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IMMEDIATE ENERGY-SAVING RESPONSES OF EU HOUSEHOLDS TO THE 2022 RUSSIAN INVASION OF UKRAINE: A CLUSTER ANALYSIS

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ABSTRACT: This article examines the immediate energy-saving strategies declared by EU households in response to the 2022 Russian invasion of Ukraine, which exposed the Union's reliance on Russian fossil fuels. Drawing on data from Flash Eurobarometer 506 (April 2022), the study applies principal component analysis and k-means clustering to identify coherent behavioural patterns. Three segments are distinguished: engaged (broad action takers), selective (focused on low-cost behavioural changes), and unwilling (low or no declared engagement). While most respondents expressed a willingness to act, only a minority reported strategies that spanned both behavioural and investment domains. Cross-country variation was more pronounced than socio-demographic differences, highlighting the role of national context, geopolitical awareness, and perceived urgency. The findings contribute to the understanding of household behaviour under acute external shocks and demonstrate the value of strategy-based segmentation. Policy implications include designing targeted interventions aligned with behavioural patterns, rather than relying solely on socio-demographic profiling.

KEYWORDS: energy consumption, household behaviour, European Union, Russian invasion of Ukraine, energy security, principal component analysis, cluster analysis

Introduction

The 2022 Russian invasion of Ukraine exposed the European Union's strategic vulnerability stemming from its heavy dependence on imported fossil fuels, particularly from Russia. In 2021, over 40% of the EU's natural gas, 27% of its oil, and 46% of its coal were sourced from Russia, with energy representing 62% of the total value of EU imports from the country (European Commission, 2022a). The annual cost of these imports reached nearly EUR 99 billion, partly driven by price increases already visible in the second half of 2021. In response, the European Commission introduced the RePowerEU plan in March 2022, later expanded in May, with the overarching aim of eliminating the Union's dependence on Russian fossil fuels (European Commission, 2022b; 2022c).

Given the short time horizon and structural constraints, demand reduction was identified as the most feasible and immediate policy lever. While the "Save Gas for a Safe Winter" plan (European Commission, 2022d) primarily targeted industrial users, households were also encouraged to reduce energy use, despite their status as protected consumers. Measures included national-level information campaigns and recommendations for individual behaviour change, as outlined in the "Save Energy" communication (European Commission, 2022e). These efforts were motivated not only by the risk of physical shortages but also by concerns over energy poverty and macroeconomic fallout from gas-dependent industry disruptions.

Energy poverty poses dual risks: politically, it may trigger unrest if basic needs remain unmet; economically, it threatens the legitimacy of the EU's climate transition, particularly the Green Deal's pledge to leave no one behind. Policy responses included expanded household support schemes, a joint EU–IEA action plan (IEA, 2022), and an inventory of good practices compiled by the Energy Poverty Advisory Hub (2021).

This article investigates how EU households responded to the energy crisis in its initial phase, focusing on declared willingness to reduce energy use in the weeks following the outbreak of the war. It explores which types of strategies households reported, how these can be meaningfully grouped, and which socio-demographic and national-level factors shape these declarations. Particular attention is paid to whether energy-saving intentions were associated with heightened awareness of the geopolitical context. While much research has examined energy behaviour during the crisis, the ultra-short-term approach is rare. This study addresses a gap by examining immediate, self-reported intentions during a pivotal moment of uncertainty, using harmonised, EU-wide survey data.

The analytical strategy employs principal component analysis and cluster analysis to derive behavioural profiles based on groups of related actions, rather than isolated measures. The analysis identifies distinct household segments and examines how they vary with respect to geography, education, age, economic activity, and engagement with wartime developments.

The findings contribute to the literature on energy behaviour and crisis response in several ways. First, they offer empirical insight into declared strategies at a time of high political salience, before major policy interventions took full effect. Second, they demonstrate that national context plays a greater role in shaping responses than socio-demographic factors alone. Third, the results highlight the limited scope of voluntary action under stress, suggesting that effective policy must go beyond awareness campaigns and consider behavioural segmentation.

The remainder of the paper is structured as follows. Section 2 reviews the existing literature on household energy behaviour and crisis-driven change. Section 3 presents the data and methodology. Section 4 outlines the empirical results. Section 5 discusses the findings in light of the analytical framework. Section 6 concludes with implications for policy and research.

An overview of the literature

Understanding household energy consumption has long been a focus of research in energy economics and behavioural science, particularly in relation to efficiency improvements and voluntary demand reduction. The literature has emphasised both investment-based and behavioural responses as means of lowering household energy use, each shaped by different structural, cognitive, and contextual factors. However, relatively little attention has been paid to how such strategies manifest in response to acute geopolitical crises, such as the 2022 Russian invasion of Ukraine. This study

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contributes to the literature by examining not isolated energy-saving actions, but the coherence and structure of declared strategies under extraordinary circumstances.

A significant portion of reduced household energy demand derives from improvements in energy efficiency and behavioural adjustments. In both domains, substantial potential for further savings remains. While energy efficiency investments offer both financial and non-financial benefits – including lower utility bills, increased comfort, and reduced environmental impact – their adoption rates remain well below the economically optimal level. This phenomenon, commonly referred to as the "energy efficiency gap", has been widely attributed to a combination of market failures, behavioural biases, and institutional barriers. Prior studies highlight weak financial incentives due to low energy prices and high upfront costs, misaligned incentives (especially in landlord-tenant arrangements), liquidity constraints, and non-monetary costs such as time, effort, or bureaucratic burdens (Linares & Labandeira, 2010; Allcott & Greenstone, 2012; Broberg & Kazukauskas, 2015; Gillingham & Palmer, 2013). Psychological factors, including bounded rationality, risk aversion, status quo bias, and hyperbolic discounting, also contribute to underinvestment. Rebound effects and the slow diffusion of energy-efficient technologies further complicate the picture.

Some of these issues have been tackled for years through public policy interventions, including the implementation of regulatory norms and standards (e.g., performance limits, equipment mandates, labelling), economic incentives such as taxes, grants and subsidies, as well as information campaigns and behavioural nudges – with mixed results (Linares & Labandeira, 2010; Allcott & Greenstone, 2012; Boza-Kiss et al., 2013; Broberg & Kazukauskas, 2015). Certain measures have proven more politically feasible than others: standards are typically preferred over taxation, while subsidies, despite their popularity, have often been found inefficient (Gillingham & Palmer, 2013). Information-based initiatives tend to be both widespread and effective, although their reach across different population groups can vary significantly (Gillingham & Palmer, 2013). Nonetheless, many programmes fail to overcome the deeper structural and behavioural barriers that inhibit widespread adoption of energy-efficient practices.

Empirical studies have examined the socio-demographic and contextual drivers of energy investments. Baldini et al. (2018), Trotta (2008), and Schleich (2019) found that age positively affects the likelihood of retrofitting, although some investment types show weaker associations (Ameli & Brandt, 2015). Larger household size appears to correlate positively with energy-efficient investments (Ameli & Brandt, 2015; Baldini et al., 2018), while income effects remain ambiguous: some studies report a positive link (Ameli & Brandt, 2015), others a negative one (Schleich, 2019), particularly for retrofitting. Energy costs are found to positively influence investments (Schleich, 2019), and awareness – proxied by energy meters or knowledge of consumption – tends to support appliance upgrades (Ameli & Brandt, 2015). Housing characteristics play a significant role: homeowners, house dwellers, and those living in newer buildings are more likely to invest (Ameli & Brandt, 2015; Schleich, 2018; Krishnamurthy & Bergstrom, 2015), while renting is associated with lower investment levels (Davis, 2012). The effects of urban–rural location vary by technology (Ameli & Brandt, 2015), and pro-environmental attitudes consistently increase the likelihood of investing (Schleich, 2018), while environmental scepticism reduces it (Ameli & Brandt, 2015).

Beyond investments, behavioural adjustments – such as turning off lights, unplugging appliances, reducing indoor temperatures, or changing transportation modes – represent lower-cost and more immediate actions. These have also been extensively studied, although the findings are often less consistent. For instance, the role of gender is mixed: some studies report men being more responsive (Karlin et al., 2014), others find no difference (Attari et al., 2010). Age effects vary as well: while some find a positive association (Martinsson et al., 2011), others report non-linear patterns (Trotta, 2018) or no significant effect (Attari et al., 2010). Education presents a similarly mixed picture, although numeracy is positively linked to energy awareness (Attari et al., 2010). Rural residents are generally more willing to adopt behavioural changes (Martinsson et al., 2011), and homeownership and electric heating increase the likelihood of action (Martinsson et al., 2011; Ek & Söderholm, 2010). Environmental concern is a strong and consistent predictor across studies (Attari et al., 2010; Gadenne et al., 2011; Martinsson et al., 2011; Trotta, 2018), although the effect may differ by type of behaviour (Karlin et al., 2014). Other determinants include awareness of one's bills (Karlin et al., 2014), perceived difficulty of conservation (Ek & Söderholm, 2010), and the framing of information (Ek & Söderholm, 2010).

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Although these two domains – investment and behaviour – are often studied separately, real-world household responses frequently combine both. Yet few studies attempt to identify coherent energy-saving strategies, understood as consistent patterns of related actions undertaken simultaneously. Moreover, segmentation approaches remain underutilised, particularly in contexts of crisis-driven decision-making.

While much of the earlier literature has focused on long-term drivers of household energy behaviour, a growing body of research has recently examined how households respond under acute energy crises triggered by geopolitical shocks. National-level studies provide complementary insights into the household response to the 2022 energy crisis. In Germany, real gas savings were achieved but were not explained by individual financial incentives (Dertwinkel-Kalt et al., 2024), while in Latvia, subsidies dampened behavioural change despite soaring energy prices (Blumberga et al., 2024). A Hungarian case study highlighted the decisive role of outdated housing stock (Tóth et al., 2024). Together, these studies underline the limits of socio-demographic profiling and point to the importance of national context, structural constraints and crisis-related attitudes – factors addressed in the present study by applying a multidimensional segmentation approach to EU-wide data.

This study builds on previous empirical findings while addressing this gap. It investigates how declared behaviours and investments cluster into broader energy-saving strategies during an acute geopolitical shock, and how these strategy types relate to demographic, geographic, and attitudinal factors. By shifting the analytical focus from isolated actions to multidimensional strategy profiles, the study aims to offer a more realistic and policy-relevant perspective on household responsiveness to external crises.

Research methods

Data source and sample

This study draws on data from Flash Eurobarometer 506, released in May 2022, with fieldwork conducted between 13 and 20 April 2022, shortly after the onset of the war and prior to the elevated public attention to fossil fuel supply concerns. The survey was administered via Computer-Assisted Web Interviewing (CAWI) and covered all 27 EU Member States, yielding a total of 26,066 completed interviews. Each country had at least 1,000 respondents, with the exception of Cyprus, Luxembourg, and Malta, which each had over 500 (Table 1). Sampling quotas were applied for age, gender, and geographic region to ensure national representativeness. Post-estimation weighting ensures the sample is representative of the EU population aged 15 and older. It is important to note that the dataset captures stated willingness to act, not observed behaviour.

Table 1. Sample characteristics

variable		N	%
	total	**26.053**	**100.0%**
gender	male	12.394	47.6%
	female	13.580	52.1%
	other/refusal	79	0.3%
age group	15-24	3.247	12.5%
	25-34	3.833	14.7%
	35-44	4.347	16.7%
	45-54	4.480	17.2%
	55-64	4.209	16.2%
	65+	5.937	22.8%

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variable		N	%
	total	**26.053**	**100.0%**
years in education	1-15	760	2.9%
	16-19	7.725	29.7%
	20+	13.026	50.0%
	still in full-time education	2.666	10.2%
	never been in full-time education	494	1.9%
	don't know	1.023	3.9%
	refusal	359	1.4%
type of community	rural area or village	6.540	25.1%
	small or middle-sized town	10.354	39.7%
	large town	9.159	35.2%

Although post-stratification weights were calculated to reflect the EU population aged 15+, no country-level weighting was applied in the analysis. This decision was made to avoid inflating the influence of larger countries and to maintain the focus on individual-level behavioural patterns across the EU rather than aggregate country-level estimates. Only respondents with complete answers to the variables of interest were included in the analysis. The absence of missing values enabled a complete-case approach, improving internal consistency and avoiding bias from imputation or case-wise deletion.

Questionnaire

- The central survey item relevant to this study asked: "What actions would you personally be willing to take to reduce your energy consumption and energy bills?" Respondents could choose from the following nine energy-saving actions, presented in a randomised order to avoid order bias:
- unplug electronic appliances when not in use (henceforth: unplug devices),
- use alternatives to private transport, such as walking, cycling, public transport, or car sharing (green transport),
- opt for renewable energy at home (e.g. solar panels) (home renewables),
- install energy control equipment (e.g. a programmable thermostat) (energy control),
- improve home insulation (home insulation),
- buy energy-efficient appliances (efficient appliances),
- reduce room temperature at home or work (lower temperature),
- take the train instead of flying (train travel),
- turn off lights when leaving a room (lights off).

The remaining response categories (other, none, and don't know) were excluded from the main analysis. To mitigate potential order bias, the options were rotated to prevent respondents from disproportionately selecting the first available items. All nine energy-saving actions were coded as binary variables, indicating whether or not the respondent selected each option.

Dimensionality reduction: Principal Component Analysis

The objective of this step was to extract latent behavioural structures from the action variables and reduce the dimensionality of the dataset prior to segmentation. Given the structure of the question, 512 unique combinations of responses were possible. To identify meaningful patterns in the data, Principal Component Analysis (PCA) was applied to the binary action variables. PCA reduces high-dimensional data into a smaller set of orthogonal components (Abdi & Williams, 2010), facilitating the interpretation of latent behavioural structures. While PCA is traditionally used for continuous variables, it is also commonly applied to binary variables in the context of behavioural research where the goal is pattern detection rather than latent scale construction.

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The number of components was selected based on the eigenvalue criterion ($\lambda \approx 1$) and visual inspection of the scree plot. The Kaiser-Meyer-Olkin (KMO) test produced a value of 0.7717, confirming the dataset's suitability for PCA. A VARIMAX rotation procedure was then applied to the original loadings to enhance interpretability. Only factor loadings above 0.3 were retained for interpretation. Following VARIMAX rotation, three components were retained and interpreted as follows:

- energy investments (home renewables, home insulation, efficient appliances, energy control),
- energy behaviours (turning off lights, unplugging devices, lowering temperature),
- transport habits (green transport, train travel).

Table 2 presents the eigenvalues and rotated loadings for all components.

Table 2. PCA eigenvalues before and after rotation

actions	unrotated				rotated			
	component			unexplained	component			unexplained
	1	2	3		1	2	3	
unplug devices	0.367	-0.353	-0.349	0.376	-0.013	0.615	-0.048	0.376
green transport	0.319	-0.199	0.521	0.420	0.001	0.057	0.640	0.420
home renewables	0.288	0.492	0.061	0.474	0.556	-0.129	0.051	0.474
energy control	0.329	0.364	0.040	0.552	0.484	-0.018	0.084	0.552
home insulation	0.329	0.398	-0.131	0.503	0.526	0.048	-0.072	0.503
efficient appliances	0.357	0.233	-0.190	0.569	0.421	0.191	-0.067	0.569
lower temperature	0.320	-0.330	-0.049	0.597	-0.051	0.421	0.184	0.597
train travel	0.288	-0.152	0.657	0.331	0.007	-0.058	0.731	0.331
lights off	0.390	-0.342	-0.338	0.348	0.008	0.618	-0.030	0.348

Note: bolded values denote final components with a 0.3 threshold applied.

Household segmentation: cluster analysis

To classify households into distinct energy-saving profiles, a *k*-means cluster analysis was performed using the principal component scores. This method partitions respondents into non-overlapping clusters, minimising within-group variance (Caliński & Harabasz, 1974).

The optimal number of clusters ($k = 3$) was selected using the elbow method, informed by changes in within-cluster sum of squares and proportional reduction in error (Hartigan & Wong, 1979; Makles, 2012). The resulting segments were:

- engaged – declared willingness to adopt multiple strategies across all domains,
- selective – focused mainly on behavioural changes,
- unwilling – low or no declared willingness to take energy-saving action.

Statistical testing

Descriptive statistics were used to examine the socio-demographic profiles of each behavioural cluster. Group differences were evaluated using chi-square tests of independence (with $\alpha = 0.05$). In addition, R^2 statistics were employed to assess the explanatory power of macro-level variables, such as GDP per capita (PPP) and geographic distance from Kyiv, in accounting for cross-country variation in cluster distribution.

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Results of the research

Declared energy-saving actions

EU citizens reported a range of actions they would be willing to take to reduce energy consumption, but only three (turning off lights, unplugging appliances, and lowering room temperature) were selected by over half of respondents (Figure 1). These low-cost behavioural changes were clearly more popular than investment-related actions such as improving home insulation, installing energy control systems, or adopting home renewables. The latter options exhibited lower median uptake and greater cross-country variation. Differences of up to 40 percentage points were observed, especially in measures requiring upfront costs, suggesting that national context plays a key role in shaping perceived feasibility and willingness to act.

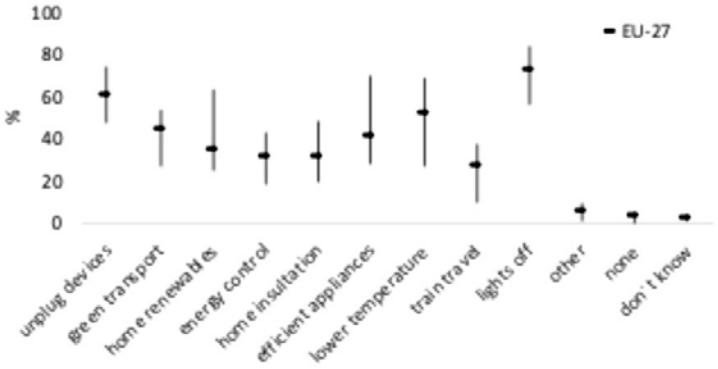

Figure 1. Declared actions – EU-27 average and the range for member states

Household saving profiles

Three segments of respondents were identified – engaged, selective and unwilling (Figure 2). *Engaged households* reported the highest level of declared activity, with respondents selecting up to seven energy-saving actions on average. Their engagement was particularly pronounced in home investment measures, such as insulation, energy-efficient appliances, and renewable energy installations – options less frequently selected by the other segments. *Selective households* reported an average of fewer than four actions, primarily low-cost behavioural changes. These respondents were generally less willing to undertake investment-related or high-effort measures.

Unwilling households were the least active, often selecting no energy-saving actions at all. When actions were chosen, their average number was just above two, and responses were largely confined to basic behavioural changes.

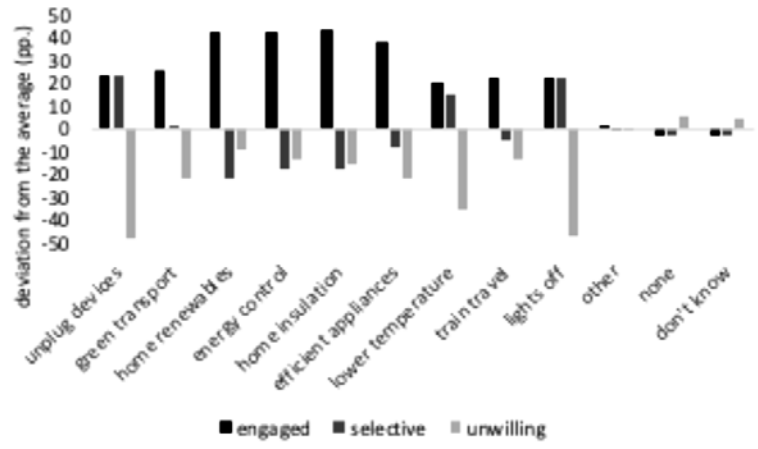

Figure 2. Declared actions by segments of respondents – deviation from the population average

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Segment characteristics

Approximately 27% of respondents can be classified as engaged, 35% as selective, and 38% as unwilling. While the differences between these groups are statistically significant, they remain relatively modest in magnitude (Table 3). The engaged segment is more frequently composed of women, individuals aged 25–44, those with higher levels of education, residents of large towns, and the self-employed. The selective group is more common among men, older individuals, those with fewer years of education, and people living in rural areas or small towns. In turn, the unwilling group includes a disproportionately high share of individuals who are still in full-time education or who have never attended it.

Table 3. Segments of respondents by individual characteristics

variable		engaged	selective	unwilling	chi-square p-value
	total	**27%**	**35%**	**38%**	
gender	male	27%	45%	28%	<0.001
	female	32%	32%	37%	
	other/refusala	23%	37%	40%	
age group	15-24	28%	35%	37%	<0.001
	25-34	29%	36%	34%	
	35-44	29%	39%	32%	
	45-54	28%	42%	29%	
	55-64	24%	48%	28%	
	65+	20%	44%	36%	
years in education	1-15	23%	42%	34%	<0.001
	16-19	31%	40%	30%	
	20+	28%	38%	35%	
	still in full-time education	19%	32%	49%	
	never been in full-time education	20%	37%	43%	
	don't know	22%	33%	45%	
	refusal	27%	39%	34%	
type of community	rural area or village	27%	40%	33%	0.003
	small or middle-sized town	27%	41%	32%	
	large town	29%	32%	39%	
rising energy prices affect purchasing power	yes	89%	88%	80%	<0.001
	no	9%	9%	16%	
	don't know	2%	3%	4%	

Note: a small sample (below 80 respondents)

The share of engaged respondents declines with age: from around 28–29% among those aged 15–44 to 20% among those aged 65 or older. Educational attainment also shows variation, with 31% of those with 16–19 years of education classified as engaged, compared to just 20% of those who never attended full-time education and 19% of those still studying. Patterns by settlement size also emerge: engaged individuals are more common in large towns (29%), while the selective group dominates in rural areas (40%) and small or medium-sized towns (41%). In terms of perceived price impact, 89% of engaged respondents reported that rising energy prices affected their purchasing

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power. In contrast, among those who reported no such impact, 16% fell into the unwilling category. Those who reported frequently following news on war developments were more likely to be classified as engaged, while those who rarely followed them were overrepresented among the unwilling ($p < 0.001$).

Member States exhibit substantial variation in the composition of their respondent clusters (Figure 3). The share of engaged individuals ranges from 16% in Lithuania to 38% in Portugal. The selective group varies from 24% in Hungary to 52% in Germany, while the unwilling segment ranges from 23% in Portugal to 45% in Slovenia. A modest positive correlation is observed between the share of selective respondents and GDP per capita (PPP) ($R^2 = 0.21$). In contrast, geographical distance from Kyiv is positively correlated with the share of the engaged ($R^2 = 0.16$) and negatively correlated with the share of the unwilling, suggesting a spatial pattern in the distribution of behavioural segments across the EU.

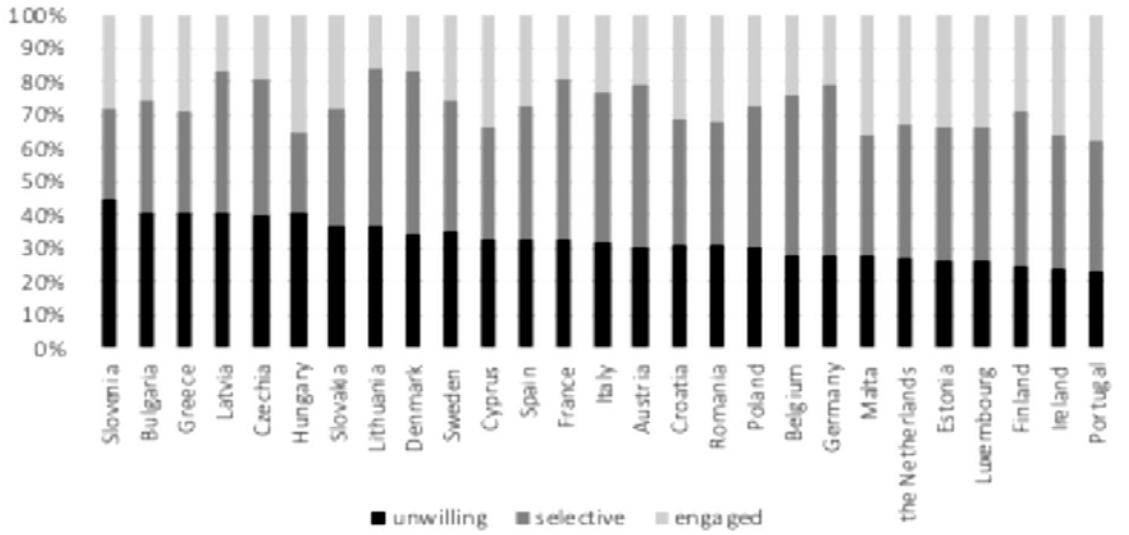

Figure 3. Structure of clusters by EU member states

Note: p-value <0.001

Discussion

This study examined how EU households responded to the 2022 energy crisis through declared energy-saving intentions. The results demonstrate that households adopt one of three distinct strategies: broad engagement across behavioural and investment actions, selective adoption of low-cost behavioural changes, or general unwillingness to act. These patterns reflect a meaningful segmentation of household behaviour that is often overlooked in energy consumption studies, which tend to focus on isolated actions or average responses. By applying principal component and cluster analysis to identify multidimensional strategy profiles, this study adds to the growing literature calling for a more holistic understanding of energy-related behaviour (cf. Ameli & Brandt, 2015; Schleich, 2019).

While some socio-demographic characteristics – such as education, employment status, or urban location – were associated with higher odds of engagement, the overall differences between groups were modest. This aligns with prior findings showing that individual-level variables tend to offer limited explanatory power for energy-saving actions (Attari et al., 2010; Martinsson, 2011; Karlin et al., 2014). Differences by age, for instance, are difficult to interpret clearly, as they may reflect both life-stage and cohort effects. Similarly, the lower engagement among individuals outside of education or the labour force could stem from limited resources, reduced exposure to institutional messaging, or differing behavioural norms. The observed patterns highlight the multidimensional nature of household decision-making and the limits of interventions that focus solely on individual characteristics.

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Cross-national variation proved to be a far stronger differentiator of energy-saving strategies than any single socio-demographic factor. The composition of behavioural segments varied widely across countries, with the proportion of engaged households ranging from 16% to 38%. This suggests that national energy mixes, public discourse, policy communication, and historical experience may all play roles in shaping behavioural intentions. In addition to these contextual factors, structural variables such as housing quality, energy infrastructure, and climatic conditions may significantly influence household capacity to respond. A Hungarian case study by Tóth et al. (2024) found that energy use during the crisis was primarily shaped by obsolete building stock and localised heating needs, rather than by individual demographic traits. As the present analysis does not include such variables, they may explain part of the observed cross-country variation.

Importantly, countries geographically closer to Ukraine – more directly exposed to the conflict – tended to have more engaged populations. This finding suggests that perceived urgency and geopolitical awareness may play important roles in motivating behavioural change, consistent with previous research on the influence of perceived risk and situational salience (Trotta, 2018; Ek & Söderholm, 2010). A similar mechanism was observed in Germany during the 2022–2023 energy crisis, where significant reductions in gas consumption occurred despite the ineffectiveness of financial incentives or government bonus schemes. Instead, behavioural change was attributed to a collective crisis mindset and societal engagement (Dertwinkel-Kalt et al., 2024).

Public awareness of the war also emerged as a statistically significant correlate of household engagement. Individuals who reported regularly following developments in Ukraine were more likely to fall into the engaged segment. While causality cannot be established, this pattern reinforces the idea that contextual and informational cues are critical triggers for short-term behavioural change. Information campaigns may thus play an important role – but only if they successfully translate abstract geopolitical threats into tangible domestic stakes.

The results also have practical implications for energy policy. The selective and unwilling segments represent a majority of the population and show limited interest in costly or effort-intensive actions. Similar patterns were observed in Germany, where substantial gas savings were achieved mainly through short-term reductions in consumption, particularly during the heating season, and were closely associated with rising energy prices and crisis salience (Ruhnau et al., 2023; Frings et al., 2024; Dertwinkel-Kalt et al., 2024).Voluntary behavioural change, while politically attractive, may therefore be insufficient to meet short-term targets. This highlights the need for differentiated interventions: targeted subsidies or financial incentives for the selective group, and stronger price signals or regulatory measures for the unwilling.

The call for behaviourally differentiated interventions is supported by recent empirical studies showing that demographic profiling alone is insufficient to capture variation in energy-saving behaviour. In Germany, Hungary, and Latvia, energy responses during the crisis were shaped less by individual characteristics and more by contextual factors such as infrastructure, policy design, and perceived urgency (Dertwinkel-Kalt et al., 2024; Tóth et al., 2024; Blumberga et al., 2024). Notably, some unwilling respondents may not be actively opposed to energy-saving, but simply unconvinced or unable to act – either due to lack of information, perceived relevance, or structural constraints such as housing type. Evidence from Latvia supports this interpretation. Blumberga et al. (2024) found that despite a sharp increase in household energy costs during the crisis, the behavioural response remained weak – largely because public subsidies had shielded residents from the full burden of energy prices. This suggests that overly protective financial measures may reduce the salience of energy-saving decisions, particularly among less-engaged consumers. As energy prices rise or supply constraints increase, some shift in behaviour may occur even without policy intervention, but such passive adjustment is unlikely to be timely or equitable.

This analysis also reinforces the view that investment-oriented strategies are far less common than simple behavioural changes. This echoes long-standing evidence on the persistence of the energy efficiency gap – the underadoption of cost-effective technologies due to market failures, behavioural biases, and institutional frictions (Allcott & Greenstone, 2012; Gillingham & Palmer, 2013; Linares & Labandeira, 2010). Although information campaigns and subsidies have shown some success, they often fail to reach the populations most in need or face political resistance. The findings of this study suggest that such limitations persist even under conditions of geopolitical crisis.

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By highlighting the segmentation of energy-saving intentions and the importance of context, this study advances the literature on household energy use and crisis response. The methodological contribution lies in combining dimensionality reduction with behavioural clustering, offering a robust and policy-relevant framework for interpreting complex response patterns.

Limitations

This study faces several limitations linked to the nature and timing of the dataset. First, while the Flash Eurobarometer provides rich cross-national coverage, it does not include key variables such as household income, energy costs, or building characteristics. These unobserved factors likely play an important role in shaping energy-saving decisions. Although GDP per capita was used as a macro-level proxy, it cannot substitute for household-level financial constraints or structural limitations. Second, the analysis is based on declared intentions rather than observed behaviours, which may be subject to overreporting or social desirability bias. Third, feasibility constraints – such as tenure status or the physical structure of dwellings – could not be accounted for, even though they strongly influence the capacity to act. Finally, the survey was conducted very early in the crisis, before the full implications of the war and supply disruptions had materialised. As such, the responses may underestimate later adjustments triggered by policy changes, fear of shortages, or price increases.

Conclusions

This study provides insights into the immediate energy-use strategies adopted by EU households in response to the 2022 Russian invasion of Ukraine. The analysis identified three distinct behavioural segments (engaged, selective, and unwilling) that differ in their level of commitment to energy-saving actions. While engaged households reported a broad range of responses, including investment and behavioural changes, selective respondents focused mainly on low-cost behavioural actions. Unwilling respondents showed minimal engagement. These results offer a nuanced view of household readiness to respond to geopolitical shocks, moving beyond isolated actions to more coherent strategy profiles.

Beyond identifying behavioural segments, the study demonstrates that cross-country variation – more than socio-demographic traits – drives differences in household strategies, confirming the critical role of national context and geopolitical awareness in shaping public responsiveness. These findings contribute to the literature on household energy behaviour by highlighting how external crises trigger differentiated short-term reactions across the EU. As the EU continues its efforts to reduce reliance on Russian fossil fuels, these insights can inform better-targeted national policies and enhance the effectiveness of public interventions aimed at fostering energy resilience.

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Sonia BUCHHOLTZ

NATYCHMIASTOWE REAKCJE GOSPODARSTW DOMOWYCH UE W ZAKRESIE OSZCZĘDZANIA ENERGII NA INWAZJĘ ROSJI NA UKRAINĘ W 2022 ROKU: ANALIZA SKUPIEŃ

STRESZCZENIE: Artykuł analizuje natychmiastowe strategie oszczędzania energii deklarowane przez gospodarstwa domowe w Unii Europejskiej w odpowiedzi na inwazję Rosji na Ukrainę w 2022 roku, która uwidoczniła zależność UE od rosyjskich paliw kopalnych. Na podstawie danych z badania Flash Eurobarometr 506 (kwiecień 2022) zastosowano analizę głównych składowych (PCA) oraz grupowanie metodą k-średnich w celu identyfikacji spójnych wzorców zachowań. Wyróżniono trzy segmenty: zaangażowanych (podejmujących szeroki zakres działań), selektywnych (koncentrujących się na niskokosztowych zmianach zachowań) oraz niezaangażowanych (brak lub niska deklarowana aktywność). Choć większość respondentów wyraziła gotowość do działania, tylko mniejszość zadeklarowała strategie obejmujące zarówno zachowania, jak i inwestycje. Zróżnicowanie między krajami okazało się wyraźniejsze niż różnice demograficzne, co podkreśla znaczenie kontekstu narodowego, świadomości geopolitycznej i poczucia pilności. Wyniki przyczyniają się do lepszego zrozumienia reakcji gospodarstw domowych na kryzysy zewnętrzne i wskazują na potrzebę projektowania polityk dostosowanych do typów zachowań, a nie jedynie profili demograficznych..

SŁOWA KLUCZOWE: zużycie energii, zachowania gospodarstw domowych, Unia Europejska, inwazja Rosji na Ukrainę , analiza głównych składowych, analiza skupień

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