrates congruence in the average number of household members ($M_{GER,\ CATI} = 2.64$, $M_{GER,\ ESS9} = 2.82$, $F(1, 2856) = 2.049$, $p < .152$). Yet, the distribution of households´ net income ($\chi^2(5) = 13.306$, $p = .021$) does not exactly match extant research (European Social Survey 2016).

2.2.2 Individual level

Energy consumption behavior

At the person level, respondents indicated the same level of engagement to electricity saving measures compared to those measured by the European Social Survey in 2016 ($M_{GER,\ CATI} = 3.84$, $M_{GER,\ ESS8} = 4.07$, $F(1, 2856) = 1.319$, $p = .251$).

Consumer behavior

In line with society´s and media´s steadily increasing interest in climate change (Sisco et al. 2021), our results demonstrate people´s growing concerns about climate change compared to prior results of the European Social Survey from 2016 ($M_{GER,\ CATI} = 3.79$, $M_{GER,\ ESS8} = 3.4$, $F(1, 3334) = 63.44$, $p < .001$).

Demography

In the area of household-level demographics, comparison of our results with those of Statistisches Bundesamt (2021), whose scale we adapted, reveals differences in the distributions of the samples across educational attainment levels ($\chi^2(5) = 265{,}5$, $p = .001$).

Most importantly, comparison between results suggest good external validity of the CATI survey data in terms of representativeness for the German population regarding households´ energy behavior. We proceed to examine similarities and differences between the samples of Germany and Karlsruhe.

2.3 Results: Comparison between the samples Germany and Karlsruhe

We test differences between the two samples surveyed, Germany and Karlsruhe, by conducting various hypotheses tests. In the case of nominally scaled single choice variables, we conduct a χ^2-test for homogeneity (e.g., distribution of households across building types), while two-sample tests for proportions are performed for questions where multiple selections are possible (e.g., number of vehicles per household by vehicle type). Again, we conduct an ANOVA for the comparison of ordinally, metrically, or quasi-metrically scaled variables (e.g., households´ stated monthly payments for electricity).

2.3.1 Household level

Energy consumption behavior

Comparison of households´ energy behavior between both samples suggest great similarities between pan-German and Karlsruhe households (see Table 1, Table 2). Despite differences in the types of buildings occupied by households ($\chi^2(4) = 14.85$, $p = .005$), proportions of installed building technologies do not differ. Thus, between samples households share equal ratios of installed photovoltaic systems to generate electricity ($RF_{GER} = 19\%$, $RF_{KA} = 18\%$, $\chi^2(1) = .192$, $p = .662$), equal proportions of solar systems for generating hot water ($RF_{GER} = 14\%$, $RF_{KA} = 13\%$, $\chi^2(1) = .063$, $p = .802$), and comparable ratios of installed heat pumps ($RF_{GER} = 9\%$, $RF_{KA} = 9\%$, $\chi^2(1) = .063$, $p = .802$). Simultaneously, neither differences in households´ preference to use electricity for water heating ($\chi^2(1)$

= .063, p = .802) nor in monthly electricity costs paid per household in general (M_{GER} = 92.14 Euro, M_{KA} = 99.99 Euro, $F(1, 754) = 1.856$, p = .174) are observed. In general, utilizing the efficiency class of a household´s main refrigerator as an indicator, households´ engagement in electricity saving behavior across the two samples turn out equal ($\chi^2(8) = 3.77$, p = .715). However, the degree to which electricity is used to heat households´ premises differs between Karlsruhe and Germany ($F(1, 965) = 7.55$, p = .006), and so does the average living space of households. On average households in Karlsruhe are bigger than pan-German households (M_{GER} = 110.73 m², M_{KA} = 122.34 m², $F(1, 754) = 1.856$, p = .174).

Since energy behavior in the context of mobility is strongly reflected in the type of vehicles used by households, we further compare the number of different vehicle types available in households as well as preferences regarding future choices of different mobility concepts. On the one hand, both Karlsruhe and German households indicate equal probabilities to buy a car ($\chi^2(6) = 2.079$, p = .912) or an electric car ($\chi^2(6) = 10.253$, p = .114) during the next five years, with about half of them each stating to exclude a car purchase altogether. On the other hand, households across samples own the same amount of vehicles of the same type, e.g., cars with combustion engine (M_{GER} = 1.29, M_{KA} = 1.48, $F(1, 996)$ = 2.155, p = .142) or cars with electric motor (M_{GER} = .08, M_{KA} = .06, $F(1, 997) = .655$, p = .419). However, Karlsruhe residents appear to be the more motivated bicyclists due to a larger number of bicycles owned per household (M_{GER} = 1.89, M_{KA} = 2.54, $F(1, 997) = 21.52$, p = .001), which might be attributed to the greater share of Karlsruhe households living in an urban area or the landscape in the area of Karlsruhe being quite flat compared to the rest of Germany (see Table 1).

Table 1: Comparison between samples – Energy consumption behavior, household level (1/2).

Comparison of energy consumption behavior between samples on household level									
	Germany				Karlsruhe (City & County)				Diff. between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Building type (Adapted from Statistisches Bundesamt 2019)									χ 2(4) = 14.85, p = .005
Detached single family house	117	23%			132	26%			
Semidetached or terraced one-family house	105	21%			126	25%			
Two-family house	30	6%			50	10%			
Residential building with three and more apartments	224	45%			178	36%			
Other building	22	4%			14	3%			
Installed building technology[a] (Adapted from Swiss Household Energy Demand Survey 2020)									
Solar plant photovoltaic (electricity)	44	19%			48	18%			χ 2(1) = .192, p = .662
Solar plant thermal (warm water)	33	14%			35	13%			χ 2(1) = .063, p = .802
Heat pump	20	9%			24	9%			χ 2(1) = .380, p = .537
None of the above	131	57%			155	59%			χ 2(1) = 2.821, p = .093
Living Space (without balcony/terrace) [m²] (Adapted from RWI, Forsa 2012)			110.73	67.41			122.34	63.83	F(1, 965) = 7.55, p = .006
Use of electricity for water heating? (Adapted from Verbraucherzentrale Rheinland-Pfalz 2016)									χ 2(4) = 7.668, p = .060
No	281	58%			306	64%			
Yes, water heating completely done with electricity	122	25%			91	19%			
Yes, water heating partially done with electricity	81	17%			84	17%			
Use of electricity for heating? (Adapted from Verbraucherzentrale Rheinland-Pfalz 2016)									χ 2(6) = 28.934, p = .001
No	405	85%			414	85%			
Yes, but only occasionally	20	4%			48	10%			
Yes, I mainly heat with a night storage heater	19	4%			12	2%			
Yes, I mainly heat with an el. direct heating system	15	3%			4	1%			
Yes, I mainly heat with an electric heat pump	18	4%			11	2%			
Estimated monthly electricity costs [€]			92.14	81.07			99.99	77.38	F(1, 754) = 1.856, p = .174
Energy efficiency class of the refrigerator									χ 2(8) = 3.77, p = .715
A+++	79	23%			78	22%			
A++	94	27%			98	28%			
A+	96	27%			79	23%			
A	42	12%			46	13%			
B	20	6%			23	7%			
C	9	3%			11	3%			
D	10	3%			16	5%			
Number of vehicles (Adapted from BMWI, Infas 2017)									
Cars with combustion engine			1.29	1.17			1.48	2.52	F(1, 996) = 2.155, p = .142
Cars with electric motor			.08	.29			.06	.26	F(1, 997) = .655, p = .419
Cars with hybrid drive			.06	.27			.05	.27	F(1, 997) = .89, p = .346
Motorcycles/mopeds			.16	.52			.16	.56	F(1, 997) = .0, p = .992
E-bikes/pedelecs/e-scooters			.3	.72			.3	.66	F(1, 997) = .004, p = .953
Normal, functional bicycles			1.89	1.66			2.54	2.64	F(1, 997) = 21.52, p = .001
Probability of car purchase during next five years									χ 2(6) = 2.079, p = .912
0%	236	49%			229	48%			
25%	64	13%			66	14%			
50%	66	14%			70	15%			
75%	37	8%			37	8%			
100%	79	16%			77	16%			

[a] Due to ownership structures only households living in a "Detached single family house" or in a "Semidetached or terraced one-family house" were asked.

Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

Table 2: Comparison between samples – Energy consumption behavior, household level (2/2).

Comparison of energy consumption behavior between samples on household level									
	Germany				Karlsruhe (City & County)				Diff. between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Probability that the next car will be an electric one									χ 2(6) = 10.253, p = .114
0%	253	53%			216	46%			
25%	65	14%			59	13%			
50%	74	16%			89	19%			
75%	35	7%			48	10%			
100%	49	10%			57	12%			
Would you like to know how the energy behavior of other households compares to your own? *(1: Not at all; 5: Yes, very precisely)*			2.13	1.44			2.2	1.49	F(1, 943) = .47, p = .493

Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

Consumer behavior

To gain insights into consumption preferences regarding economic and environmental aspects, we examine the decision-making process and choice behavior of households choosing an electricity provider (see Table 3). Overall, Karlsruhe households do not differ in the frequency of switching electricity providers compared to pan-German households – neither in the past ($\chi^2(1) = 2.715$, $p = .099$), nor concerning future ambitions to switch providers ($\chi^2(6) = 8.67$, $p = .193$). Furthermore, the amount of households consciously purchasing green electricity, i.e., electricity from renewables only, adds up about one third for both samples ($\chi^2(1) = .678$, $p = .410$). Notably, the number of households willing to pay a 2% premium for purely green electricity (compared to a mix of 50% green electricity and 50% conventional electricity) differ between samples but seem to converge at about two-thirds in each case (see Table 3; $\chi^2(1) = 4.711$, $p = .03$).

Table 3: Comparison between samples – Consumer behavior, household level.

Comparison of consumer behavior between samples on household level									
	Germany				Karlsruhe (City & County)				Diff. between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Has household changed electricity providers in the last five years?									χ 2(1) = 2.715, p = .099
Yes	166	34%			143	29%			
No	321	66%			347	71%			
Probability of electricity provider change during the next twelve months									χ 2(6) = 8.67, p = .193
0%	330	69%			351	73%			
25%	42	9%			45	9%			
50%	55	12%			50	10%			
75%	23	5%			14	3%			
100%	27	6%			22	5%			
Electricity contract with share of green electricity at 100% ?									χ 2(1) = .678, p = .410
Yes	149	35%			138	33%			
No	274	65%			286	67%			
Willingness to pay X% more for 100% green electricity instead of 50% /50% green/conventional electricity.[a]									
2% additionally									χ 2(1) = 4.711, p = .03
Yes	320	64%			352	70%			
No	156	31%			126	25%			
5% additionally									χ 2(1) = 1.692, p = .193
Yes	231	46%			261	52%			
No	78	16%			69	14%			
10% additionally									χ 2(1) = 2.097, p = .148
Yes	96	19%			130	26%			
No	118	24%			122	24%			
15% additionally									χ 2(1) = .531, p = .466
Yes	49	10%			62	12%			
No	40	8%			62	12%			

[a] Relative frequencies in each case in relation to the entire sample.
Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

Demography

Household-level demographics (see Table 4) indicate different distributions in terms of sizes of locality ($\chi^2(4) = 9.383$, $p = .001$), for which arguably the higher share of Karlsruhe urban area compared to the pan-German sample can be held responsible. Importantly, however, the Karlsruhe sample is representative of Germany with respect to the distribution of household net income ($\chi^2(5) = 9.009$, $p = .109$) and also regarding the number of household members including persons under 18 ($M_{GER} = 2.82$, $M_{KA} = 2.95$, $F(1, 998) = .931$, $p = .335$) or excluding persons under 18 ($M_{GER} = .63$, $M_{KA} = .72$, $F(1, 651) = 1.244$, $p = .265$). The distribution of responsibility for choosing a provider among household members is the same for both samples ($\chi^2(1) = 4.711$, $p = .172$).

Table 4: Comparison between samples – Demography, household level.

Comparison of demographic statistics between samples on household level									
	Germany				Karlsruhe (City & County)				Diff. Between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Size of locality									χ 2(4) = 9.383, p = .001
Up to less than 2,000	24	5%			0	0%			
2,000 to less than 5,000	34	7%			9	2%			
5,000 to less than 20,000	107	21%			143	29%			
20,000 to less than 50,000	75	15%			104	21%			
50,000 to less than 100,000	42	8%			0	0%			
100,000 to less than 500,000	88	18%			244	49%			
500,000 and more	130	26%			0	0%			
Federal State									n/a
Schleswig-Holstein	10	2%			0	0%			
Hamburg	19	4%			0	0%			
Niedersachsen	42	8%			0	0%			
Bremen	7	1%			0	0%			
Nordrhein-Westfalen	83	17%			0	0%			
Hessen	23	5%			0	0%			
Rheinland-Pfalz	22	4%			0	0%			
Baden-Württemberg	55	11%			500	100%			
Bayern	94	19%			0	0%			
Saarland	7	1%			0	0%			
Berlin	42	8%			0	0%			
Brandenburg	18	4%			0	0%			
Mecklenburg-Vorpommern	14	3%			0	0%			
Sachsen	27	5%			0	0%			
Sachsen-Anhalt	22	4%			0	0%			
Thüringen	15	3%			0	0%			
Household size									
All persons			2.82	2.39			2,95	1,91	F(1, 998) = .931, p = .335
Younger than 18			0.63	1.11			0,72	0,95	F(1, 651) = 1.244, p = .265
Monthly net household income (Adapted from Statistisches Bundesamt 2019)									χ 2(5) = 9.009, p = .109
Less than 1300€	45				40				
1300 – less than 1700€	36				32				
1700 – less than 2600€	72				63				
2600 – less than 3600€	92				80				
3600 – less than 5000€	65				97				
5000€ or more	68				80				
Responsibility for choosing electricity supplier or tariff (Adapted from BMWI, RWI, Forsa 2012)									χ 2(1) = 4.711, p = .172
Me, only	277	56%			256	52%			
Me, together with others	154	31%			164	33%			
This is done by others	64	13%			75	15%			

Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

2.3.2 Individual level

Energy consumption behavior

In line with the highly congruent energy consumption behavior across samples on household level, we observe comparable patterns on individual level (see Table 5). For example, on average, individuals across both samples are equally concerned with saving energy wherever possible (M_{GER} = 3.84, M_{KA} = 3.93, $F(1, 976) = 1.728$, $p = .189$).

Table 5: Comparison between samples – Energy consumption behavior, individual level.

Comparison of energy consumption behavior between samples on individual level									
	Germany				Karlsruhe (City & County)				Diff. between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Engagement in electricity saving measures (Adapted from European Social Survey 2016) *(1: Never; 5: Always)*			3.84	1.14			3.93	1.07	F(1, 976) = 1.728, p = .189

Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

Consumer behavior

However, when we look at individuals´ worries about climate change (see Table 6), we observe differences between samples. Specifically, Karlsruhe individuals are more concerned about climate change (M_{GER} = 3.79, M_{KA} = 3.99, F(1, 977) = 6.807, p = .009) than individuals in the pan-German sample.

Table 6: Comparison between samples – Consumer behavior, individual level.

Comparison of consumer behavior between samples on individual level									
	Germany				Karlsruhe (City & County)				Diff. between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Worries about climate change (Adapted from European Social Survey 2016) *(1: Not worried at all; 5: Extremely worried)*			3.79	1.27			3.99	1.18	F(1, 977) = 6.807, p = .009

Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

Demography

Finally, we compare basic demographic statistics at the individual level between samples (see Table 7). While people did not differ in terms of their highest level of education ($\chi^2(7) = 9.113$, $p = .245$), their current occupation ($\chi^2(7) = 13.887$, $p = .053$), and age ($\chi^2(4) = 9.384$, $p = .052$), unfortunately an equal gender distribution across both samples could not be obtained ($\chi^2(1) = 13.757$, $p = .001$). Because previous research demonstrates the interdependence of energy consumption behavior and personal political ideology (e.g., Gromet et al. 2013), it is of particular importance that the samples do not differ with respect to political preferences ($\chi^2(6) = 10.537$, $p = .104$).

Table 7: Comparison between samples – Demography, individual level.

Comparison of demographic statistics between samples on individual level									
	Germany				Karlsruhe (City & County)				Diff. Between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Age									χ 2(4) = 9.384, p = .052
40-49	56	11%			82	16%			
30-39	64	13%			73	15%			
50-64	74	15%			81	16%			
18-29	151	30%			138	28%			
65 and older	155	31%			126	25%			
Gender									χ 2(1) = 13.757, p = .001
Male	292	59%			233	47%			
Female	207	41%			265	53%			
Education									χ 2(7) = 9.113, p = .245
(Adapted from Statistisches Bundesamt 2021)									
Still in school	5	1%			1	0%			
Secondary/elementary school diploma	47	10%			52	11%			
Completion of polytechnic high school	20	4%			10	2%			
Secondary school leaving certificate	113	23%			115	23%			
Technical college/university entrance qualification	295	61%			310	63%			
Without general school leaving certificate	6	1%			3	1%			
Occupation									χ 2(7) = 13.887, p = .053
(Adapted from European Social Survey 2018)									
In paid work	291	60%			288	58%			
Military service or social service	3	1%			1	0%			
In training/teaching/studying	20	4%			24	5%			
In (early) retirement	152	31%			144	29%			
In domestic work, raising children or caring	1	0%			14	3%			
Unemployed, actively looking for a job	13	3%			19	4%			
Unemployed, wanting a job, not actively looking	4	1%			4	1%			
Unable to work (e.g., due to illness or disability)	2	0%			2	0%			
Political preference									χ 2(6) = 10.537, p = .104
(Adapted from European Social Survey 2018)									
CDU/CSU	48	20%			50	20%			
SPD	49	20%			48	19%			
Linke	16	7%			11	4%			
Grüne	75	31%			107	42%			
FDP	30	12%			22	9%			
AfD	9	4%			3	1%			
Others	14	6%			13	5%			

Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

2.3.3 Smart meter installation

To investigate the feasibility of an energy panel (the so-called “Future Energy Panel”) in Karlsruhe, we first ask participants whether they already own a smart meter and, second, we document participants´ willingness to participate in such a panel (see Table 8). First, our results demonstrate that households in Karlsruhe and Germany have an equal share of smart meters already installed (RF_{GER} = 8%, RF_{KA} = 9%, $\chi^2(1) = 2.06$, $p = .65$). Second, Karlsruhe residents tend to agree on participating in the Future Energy Panel to a greater extent than pan-German participants ($\chi^2(3) = 13.734$, $p = .003$), although we believe that a vast proportion of this variance can be attributed to the physical proximity of Karlsruhe participants to the Karlsruhe Institute of Technology as the initiator of the CATI conducted.

Table 8: Comparison between samples – Smart meter and interest in panel participation.

Comparison of smartmeter availability and interest in energy panel participation between samples									
	Germany				Karlsruhe (City & County)				Diff. between Samples
	Abs. Freq.	Rel. Freq.	Mean	SD	Abs. Freq.	Rel. Freq.	Mean	SD	Test Statistic, p-value
Questions on household level									
Smartmeter is already installed in household									χ 2(1) = 2.06, p = .650
Yes	37	8%			41	9%			
No	428	92%			426	91%			
Willingness to participate in the Future Energy Panel									χ 2(3) = 13.734, p = .003
Yes, definitely	42	9%			61	14%			
Yes, in principle, but I would need more information	144	31%			159	36%			
No, rather not	120	26%			120	27%			
No, not at all	153	33%			103	23%			

Notes: Categories "Don´t know"/"No information" are not reported and not considered for the calculation of p-values.

3 Discussion

3.1 Key findings and implications

Against the backdrop of climate change and the associated transformation of energy supply and demand structures, household consumers will take a much more active role in the future energy system. To date, however, the energy behavior of households is poorly understood. In particular, prior research lacks longitudinal energy behavior data and knowledge of factors driving that behavior. Energy panels, i.e., samples of consumers whose behavior is observed over time, are one way to obtain adequate data for both qualitative and quantitative analyses and inferences. Since hosting a panel involves significant costs, restricting the panel to a certain geographical area can be a viable option to keep costs in check. However, before using such data, it is essential to determine similarities and differences between the panel at hand and the population of interest. Since we plan to establish an energy panel in the Karlsruhe area ("Future Energy Panel") to study the energy-related behavior on household and individual levels, this present research is concerned with an ex-ante comparison between Karlsruhe and Germany. To this end, we used computer-assisted telephone interviews to collect data in both areas from more than 1,000 respondents during the summer of 2021.

Overall, results demonstrate strong similarities between Karlsruhe and Germany, both in terms of demographics (e.g., household net income) and energy consumption behavior (e.g., choice of building technology) or other energy-related behaviors (e.g., frequency of switching tariffs). However, there are also differences between the two samples: since Karlsruhe is an urban, economically thriving area with a larger proportion of young people, it is not surprising that Karlsruhe participants find themselves in slightly better economic situation than the respondents in the rest of Germany. Not only do people earn (somewhat) more money, but they more frequently live in single- and two-family homes, they are more willing to pay for green electricity, they care more about the environment, and they vote Green to a greater extent. These differences should be taken into account when collecting further data from Karlsruhe. Extant research demonstrates that political preferences or the level of income can have an effect on individuals' energy-related behavior, such as their engagement with energy conservation (e.g., Costa and Kahn 2013), energy technology adoption (e.g., Kastner and Stern 2015), or choices of electricity tariffs (e.g., Lehmann et al. 2021). That said, it is important to keep in mind that not all of the differences we identified will necessarily be relevant to subsequent data collection and analyses. Finally, the above-average willingness of the Karlsruhe sample to participate in our panel, which is most likely

a result of the familiarity of the KIT among the respondents, also speaks in favor of establishing a panel locally where the hosting party is known.

3.2 Future research

Future research could tie in with our work in several aspects. First, even if there are differences between panel participants and the population of interest, it is too early to conclude that a sample is ill-suited. On the contrary, it is essential to identify which personal and exogenous factors actually drive individual behavior. Consequently, representativeness must only be ensured with regard to those factors affecting behavior, while others can be disregarded. Second, in addition to identifying underlying factors, the next step is to quantity their effects. By doing so, panel samples could be adjusted accordingly to correspond with the population of interest. However, how to realize such adjustments is far from trivial and requires future work. Closely related to this, and the third point to mention, are changes over time in the factors underlying behavior. Future research could examine how to deal with such changes, for example, by adjusting the importance weights for sample composition.

3.3 Limitations

Needless to say, our work also has its limitations. The survey at hand was conducted at a specific point in time. Even though the majority of our questions address (rather) static values, such as the current living space or the number of vehicles in a household, the answers to some questions may have changed in the meantime. Sudden events, such as the Russia-Ukraine conflict and the associated rise in energy prices and reduction in supply security, are likely to have a substantial impact on individual energy behavior. For example, households may have become less willing to pay a premium for green electricity, or they may have replaced inefficient household appliances with new ones. Since this work is based on a one-time survey, these changes do not reflect in our results. The second point concerns data collection: Even though our data were collected via CATI, thereby circumventing some of the problems associated with online surveys that are the workhorse of today's empirical studies, participation was still voluntary. Therefore, our data are most likely biased to some degree and do not exactly reflect the two populations of Karlsruhe and Germany, which, for example, also include non-responsives, but they probably come close. Notably, it is not far-fetched to assume that systematic biases extend equally across both samples. This present research seeks, however, to analyze differences between the regional sample Karlsruhe and the superordinate sample Germany. For this reason, systematic biases of equal direction and amount across both samples would not affect our results at all. Last, it is important to keep in mind that our data are stated responses, i.e., we cannot verify the accuracy of the information given by our survey participants. On the other hand, we did not provide incentives that suggest otherwise.

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A. Appendix

A.1 CATI questionnaire

Projekt Überblick	
Thema	Future Energy Panel - Energienutzungsverhalten der Bevölkerung
Methode	Computer-Assisted Telephone Interviews CATI
Grundgesamtheit	**(a) Deutschland:** via Festnetz oder mobil erreichbare deutschsprachige Personen ab 18 Jahren **(b) Stadt-/ Landkreis Karlsruhe:** via Festnetz oder mobil erreichbare deutschsprachige Personen ab 18 Jahren
Stichprobe und Quotierung	Repräsentative, mehrstufig geschichtete Stichprobe aus dem ADM-Auswahlrahmen für Telefonstichproben. (a) Deutschland: Duale Frame, 40% Mobilfunk/ 60% Festnetz (keine Quotierung auf Alter) (b) Stadt-/ Landkreis Karlsruhe: 100% Festnetz (mit Quotierung auf Alter)
Fallzahlen (netto)	(a) Deutschland: 500 (b) Stadt-/ Landkreis Karlsruhe: 500
Fragebogen	ca. 10 Minuten inklusive Demographie
Durchführung	August / September 2021

ANMERKUNG FÜR INTERVIEWER: EINE REIHE VON FRAGEN BETREFFEN ZAHLEN ZUM HAUSHALT, Z.B. WOHNFLÄCHE, STROMKOSTEN ETC. HIER BITTE DEN BEFRAGTEN IMMER UM EINE SCHÄTZUNG BITTEN. EIN SCHÄTZWERT IST BESSER, ALS KEINE ANTWORT. DAS GILT AUCH FÜR DIE ABFRAGE VON WAHRSCHEINLICHKEITEN (IN PROZENT), Z.B. ZU KAUF- ODER NUTZUNGSABSICHTEN. AUCH HIER BITTE SCHÄTZEN LASSEN.

KONTAKTAUFNAHME

Guten Tag. Mein Name ist ... vom Meinungsforschungsinstitut Ipsos. Wir führen derzeit eine Umfrage im Auftrag des Karlsruher Instituts für Technologie (kurz: KIT), eine technische Universität in Baden-Württemberg, durch.

Am KIT wird derzeit das Energieverhalten deutscher Haushalte erforscht, um die Energiewende wissenschaftlich zu begleiten. Dazu führen wir eine kurze deutschlandweite telefonische Umfrage durch, zu der wir Sie herzlich einladen möchten. Wir würden uns freuen, wenn Sie einige Minuten Zeit für uns hätten. Das Interview wird ca. 10 Minuten dauern.

(i) **INT. [BEI NACHFRAGEN ZUR AUSWAHL DER TELEFONNUMMER]:** Ihre Telefonnummer wurde durch ein wissenschaftliches Zufallsverfahren ausgewählt. Damit wir aussagekräftige Ergebnisse erzielen können, müssen die Befragten der Studie zufällig ausgewählt werden. Das ist ein gängiges Verfahren in der Meinungsforschung, um eine repräsentative Personengruppe befragen zu können.

(ii) **INT. (BEI FESTNETZSTICHPROBEN, SPLIT A - DEUTSCHLAND und SPLIT B – KARLSRUHE; JEDOCH NICHT BEI DER MOBILFUNKSTICHPROBE):**
Um einen genauen Querschnitt der Bevölkerung zu erreichen, müsste ich mit der Person aus Ihrem Haushalt sprechen, die zuletzt Geburtstag hatte und mindestens 18 Jahre alt ist. Sind Sie das?

(iii) **INT. [FALLS NEIN]:** In diesem Fall hätte ich gerne die Person gesprochen, die als letztes Geburtstag hatte und mindestens 18 Jahre alt ist.

INT.: WENN ZIELPERSON AM TELEFON, VON VORN BEGINNEN.

Die Teilnahme ist freiwillig, aber es ist sehr wichtig, dass möglichst alle ausgewählten Personen teilnehmen, damit die Umfrage ein richtiges Ergebnis liefert. Die Auswertung erfolgt anonym, also nicht in Verbindung mit Ihrem Namen, Ihrer Anschrift oder Telefonnummer. Diese werden nach Abschluss des wissenschaftlichen Projekts vernichtet.

Bevor das Interview startet, habe ich noch ein paar kurze Informationen: Auf unserer Internetseite ipsos.de finden Sie ganz unten den Punkt „Datenschutzerklärungen für telefonische Befragungen“ mit Informationen zu Ihren Rechten auf Auskunft, Berichtigung, Löschung und Einschränkung sowie Widerspruch gegen die Verarbeitung Ihrer Daten und das Recht auf Beschwerde bei der Datenschutzaufsichtsbehörde.

Unseren Datenschutzbeauftragten erreichen Sie unter der E-Mail-Adresse datenschutz@ipsos.de.
Zum Einstieg möchten wir Ihnen gern ein paar allgemeine Fragen zu Ihrer Person stellen, um sicherzustellen, dass wir mit dem richtigen Personenkreis sprechen.

AN ALLE

Frage S1 (POSTLEITZAHL)

Nennen Sie mir bitte zuerst die Postleitzahl Ihres Wohnortes.
INT (NUR BEI NACHFRAGEN): Die Erfassung des Wohnortes ist wichtig. Um im Nachhinein eine genaue regionale Zuordnung der durchgeführten Interviews vornehmen zu können.

Postleitzahl: I___I___I___I___I ___I ***(Prg.: numerisch, vierstellig, 1-99999)***

Weiß nicht ***(INT: NICHT VORLESEN)***
Keine Angabe ***(INT: NICHT VORLESEN)***
Prg. (Split Karlsruhe): Wenn PLZ nicht im definierter Region => Screenout

AN ALLE

Frage S2 (WOHNORT)

Die von uns angewählten Telefonnummern werden per Computer zufällig zusammengestellt. Nennen Sie mir daher bitte Ihren Wohnort.
INT (NUR BEI NACHFRAGEN): Die Erfassung des Wohnortes ist wichtig, um im Nachhinein die Interviews regional genau zuzuordnen. Die angegebenen Städte/Gemeinden ergeben sich aus der Postleitzahl.

AN ALLE

S3 BUNDESLAND

Prg.: Nicht abfragen, sondern automatisch erfassen.

1 Schleswig-Holstein
2 Hamburg
3 Niedersachsen
4 Bremen
5 Nordrhein-Westfalen
6 Hessen
7 Rheinland-Pfalz
8 Baden-Württemberg
9 Bayern
10 Saarland
11 Berlin
12 Brandenburg
13 Mecklenburg-Vorpommern
14 Sachsen
15 Sachsen-Anhalt
16 Thüringen

AN ALLE

Frage S4a (Alter 1)

In welchem Jahr wurden Sie geboren?

Geburtsjahr: : I___I___I___I___I ***(Prg.: numerisch, vierstellig)***
Weiß nicht ***(INT: NICHT VORLESEN)***
Keine Angabe ***(INT: NICHT VORLESEN)***

BEI VERWEIGERUNG, IT: FRAGE S4

Frage S4a (Alter 2)

Und würden Sie sich in eine der folgenden Altersgruppen einordnen?
INT: VORLESEN. NUR EINE ANTWORT

1 18-29 Jahre
2 30-39 Jahre
3 40-49 Jahre
4 50-65 Jahre
5 66 Jahre und älter
6 *Keine Angabe* ***(INT: NICHT VORLESEN) => Screenout***

HAUTPTFRAGEBOGEN

Vielen Dank für Ihre Unterstützung. Für alle Fragen gilt: Eine Schätzung ist für uns hilfreicher als keine Angabe. Sollten Sie die Antwort auf eine Frage nicht genau wissen, schätzen Sie gerne. Alternativ gibt es stets die Optionen „Weiß nicht“ oder „Keine Angabe“.

1 Haushaltsebene

1.1 Energienutzungsverhalten

Es folgen zunächst Fragen zum Energienutzungsverhalten Ihres Haushalts.

AN ALLE

Frage 1 (Wohngebäude)

In welcher Art von Gebäude wohnen Sie?
INT: VORLESEN. NUR EINE ANTWORT

1 Freistehendes Einfamilienhaus
2 Einfamilienhaus als Doppelhaushälfte oder Reihenhaus
3 Zweifamilienhaus
4 Wohngebäude mit drei und mehr Wohnungen
5 Sonstiges Gebäude
6 *Weiß nicht **(INT: NICHT VORLESEN)***
7 *Keine Angabe **(INT: NICHT VORLESEN)***

FALLS „WOHNGEBÄUDE“: IT. FRAGE 1, POS. 1,2

Frage 2 (Solaranlage)

Mit welchen der folgenden Technologien ist Ihr Gebäude ausgestattet?
INT: VORLESEN. MEHFACHANTWORTEN
Prg.: JEWEILS Ja/Nein pro Zeile

1 Photovoltaik-Solaranlage (zur Stromproduktion)
2 Thermische Solaranlage (zur Warmwasserproduktion)
3 Wärmepumpe
4 Nichts davon
5 *Weiß nicht **(INT: NICHT VORLESEN)***
6 *Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 3 (Wohnfläche)

Wie groß ist die Wohnfläche, die von Ihrem Haushalt zum Wohnen genutzt wird, d.h. ohne Balkon und Terrasse, in Quadratmetern?

Wohnfläche: I___I____I____I qm ***(Prg.: numerisch, dreistellig)***
*Weiß nicht **(INT: NICHT VORLESEN)***
*Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 4 (Stromnutzung Warmwasser)

Nutzen Sie in Ihrem Haushalt Strom auch zur Warmwasserbereitung?
INT: ANTWORTVORGABEN VORLESEN. NUR EINE ANTWORT

1 Nein
2 Ja, die Warmwasserbereitung erfolgt vollständig mit Strom
(INT. BEI NACHFFRAGEN ERLÄUTERN): z.B. im Bad und in der Küche über elektrische Durchlauferhitzer oder Boiler
3 Ja, die Warmwasserbereitung erfolgt teilweise mit Strom
(INT. BEI NACHFFRAGEN ERLÄUTERN): z.B. nur in der Küche oder im Gäste-WC über elektrische Durchlauferhitzer
4 *Weiß nicht* ***(INT: NICHT VORLESEN)***
5 *Keine Angabe* ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 5 (Stromnutzung Heizung)

Nutzen Sie in Ihrem Haushalt Strom auch zum Heizen?
INT: ANTWORTVORGABEN VORLESEN. NUR EINE ANTWORT

1 Nein
2 Ja, aber nur gelegentlich (z.B. zusätzlicher Heizlüfter im Bad)
3 Ja, ich heize überwiegend mit einer Nachtspeicherheizung
4 Ja, ich heize überwiegend mit einer elektrischen Direktheizung
5 Ja, ich heize überwiegend mit einer elektrischen Wärmepumpe
6 *Weiß nicht* ***(INT: NICHT VORLESEN)***
7 *Keine Angabe* ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 6 (Stromverbrauch)

Was schätzen Sie, wie hoch beläuft sich Ihre monatliche Haushaltsabschlagszahlung für Strom? Sofern Sie alle zwei Monate bezahlen, rechnen Sie den Betrag bitte auf einen Monat um.

Haushaltsabschlagszahlung pro Monat: I___I___I___I___I EURO ***(Prg.: numerisch, vierstellig)***
Weiß nicht ***(INT: NICHT VORLESEN)***
Keine Angabe ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 7 (Engagement Stromsparmaßnahmen: Kühlschrank)

Welche Energieeffizienzklasse hat ihr Kühlschrank in der Küche nach der Skala von A+++ bis D?
INT: ANTWORTVORGABEN VORLESEN. NUR EINE ANTWORT

1 A+++
2 A++
3 A+
4 A
5 B
6 C
7 D
8 *Weiß nicht* ***(INT: NICHT VORLESEN)***

9 *Keine Angabe* ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 8 (Mobilität / Einstellung E-Mobilität 1)

Wie viele der folgenden Fahrzeuge gibt es in Ihrem Haushalt?

INT: FÜR JEDE FAHRZEUGART DIE ANZAHL ERFRAGEN.

Prg.: numerisch, zweistellig je Zeile

1	Autos mit Verbrennungsmotor, einschließlich Kombi/Van/ Kleinbus/Wohnmobil	I___I___I
2	Autos mit Elektromotor	I___I___I
3	Autos mit hybridem Antrieb	I___I___I
4	Motorräder, Mopeds, Mofas	I___I___I
5	Elektrofahrräder, Pedelecs, Elektroroller	I___I___I
6	Funktionstüchtige normale Fahrräder	I___I___I

Prg.: Je Zeile:
Weiß nicht ***(INT: NICHT VORLESEN)***
Keine Angabe ***(INT: NICHT VORLESEN)***

INT (INFO BEI RÜCKFRAGE – PEDELEC): Im Gegensatz zu E-Bikes ausschließlich elektrisch unterstützend; zu jeder Zeit muss in die Pedale getreten werden.

AN ALLE

Frage 9 (Mobilität / Einstellung E-Mobilität 2)

Wie wahrscheinlich ist es, dass Sie/Ihr Haushalt sich in den nächsten 5 Jahren ein Auto kauft oder least?

INT: ANTWORTVORGABEN VORLESEN. NUR EINE ANTWORT

1 0%
2 25%
3 50%
4 75%
5 100%
6 *Weiß nicht* ***(INT: NICHT VORLESEN)***
7 *Keine Angabe* ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 10 (Mobilität / Einstellung E-Mobilität 3)

Wie wahrscheinlich ist es, dass das nächste von Ihnen/ Ihrem Haushalt gekaufte oder geleaste Fahrzeug ein rein elektrisches sein wird?

INT: ANTWORTVORGABEN VORLESEN. NUR EINE ANTWORT

1 0%
2 25%
3 50%
4 75%
5 100%
6 *Weiß nicht* ***(INT: NICHT VORLESEN)***

7 *Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 11 (Vergleichswunsch Energieverhalten)

Wüssten Sie gerne, wie das Energieverhalten anderer Haushalte im Vergleich zu Ihrem eigenen aussieht? Bitte geben Sie mir Ihre Antwort auf einer Skala von „1“ bis „5“. „1“ bedeutet „Nein, überhaupt nicht“ und „5“ „Ja, exakt“

*Weiß nicht **(INT: NICHT VORLESEN)***
*Keine Angabe **(INT: NICHT VORLESEN)***

1.2 Kundenverhalten

AN ALLE

Frage 12 (Vergangene Stromanbieterwechsel)

Hat Ihr Haushalt in den letzten 5 Jahren den Stromanbieter gewechselt?
INT: NUR EINE ANTWORT

1 Ja
2 Nein
3 *Weiß nicht **(INT: NICHT VORLESEN)***
4 *Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 13 (Bereitschaft Stromanbieterwechsel)

Wie wahrscheinlich ist es, dass Ihr Haushalt in den nächsten 12 Monaten den Stromanbieter wechselt?
INT: NUR EINE ANTWORT

1 0%
2 25%
3 50%
4 75%
5 100%
6 *Weiß nicht **(INT: NICHT VORLESEN)***
7 *Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 14 (Ökostrom)

Die nächsten Fragen nehmen Bezug zu „Ökostrom“ (oder auch „Grünstrom“ genannt). Ökostrom ist Strom aus erneuerbaren Energiequellen, im Gegensatz zu konventionellem Strom, der z.B. in Kohle- und Gaskraftwerken erzeugt wird. Hat Ihr Haushalt derzeit einen Vertrag, bei dem der Ökostrom-Anteil 100% beträgt?

INT: NUR EINE ANTWORT

1 Ja
2 Nein
3 *Weiß nicht* ***(INT: NICHT VORLESEN)***
4 *Keine Angabe* ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 15 (Preissensitivität Ökostrom)

Stellen Sie sich vor, Sie müssen zwischen 2 Stromanbietern auswählen. Die Angebote sind völlig identisch und unterscheiden sich nur in einem Punkt. Der eine Anbieter liefert zu 100% Ökostrom aus erneuerbaren Energiequellen, der andere liefert einen aktuell durchschnittlichen Strommix, d.h. ca. zur Hälfte Ökostrom und zur Hälfte konventionellen Strom. Wären Sie bereit 2% mehr für reinen Ökostrom zu bezahlen?

INT: NUR EINE ANTWORT

1 Ja
2 Nein
3 *Weiß nicht* ***(INT: NICHT VORLESEN)***
4 *Keine Angabe* ***(INT: NICHT VORLESEN)***

Falls Frage 15, Pos. 1 (= Ja)
AN ALLE

Frage 16a

Wären Sie bereit 5% mehr für reinen Ökostrom zu bezahlen?

INT: NUR EINE ANTWORT

1 Ja
2 Nein
3 *Weiß nicht* ***(INT: NICHT VORLESEN)***
4 *Keine Angabe* ***(INT: NICHT VORLESEN)***

Falls Frage 16a, Pos. 1 (= Ja)
AN ALLE

Frage 16b

Wären Sie bereit 10% mehr für reinen Ökostrom zu bezahlen?

INT: NUR EINE ANTWORT

1 Ja
2 Nein
3 *Weiß nicht* ***(INT: NICHT VORLESEN)***
4 *Keine Angabe* ***(INT: NICHT VORLESEN)***

Falls Frage 16b, Pos. 1 (= Ja)
AN ALLE

Frage 16c

Wären Sie bereit 15% mehr für reinen Ökostrom zu bezahlen?

INT: NUR EINE ANTWORT

1 Ja
2 Nein
3 *Weiß nicht* ***(INT: NICHT VORLESEN)***
4 *Keine Angabe* ***(INT: NICHT VORLESEN)***

1.3 Demografie

AN ALLE

Frage 17

Wie viele Personen leben insgesamt in ihrem Haushalt? Bitte zählen Sie sich selbst auch mit.

1 1 Person
2 2 Personen
3 3 Personen
4 4 Personen
5 5 Personen und mehr
6 *Weiß nicht* ***(INT: NICHT VORLESEN)***
7 *Keine Angabe* ***(INT: NICHT VORLESEN)***

Falls mind. 2 Personen im Haushalt (lt. Frage 17 ≠ 1)

Frage 18 (Kinder im Haushalt)

Und wie viele Personen leben in Ihrem Haushalt, die unter 18 Jahre alt sind?

1 1 Person
2 2 Personen
3 3 Personen
4 4 Personen und mehr
5 keine Person
6 *Weiß nicht* ***(INT: NICHT VORLESEN)***
7 *Keine Angabe* ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 19 (Energieentscheidung)

Wer ist in Ihrem Haushalt für die Wahl des Stromanbieters bzw. –tarifs zuständig?

1 Ich, allein
2 Ich, zusammen mit anderen, z.B. LebenspartnerIn, MitbewohnerIn usw.
3 Das übernehmen andere, z.B. LebenspartnerIn, MitbewohnerIn usw.
4 *Weiß nicht* ***(INT: NICHT VORLESEN)***
5 *Keine Angabe* ***(INT: NICHT VORLESEN)***

<u>Haushaltsnettoeinkommen</u>

Wenn Sie einmal alles zusammenrechnen: Wie hoch ist dann etwa das monatliche Netto-Einkommen, das Sie alle zusammen in Ihrem Haushalt haben, nach Abzug der Steuern und Sozialversicherung?

1. Unter 1300€
2. 1300 – unter 1700 €
3. 1700 – unter 2600€
4. 2600 – unter 3600€
5. 3600 – unter 5000€

6. 5000€ und mehr
7. *Weiß nicht* ***(INT: NICHT VORLESEN)***
8. *Keine Angabe* ***(INT: NICHT VORLESEN)***

2 Personenebene (Interviewee)

2.1 Energienutzungsverhalten

Die nachfolgenden Fragen beziehen sich nun nicht mehr auf Ihren Haushalt, sondern auf Ihre Person.

AN ALLE

Frage 20 (Engagement Stromsparmaßnahmen)

Prg: Skala von „1" bis „6"

Es gibt einige Dinge, die getan werden können um den Energieverbrauch zu reduzieren, z.B. nichtgenutzte Geräte abschalten, kurze Distanzen gehen statt fahren oder die Heizung bzw. Klimaanlage nur nutzen, wenn unbedingt nötig. Wie oft setzen Sie in Ihrem täglichen Leben solche Dinge um, um Energie zu sparen? Bitte geben Sie mir Ihre Antwort auf einer Skala von „1" bis „5". „1" bedeutet „Nie" und „5" „Immer". Mit den Werten dazwischen können Sie Ihre Antwort abstufen.

INFORMELLE INTERVIEWERFESTSTELLUNG: Wenn die Befragungsperson spontan die Meinung äussert, die Energienutzung sei nicht reduzierbar, dann den Skalenpunkt „6" vergeben.
Weiß nicht ***(INT: NICHT VORLESEN)***
Keine Angabe ***(INT: NICHT VORLESEN)***

2.2 Kundenverhalten

AN ALLE

Frage 21 (Involvement 1)

Wie besorgt sind Sie wegen des Klimawandels? Bitte geben Sie mir Ihre Antwort auf einer Skala von „1" bis „5". „1" bedeutet „Überhaupt nicht besorgt" und „5" „Extrem besorgt". Mit den Werten dazwischen können Sie Ihre Antwort abstufen.
Weiß nicht ***(INT: NICHT VORLESEN)***
Keine Angabe ***(INT: NICHT VORLESEN)***

2.3 Demografie

AN ALLE

Frage 22 (Schulischer Bildungsabschluss)

Was ist Ihr höchster Schulabschluss?
INT.: GEMEINT IST DER BISHER HÖCHSTE ERREICHTE SCHULABSCHLUSS

1 Noch in schulischer Ausbildung
2 Haupt-/Volksschulabschluss
3 Abschluss der Polytechnischen Oberschule
4 Mittlerer Abschluss, *auch Mittlere Reife, Realschule*
5 Fachhochschul- oder Hochschulreife, *auch Abitur*
6 Ohne allgemeinbildenden Schulabschluss
7 *Weiß nicht* ***(INT: NICHT VORLESEN)***

8 *Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 23 (Berufstätigkeit)

Welche der folgenden Tätigkeiten führen Sie jetzt aus? Sind Sie zurzeit...?

1 In bezahlter Arbeit *(Voll- oder Teilzeit erwerbstätig, selbstständig/Familienunternehmen; auch vorübergehende Beurlaubung wie Mutterschafts-/Erziehungsurlaub)*
2 Militärdienst oder sozialer Dienst
3 In Ausbildung/Lehre/Studium
4 In Rente/Pension/Vorzeitiger Ruhestand
5 Hausarbeit, Kindererziehung oder Pflege anderer Personen
6 Ohne Beschäftigung und auf aktiver Jobsuche
7 Ohne Beschäftigung, einen Job wollend, aber nicht aktiv suchend
8 Berufsunfähig, z.B. durch Krankheit oder Behinderung
9 *Weiß nicht **(INT: NICHT VORLESEN)***
10 *Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 24 (Politische Ausrichtung Vers. B)

Welcher politischen Partei fühlen Sie sich am meisten verbunden?
INT: BITTE NICHT VORLESEN, SONDERN ZUORDNEN

1 CDU/CSU
2 SPD
3 Linke
4 Grüne
5 FDP
6 AfD
7 Andere
8 *Weiß nicht **(INT: NICHT VORLESEN)***
9 *Keine Angabe **(INT: NICHT VORLESEN)***

AN ALLE

Frage 25 (Geschlecht)

Der/ die Befragte ist…

1 Männlich
2 weiblich

3 Abschlussfrage Smartmeter Installation

Zum Abschluss: Das Karlsruher Institut für Technologie plant im Rahmen eines Forschungsprojekts einige Haushalte ab 2023 kostenfrei mit Smartmetern auszustatten, um die Energiewende wissenschaftlich zu begleiten und tagesaktuelle Verbrauchsdaten zu erheben. Ein Smartmeter ist ein intelligentes Messsystem bestehend aus einem digitalen Stromzähler und einer Kommunikationseinheit zur Analyse und Optimierung des Gas-/Wasser-/Strom- und

Wärmeverbrauchs. Die Verbrauchsdaten werden vom KIT in anonymisierter und aggregierter Form für wissenschaftliche Zwecke verwendet.

AN ALLE

Frage 26 (Smartmeter Vorhandensein)

Ist bereits ein Smartmeter in Ihrem Haushalt installiert?

1 Ja
2 Nein
3 *Weiß nicht* ***(INT: NICHT VORLESEN)***
4 *Keine Angabe* ***(INT: NICHT VORLESEN)***

AN ALLE

Frage 27 (Smartmeter Installationsbereitschaft)

Wäre in Ihrem Haushalt die Bereitschaft zur Teilnahme vorhanden?

1 Ja, auf jeden Fall
2 Ja, grundsätzlich schon, aber ich bräuchte noch mehr Informationen
3 Nein, eher nicht
4 Nein, überhaupt nicht
5 *Weiß nicht* ***(INT: NICHT VORLESEN)***
6 *Keine Angabe* ***(INT: NICHT VORLESEN)***

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Impressum

Karlsruher Institut für Technologie

Institut für Industriebetriebslehre und Industrielle Produktion (IIP)
Deutsch-Französisches Institut für Umweltforschung (DFIU)

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KIT – Universität des Landes Baden-Württemberg und
nationales Forschungszentrum in der Helmholtz-Gemeinschaft

Working Paper Series in Production and Energy
No. 65, October 2022

ISSN 2196-7296

www.iip.kit.edu