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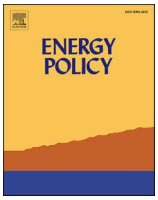

Public perceptions of fossil and alternative energy in Serbia: Between NIMBYism and nationalism

Marko Galjak [a,*], Marina Budić [b]

[a] Centre for Demographic Research, Institute of Social Sciences, Belgrade, Serbia
[b] Centre for Philosophy, Institute of Social Sciences, Belgrade, Serbia

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ABSTRACT

Understanding public perceptions of energy sources is essential for successful policy formulation. Our study explores the Serbian public's attitudes toward different types of energy, taking into account NIMBY ("Not In My Back Yard") sentiments, nationalist orientation, and pro-Russian attitudes. A correlational cross-sectional design utilized an online survey disseminated via social media platforms. The study examined public preferences for various energy types and their correlations with nationalist and pro-Russian tendencies. Poststratification weighting was applied to address sample representativeness. Our research revealed the public's preference for renewable energy, particularly solar and wind. Surprisingly, nationalist views did not significantly align with fossil fuel preferences, differentiating Serbia from Western European trends. Geopolitical considerations, such as Serbia's relationship with Russia, did not strongly influence public opinion. These findings underscore the importance of considering public preferences in shaping Serbia's energy policy, emphasizing the need for investment in renewables. Based on the results we offer concrete policy recommendations. This study offers a methodological approach adaptable to other countries undergoing similar energy transition.

1. Introduction

As recognized by the United Nations (2015), affordable, renewable, clean, and modern energy is essential for combating poverty and protecting our environment and climate. With fossil fuels being the primary contributor to climate change (Stephenson, 2018), a global effort is required to increase the share of alternative energy, expand infrastructure, and improve technology. The transition to renewable energy is an important driver for mitigating climate change and reducing carbon emissions (Sæþórsdóttir and Ólafsdóttir, 2020, p. 127). Over the past decade, there has been a significant surge in investment toward renewable energy resources and accompanying academic research exploring various aspects of this sector (Djurisic et al., 2020, p. 395). However, the global energy ecosystem is marked by diversity and complexity regarding energy sources and their acceptance as a constraining factor (Can Şener et al., 2018; Wüstenhagen et al., 2007). Public attitudes can significantly affect the feasibility of energy policies (Anderson et al., 2017). A successful shift away from fossil fuels is contingent on technological advancements and people's support (O'Connor et al., 2022). Public perception, shaped by a clear understanding of the advantages and disadvantages of energy transition, is important for achieving energy policy goals and ensuring broad acceptance of renewable energies (Karlstrøm & Ryghaug, 2014). Factors ranging from local economic development job creation to financial compensation schemes carry weight for the public and private investors, who must secure public approval to avoid cost overruns or project failures (Ribeiro et al., 2014, p. 39). As such, the social acceptance of technologies will significantly influence any move away from fossil fuels (Bauwens and Devine-Wright, 2018, p. 612). The active involvement of the public in this process is not only expected but necessary for success. Examining overall attitudes towards renewable energy is thus an important exercise, given that such insights can directly inform energy policies. Policymakers often draw on these broad attitude surveys to craft and adjust energy strategies (Bauwens and Devine-Wright, 2018, p. 612). Energy policy formulation hinges on public opinion (Anderson et al., 2017), and this public opinion is influenced not just by acceptance of different energy types but also by broader geopolitical issues. The interplay between local public attitudes and international geopolitical dynamics can significantly impact energy policy, especially in the sense of energy security, by influencing decisions on supply diversity, environmental protections, and equitable access to energy resources (Knox-Hayes et al., 2013). The recent escalation of geopolitical tension

* Corresponding author.
E-mail address: galjak@gmail.com (M. Galjak).

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and the resultant energy crisis, triggered by Russia's invasion of Ukraine, have underscored the urgency of reassessing reliance on fossil fuels as primary energy sources. This crisis has catalyzed a global and European reevaluation of energy policies, emphasizing the need to diversify energy supplies and accelerate the transition to renewable energy sources. For the formulation of energy policies that are both effective and responsive, it is necessary to have a clear understanding of how the public views different energy sources in light of the current geopolitical situation, which is especially pertinent in the Serbian context.

1.1. Serbian context

Serbia is a net importer of energy, encompassing coal, oil, gas, and electricity (Statistical Office of the Republic of Serbia, 2023). Serbia faces a unique triad of energy challenges: combating global climate change, reducing dependence on Russian energy, and rejuvenating its crumbling primary energy infrastructure. The country heavily relies on fossil fuels, which causes air pollution problems (Josimović et al., 2023). Without global warming and geopolitical tensions, Serbia would still face an energy crisis due to its endogenous issues. Its aged and frequently malfunctioning TPPNT system (Thermal Power Plant "Nikola Tesla") necessitates significant energy imports, costing Serbia between 1 and 1.5 billion euros each winter season, according to Demostat's estimates (Demostat, 2022). In the fall of 2022, Serbia's Energy Minister Zorana Mihajlovic announced that the country would allocate 3 billion euros, equivalent to 4.5% of its GDP, for electricity, gas, and oil imports from October to March to address escalating electricity and heating costs (Sekularac and Vasovic, 2022). Public enterprises in Serbia's energy sector, specifically Elektroprivreda Srbije (the state-owned power company) and Srbijagas (the state-owned gas company), have been facing significant underperformance, necessitating state interventions amounting to 3 billion euros between September 2021 and May 2023 (Fiscal Council of the Republic of Serbia, 2023).

Serbia's energy production is dominated by fossil fuels, which add up to 69.7% of primary electricity generation, while 27.58% comes from hydropower and only 2.72% from other renewable sources (Elektromreža Srbije, 2023). There has been a consensus across all strategic documents of Serbia that as part of its energy transition, Serbia needs to diversify its energy sources (The Ministry of Mining and Energy of Serbia, 2016). This diversification would mitigate environmental risks and reduce dependence on Russian energy.

Serbia's green transition requires a systematic shift in energy production, which necessitates public support. Its energy policies and their public perceptions are of considerable concern. The country's energy mix, the level of public support for different types of energy sources, and factors influencing these perceptions require thorough exploration, particularly in light of increasing pressure for countries to transition to more sustainable forms of energy.

1.2. The cleavage

The primary lens that will help us examine public perceptions about energy and NIMBY sentiments is cleavage theory. From the seminal work of Seymour Martin Lipset and Stein Rokkan (1967), cleavage theory posits that societal divisions based on fundamental values and identities shape individual attitudes and preferences. The cleavage in Serbian society persisted from the Milosevic era of Serbia in the 1990s, and it was characterized by the tendency of the less educated, older, and rural populations to lean more towards authoritarianism, nationalism, and feel nostalgia for communism (Todosijevic, 2006). Another study by Jou (2010) found that the most important cleavages during Serbia's first post-communist decade were defined by differences in age and religiosity, assessments of communist governance, and levels of satisfaction with democratic progress. In Serbia, the typical division seen in post-communist countries is made stronger by a significant split between groups that lean towards the European Union and those that focus on the Kosovo issue (Spasojević, 2016). Serbian society is sharply polarized between aspirations for European integration and entrenched nationalist sentiments (Vucenovic, 2019). Obradovic and Howarth (2018) describe this as the emergence of a "Second Serbia," characterized by an alternative discourse on national identity and Serbian character. This societal division manifests in divergent perceptions of historical events, national security concerns, and attitudes toward E.U. integration. Given that research from the UK suggests a correlation between conservative beliefs and skepticism toward renewable energy and climate change (Clements, 2014), it is important to explore how nationalism shapes energy preferences in Serbia. To the best of our knowledge, this study is the first to systematically examine energy preferences along the specific socio-political cleavages present in Serbian society, an area that remains underexplored in existing literature.

1.3. Russian influence

Energy issues are frequently politicized in public discourse, as they are closely tied to foreign policy and self-reliance questions. A common view is that Russia leverages energy to strengthen political and diplomatic ties in the Western Balkans (Cruz, 2021). This is particularly evident in Serbia. It has been pointed out that Russia's strategy in information warfare is to intensify existing cleavages and foster supportive echo chambers (Metodieva, 2019, as cited in Pomerantsev and Weiss, 2014). The relationship between right-wing extremists and the Russian state has been well-established across Europe (Butt and Byman, 2020), particularly in the case of Serbia, where there are strong connections between far-right groups in Serbia and Russia (Dzombic, 2014). Russia's clout in Serbia is particularly pronounced, as underscored by Gazprom, Russia's state-owned energy giant, securing a 50% stake in Serbia's national oil company (Council, 2008). Russia has consistently aimed to influence the E.U.'s fossil fuel policies through targeted lobbying efforts (Dupont, 2016). The significant influence of Russia on Serbia's energy sector, combined with nationalist and pro-Russian sentiments, could have significantly shaped public perceptions of energy sources. As of the start of the Russian invasion of Ukraine in 2022, the pro-Russia sentiments in Serbia are inextricably tied up with the conflict. Existing polls suggest that most people in Serbia blame the collective West for the outbreak of the Russia-Ukraine war (Samorukov and Vuksanovic, 2023). While there is substantial literature that explores the relationship between geopolitical alignments and energy policies (Bilgin, 2011; Romanova, 2016; Siddi, 2018), our research investigates the direct connection between pro-Russian sentiments and specific energy preferences within the Serbian context, a linkage previously unaddressed.

1.4. NIMBY

"NIMBY" is a term employed to describe the oppositional attitudes and tactics employed by communities facing unwanted development or projects in their vicinity (Dear, 1992). The term originated in the U.S. during the 1980s (Gates, 1980), and it describes resistance to various unwanted developments, from environmental hazards like landfills and waste incinerators to social and aesthetic concerns, including homeless shelters, prisons, wind turbines, airports, and cell towers (Devine-Wright, 2013). The NIMBY phenomenon suggests that individuals may support a project if it is not near their property. This viewpoint presents NIMBY as a social dilemma or collective action problem, where individuals aim to reap project benefits, often with public good characteristics, without bearing its associated costs, presuming that proximity to the project results in personal inconveniences (Uji et al., 2021).

The NIMBY concept encapsulates how individuals often prioritize personal interests over collective energy needs. However, as noted by some researchers, this characterization is overly simplistic and does not adequately capture the complex nature of people's attitudes toward energy technologies (O'Connor et al., 2022, p. 333), and toward projects

with significant environmental impacts (Burningham, 2000).

Research into alternative energy sources and public perceptions reveals a broad favorability towards these sources, alongside a readiness to accept higher costs for their adoption (Gargallo et al., 2020; Bidwell, 2016; Hansla et al., 2008; Longo et al., 2006; Zyadin et al., 2014). Countries with high environmental consciousness, such as Sweden, strongly support alternative energy, suggesting a link between environmental awareness and energy acceptance (Ek, 2005; Djurisic et al., 2020). In the U.S., there is significant public support for solar and wind energy expansion. Nevertheless, local opposition to specific alternative energy projects points to a common pattern of support in principle but resistance to local implementation, often examined through the NIMBY paradigm (Ansolabehere, 2014; Klick and Smith, 2010; Evans et al., 2011; Toke et al., 2008; Larson and Krannich, 2016; Devine-Wright, 2011; Swofford and Slattery, 2010; Thayer and Freeman, 1987; Jones and Eiser, 2009; Warren et al., 2005).

Different studies have pointed out various factors influencing acceptance of alternative energy, including type of energy source, proximity to living areas, economic incentives, reliability, cost, and trust (Tanujaya et al., 2020; Park, 2019; Mezger et al., 2020; Alam et al., 2014). For example, Baur et al. (2022) found that general acceptance was slightly higher than local acceptance and that trust in stakeholders and attitudes towards financial support were relatively high across different technologies.

Serbia has recently witnessed two notable instances that could be classified as manifestations of NIMBY-ism (an acronym for "Not In My Back Yard"). The first involved public opposition to small hydroelectric plants (SHP) (Mišić and Obydenkova, 2022). This resistance is often considered warranted, given the ecological and economic questions surrounding it (Couto and Olden, 2018; Premalatha et al., 2014). The second instance concerned public disapproval of Rio Tinto's lithium mining operations in Serbia (Sekularac, 2022; Stefanović et al., 2023). Both cases have been significant in the Serbian context, as they have ignited public discourse and led to the emergence of new green movements, a recent development in Serbia's political scene. Serbia lacks detailed studies on public acceptance of different energy capacities.

A systematic literature review by Carley et al. (2020) finds that surveys on public opinion and NIMBYism rarely incorporate assessments of political ideology, even though political ideology and partisan identification are found to be important determinants of support for multiple energy types in the sample of studies they covered. Carley et al. (2020) also point out that where such studies exist, they are typically done in the U.S. context.

1.5. Aims and contribution

Our first aim is to analyze Serbian public preferences between fossil fuels and alternative energy sources. Second, to explore the presence and extent of NIMBY sentiments among the Serbian population and how these sentiments contrast with general support for various energy sources. We also wanted to evaluate how nationalistic tendencies and perceptions of geopolitical dynamics, particularly attitudes toward Russia, impact public attitudes toward different energy sources. Such an examination enables us to place support or opposition to energy sources within the broader context of societal cleavages, thereby offering insights into the challenges of energy transition in post-communist societies. Our investigation extends beyond the typical assessment of NIMBY attitudes by exploring the specific energy capacity types that trigger such sentiments in Serbia. This contributes to a better understanding of local resistance to energy infrastructure, informing strategies to mitigate these challenges. This paper contributes to the discourse by examining how nationalism and pro-Russian sentiments among Serbians correlate with their energy preferences. In doing so, it sheds light on how national identity and international politics intertwine with Serbia's energy policy and public opinion. Given the scarcity of similar research in Serbia (and other Western Balkan countries), this study provides important empirical data and insights into the public's energy preferences, NIMBY attitudes, and the influence of nationalism and geopolitics. At the end of our paper, we offer concrete policy recommendations based on our findings.

2. Methods

2.1. Study design

We employed a correlational cross-sectional research design in order to examine the relationships between public attitudes towards different energy sources, detect any NIMBY effects, and factors such as nationalist tendencies and pro-Russian attitudes in Serbia in the first half of 2023.

2.2. Hypotheses

H1. General public in Serbia supports fossil energy sources to a lesser extent (compared to alternative ones);

H2. NIMBY effect exists for all energy sources (respondents provide less support for the construction of energy capacities in their vicinity than in principle);

H3. Respondents who scored highly on the Nationalistic Orientation Scale (NOS) will show more significant support for fossil energy sources.

H4. Pro-Russian attitudes will also mean greater support for using fossil energy sources.

H5. Socio-demographic variables (age, sex, education levels) influence the NIMBY effect.

H6. NIMBY attitudes are correlated with the NOS.

2.3. Data collection method

We used an online questionnaire to examine the public's views in Serbia. The survey was posted online via the EUSurvey platform, and the participants were people from Serbia (N = 264) who voluntarily completed the questionnaire. The survey was in Serbian language. Our sampling approach was convenience sampling, dictated mainly by accessibility and ease of recruitment. Participants were primarily reached through social media advertising, which allowed for a broad demographic reach within the Republic of Serbia (Table 1).

The survey was administered from January to April 2023 and took participants approximately 5–7 min to complete. The questionnaire comprised 40 questions divided into four sections of questions (see Supplementary information for the entire questionnaire). The first section included general socio-demographic questions and an inquiry about the respondent's municipality. The second section consisted of questions about attitudes regarding different energy sources. The third section contained questions about respondents' preferences for constructing

Table 1
Sample descriptive statistics.

	N	%
Sex		
Men	139	52.7%
Women	125	47.3%
Age		
15-24	34	12.9%
25-34	56	21.2%
35-64	151	57.2%
65+	23	8.7%
Education		
Highschool and lower	72	27.3%
College	50	18.9%
Bachelor's degree	64	24.2%
Advanced degree	78	29.5%

different capacities of energy facilities in their municipality. The fourth section contained the items for the national orientation scale. The last, fifth section consisted of questions about who the respondents support in the ongoing Russia – Ukraine war. Participants answered the form using a Likert scale of 1–5, where one indicated that they do not agree, while five indicated that they agree entirely (except for the socio-demographic questions and question about which side they supported in the Russia-Ukraine war where they had the following options – Ukraine, Russia, and Neutral).

Answering all questions was required for the form to be submitted. The only free text field was the municipality, where participants were asked to provide the municipality where they reside. The research design was tailored for national-level inferences. We included a question for participants to specify their municipality to prime them psychologically and ensure that subsequent survey responses would be linked to that particular municipality.

A series of parallel questions were posed to study the NIMBY aspect (the third category of questions): "Serbia should rely on the following energy sources:". These were contrasted with, "If there were a potential for constructing the following capacities in the municipality where you live, to what extent would you support the construction."

We pretested the survey with our colleagues to get feedback on the survey. Our aim was for respondents to be able to fill out the survey quickly, within 5–10 min. We have confirmed that the survey took 5–7 min. The feedback we received was positive, but the questions relating to the nationalist orientation scale and views about the Russian invasion of Ukraine seemed "too forward." At that point, we had to decide whether to remove or include those questions in the final survey. We have determined that in light of existing divisions in Serbia, it was important to explore those views even if it meant that some of the respondents abandoned the survey when they reached those "sensitive" questions.

The survey was conducted with people who gave their informed consent to participate. Respondents were informed that their participation was voluntary, that their refusal to participate did not entail any penalty, and that they could terminate their participation at any time. We used EUSurvey, the E.U.'s General Data Protection Regulation compliant tool, which ensured the anonymity of the respondents.

We have discovered three spurious submissions that provided straight-line responses (detected by calculating the standard deviation of Likert questions for each submission), which we have removed from the sample.

2.4. Poststratification

We identified two potential problems with the sample. First, the sample was only partially representative of the Serbian population. The deviation check suggested that certain demographic groups, particularly older individuals with lower educational levels, were underrepresented in our sample, while younger individuals, especially those more educated, were overrepresented. Second, the response rate for the survey administered through social media ads was 10.4%, which is low and could have introduced some degree of non-response bias that could account for the imbalance. Due to the cleavage in Serbian society (outlined in the introduction) that exists along the lines of age and education, we determined that it is important for our sample to be weighted in a way that will correct this sampling bias. Therefore, we employed poststratification weighting to ensure that our sample accurately reflects the Serbian population regarding age, sex, and education.

To implement poststratification weighting, we first categorized respondents into groups based on three criteria: sex (male, female), age groups (15–24, 25–34, 35–64, 65+), and education levels (High School or less, College, Bachelor, Advanced degree). This categorization resulted in a multidimensional matrix of groups, allowing for an adjustment that reflects the structure of the population. We calculated the proportions of these groups within our sample and compared them to the known proportions in the Serbian population, as derived from census data. By calculating the ratio of population proportions to sample proportions for each sex-age-education group, we determined the weights to be applied to each response. These weights were then assigned to the survey data, effectively adjusting the influence of each response to represent the Serbian population's views more accurately. This weighting process allows us to mitigate the issues of non-representativeness and non-response bias, providing a more reliable basis for analyzing the attitudes and behaviors regarding energy policy in Serbia.

2.5. Nationalist orientation scale

The Nationalistic Orientation Scale (NOS) for the Serbian context, as defined by Bojan Todosijević (2013), is an 11-item scale that measures different aspects of nationalist ideology, such as national pride, belief in national superiority, and support for national sovereignty. It aligns with other established measures of nationalistic orientation (Dekker et al., 2003; Kosterman and Feshbach, 1989), ensuring its relevance and applicability. This scale, derived from the mean of 11 questionnaire items, demonstrated excellent reliability in our study, with Cronbach's α and Guttman's 6 λ values of 0.87 and 0.89, respectively, indicating high internal consistency. These reliability metrics, alongside the scale's theoretical foundation and empirical alignment with similar measures, substantiate its construct validity within the Serbian context.

2.6. NIMBY

NIMBY sentiment in our study is quantified as the relative difference between the general support for a particular energy source that respondents believe Serbia should rely on and their willingness to have the infrastructure for that energy source constructed in their own municipality. For example, to measure NIMBY sentiment towards wind energy, we calculate the difference between each respondent's Likert scale response to the question of how much Serbia should rely on wind energy and their response to a subsequent question about their support for building wind farms in their municipality. This difference is then divided by the score from the first question (general support for wind energy) and multiplied by 100 to obtain a percentage representing the NIMBY sentiment. This method allows us to quantitatively assess the extent of NIMBY attitudes across different energy sources, providing insight into the discrepancy between national-level energy support and local-level acceptance for each energy source.

We attempted to create a composite variable that would represent a general NIMBY effect. While the internal consistency and reliability metrics showed promising results, the principal component analysis (PCA) showed that such a construct lacks validity. PCA is a statistical technique that reduces the dimensionality of data by identifying a few orthogonal components that capture the most variance in the data (Jolliffe, 2002). This method is useful for distilling complex datasets into simpler, interpretable structures without major loss of information. We used parallel analysis, which involves comparing the eigenvalues derived from the observed dataset with those generated from a random data matrix of identical dimensions (Humphreys and Montanelli Jr, 1975), which showed that a two-component solution was optimal. We extracted the two-component solution and rotated it using the varimax approach. It accounted for a total of 49.5% of total variance. The first component loaded on fossil fuel NIMBY variables (32.8% of variance). We named this component the Fossil component, while the second was strongly correlated with alternative NIMBY attitudes towards sources (15.7% of variance). We name the second component the Alternative component. The two-component solution was statistically significant $\chi^2 = 712.87$, $p < 0.001$); furthermore, the model's fit was assessed using the Root Mean Square of the Residuals of 0.11, suggesting that the fit is not perfect but acceptable. The two components were used for hypothesis testing (see Supplementary Materials for loadings and PCA

visualizations).

2.7. Hypothesis testing

Hypotheses were tested using different statistical methods to account for the nature of our data and the types of variables in our study. Given that our data was Likert-type, poststratified through weights, and did not follow the normal distribution, traditional parametric tests would not be appropriate. Therefore, we employed a variety of nonparametric statistical tests suitable for our weighted data.

We employed bootstrapping, a non-parametric resampling technique, to estimate the distribution of sample statistics and calculate robust confidence intervals, particularly for means and Spearman correlation coefficients. This method, introduced by Efron (1979), is especially useful in situations where the theoretical distribution of a statistic is unknown or difficult to derive. Bootstrapping allows us to approximate the sampling distribution of almost any statistic by resampling with replacement from the original dataset and computing the statistic of interest across many replications. For our analysis, each bootstrap involved 10,000 replications. This high number of replications was chosen to ensure a sufficiently accurate approximation of the sampling distribution, thereby enhancing the reliability of our confidence interval estimates. In each replication, a new sample was drawn from the original dataset with replacement. This means each draw could include any observation from the dataset, and the same observation could be drawn multiple times. For each of these bootstrapped samples, we calculated either the difference in weighted means or the Spearman correlation coefficients, depending on the hypothesis being tested. We specifically applied bootstrapping with weighted means to test hypotheses H1 and H2. Hypothesis H1 posits a general public preference in Serbia for alternative energy sources over fossil fuels, and H2 examines the presence of a NIMBY effect across different energy sources. The weighting in our analysis accounts for the demographic composition of our sample, adjusting for any biases that might affect the generalizability of our findings. For hypotheses H3, H5, and H6, which involve relationships between variables (e.g., the association between nationalist tendencies and support for fossil fuels), we used bootstrapped Spearman's rank correlation. Spearman's method was chosen due to its ability to measure the strength and direction of a relationship between two ranked variables, making it suitable for our Likert-scale data. This non-parametric approach does not assume a normal distribution of the data, aligning with the nature of our collected responses. By employing bootstrapping, we were able to derive stable and accurate estimates of the mean differences and correlation coefficients, along with their respective confidence intervals. This methodological choice ensures that our statistical inferences remain robust even in the face of potential non-normality and sample bias, providing a solid foundation for the conclusions drawn from our hypotheses testing.

In our analysis, to address the challenges posed by non-normally distributed data and the need to account for the weights derived from poststratification, we utilized the weighted Mann-Whitney test (MW) and the weighted Kruskal-Wallis test (KW). The weighted MW, an assessment tool that doesn't rely on the usual assumptions of parameter-based tests for evaluating if two separate samples originate from identical distributions, was employed to investigate the disparities between two groups (Mann and Whitney, 1947). Similarly, the weighted KW, which builds upon the MW test to accommodate analyses involving three and more groups (Kruskal and Wallis, 1952), was utilized to assess variations among several groups. These non-parametric statistical tests are particularly suited for analyzing differences between two or more groups when the data does not meet the assumptions necessary for traditional parametric tests, such as normality and homogeneity of variances. The weighted MW was applied to evaluate hypothesis H4, which posited differences in support for fossil energy sources based on pro-Russian attitudes. This test compares the medians between two independent groups while incorporating the weights from poststratification, allowing us to adjust for potential sampling biases and more accurately reflect the population structure. By using weights, we ensured that each respondent's data contributed to the analysis in proportion to their demographic group's representation in the overall population, enhancing the ecological validity of our findings. For hypothesis H5, which explored the impact of socio-demographic variables on the NIMBY effect, we employed the weighted KW. This test extends the MW test to more than two groups, enabling us to assess whether there are statistically significant differences across multiple demographic categories. Similar to the weighted MW, the KW takes into account the poststratification weights. In instances where the KW yielded statistically significant results, indicating differences among the groups, we proceeded with Dun's post hoc test to conduct pairwise comparisons between groups, a method recommended for its control over type I error in multiple comparisons scenarios (Dunn, 1964). By applying Dun's post hoc test, we were able to conduct pairwise comparisons between demographic groups, further inspecting the nature of the socio-demographic influences on the NIMBY effect observed in our study.

2.8. Replication

Data were processed and analyzed in R (R Core Team, 2014), a statistical computing and graphics programming language. For statistical analysis, we used psych (Revelle, 2023), boot (Canty and Ripley, 2022; Davison and Hinkley, 1997), survey (Lumley, 2004, 2010, 2023), and sjstats (Lüdecke, 2022); for data visualization ggpubr (Kassambara, 2023), ggplot2 (Wickham, 2016) and extrafont (Chang, 2023); for data processing we used tidyverse (Wickham et al., 2019) and openxlsx (Schauberger and Walker, 2023). The data and R code necessary to run the statistical analysis and produce visualizations are posted on the public OSF repository https://osf.io/wmhqt.

3. Results

H1. The Serbian public exhibits a discernible preference for alternative energy sources over fossil fuels, as indicated by the weighted mean scores (Fig. 1). Among the various energy sources evaluated, natural gas is the only fossil fuel that receives notable support from the Serbian public. Conversely, nuclear energy is the singular alternative energy source that lacks support. Specifically, the weighted mean scores reveal that solar energy ($\bar{x}_w = 4.03$, 95% CI [3.82, 4.21]) and wind energy ($\bar{x}_w = 3.83$, 95% CI [3.62, 4.04]) are the most favored sources, followed by hydro ($\bar{x}_w = 3.68$, 95% CI [3.28, 3.95]), geothermal ($\bar{x}_w = 3.40$, 95% CI [3.04, 3.68]), and biomass ($\bar{x}_w = 3.26$, 95% CI [2.96, 3.52]). The fossil fuels such as coal ($\bar{x}_w = 2.20$, 95% CI [1.96, 2.42]) and oil ($\bar{x}_w = 2.16$, 95% CI [1.94, 2.38]) receive less support, while shale ($\bar{x}_w = 1.84$, 95% CI [1.62, 2.14]) and nuclear ($\bar{x}_w = 2.08$, 95% CI [1.79, 2.41]) are the least favored. However, natural gas ($\bar{x}_w = 3.23$, 95% CI [2.99, 3.50]) is an exception among fossil energy sources, receiving a level of support comparable to some alternative energy sources. These findings substantiate our hypothesis that the Serbian public prefers alternative energy sources over fossil fuels, except for natural gas, which receives a relatively higher level of support than other fossil fuels, and nuclear energy, which is less favored than other alternative energy sources.

H2. The NIMBY effect is not uniformly observed across all energy sources, indicating that respondents' support for constructing energy capacities varies when considered in their vicinity instead of in principle (Fig. 2).

A clear YIMBY (Yes In My Backyard) effect emerges for solar capacities, as indicated by the negative percentage (−8.80%, 95% CI [−15.05, −2.85]). Among the energy sources evaluated, the NIMBY effect is most pronounced for SHP capacities (36.68%, 95% CI [23.29, 45.62]), followed by coal power plants (27.21%, 95% CI [9.79, 35.55])

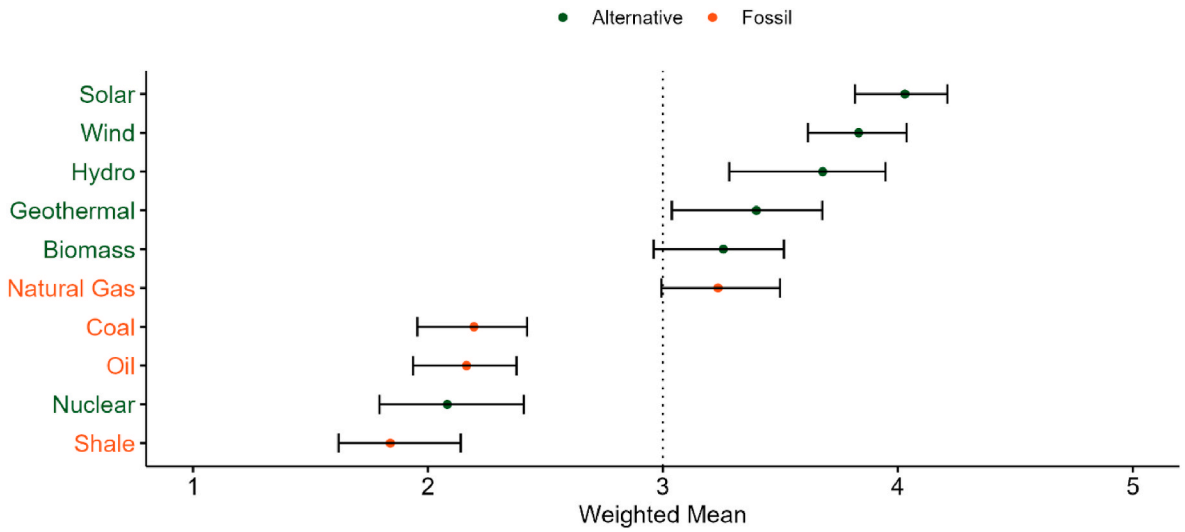

Fig. 1. Public opinion on which energy sources Serbia should rely on.

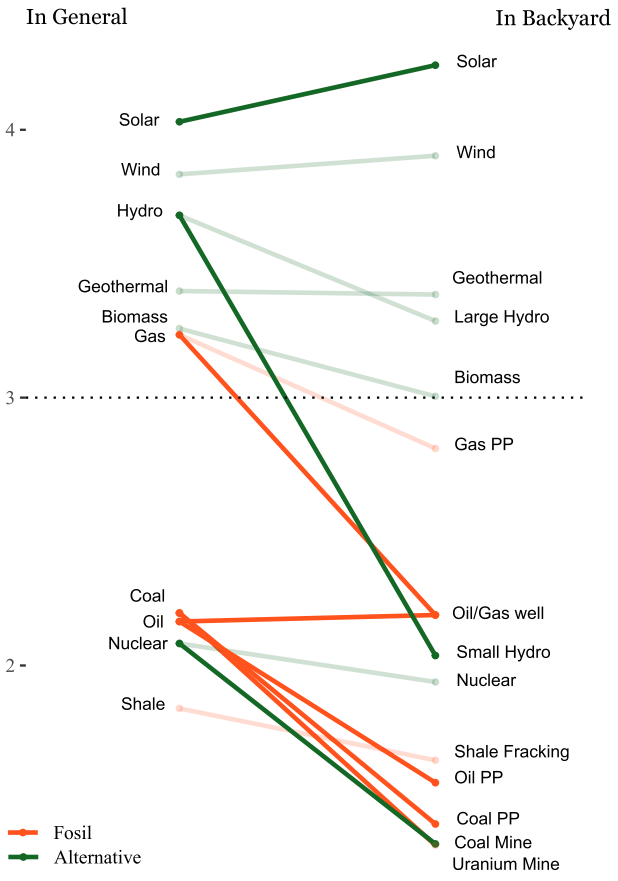

Fig. 2. NIMBY effect – the difference between the belief that Serbia should rely on specific energy sources and that the capacities for each source should be built in the respondents' own municipality. The cases where there is no statistically significant NIMBY effect are presented with transparent lines.

and coal mines (25.19%, 95% CI [7.81, 33.56]). Uranium mines also display a significant NIMBY effect (21.02%, 95% CI [14.26, 29.28]). Conversely, wind capacities (−3.50%, 95% CI [−8.16, 1.73]) and geothermal capacities (−15.63%, 95% CI [−71.19, 2.78]) lean towards the YIMBY effect but fall within a confidence interval that includes zero, suggesting ambiguity in public perception. Interestingly, nuclear power plants present a positive bias but lie within a neutral range (2.53%, 95% CI[−4.13, 10.02]), indicating an alignment between the general support and support for those capacities existing in one's municipality. People seem less NIMBY oriented towards oil and natural gas extraction (−22.26%, 95% CI [−77.31, −1.08]) than to facilities combusting oil (15.89%, 95% CI [1.61, 26.05]) and gas (10.56, 95% CI [−1.93, 18.22]) in their municipality. The NIMBY effect across all energy sources evaluated averages 7.49% (95% CI [−5.69, 13.35]). This demonstrates that public attitudes toward constructing energy capacities near them vary considerably depending on the energy source in question. Fossil fuel capacities seem less desirable in the backyard (Fig. 3).

H3. The relationship between the NOS scores and support for specific fossil energy sources yielded no conclusive results. For oil, the correlation was not statistically significant ($\rho = 0.090$, 95% BCa CI [-0.159, 0.320]). However, coal displayed a hint of correlation ($\rho = 0.175$, 95% BCa CI [-0.071, 0.376]) that approached significance, suggesting a potential association between coal support and nationalist orientation, though this remains inconclusive. The negative correlation for shale ($\rho = -0.150$, 95% BCa CI [-0.364, 0.066]) and the near-neutral stance for natural gas ($\rho = -0.009$, 95% BCa CI [-0.230, 0.207]) were also not statistically significant. Still, the correlation with shale approached significance. Given the range of findings, the data does not conclusively support the hypothesis that higher scores on the NOS correspond to stronger support for fossil fuels.

H4. We employed the weighted KW to investigate the relationship between pro-Russian attitudes and support for specific fossil energy sources. The results demonstrated no statistically significant differences for the evaluated fossil energy sources: shale ($\chi^2(2) = 4.543$, $p = 0.105$), natural gas ($\chi^2(2) = 0.061$, $p = 0.970$), oil ($\chi^2(2) = 1.328$, $p = 0.516$), and coal ($\chi^2(2) = 5.515$, $p = 0.065$). These results suggest that the prevailing attitudes towards Russia did not discernibly alter the support for these energy types (Fig. 4). Therefore, our findings do not validate the hypothesis positing an association between pro-Russian attitudes and increased backing for fossil energy sources. Our results show that 48.2% of the respondents are neutral, 28.3% support Russia and 23.5% support Ukraine.

H5. Socio-demographic variables – age, sex, and education, largely cannot be used to predict NIMBY sentiments. The first NIMBY component (Fossil component) component is uncorrelated with age ($\rho = -0.058$, 95% BCa CI [-0.279, 0.152]), does not differ between the two sexes ($\chi^2(262) = 0.749$, $p < 0.455$). While there is some evidence of differences between the levels of education ($\chi^2(3) = 9.828$, $p < 0.022$),

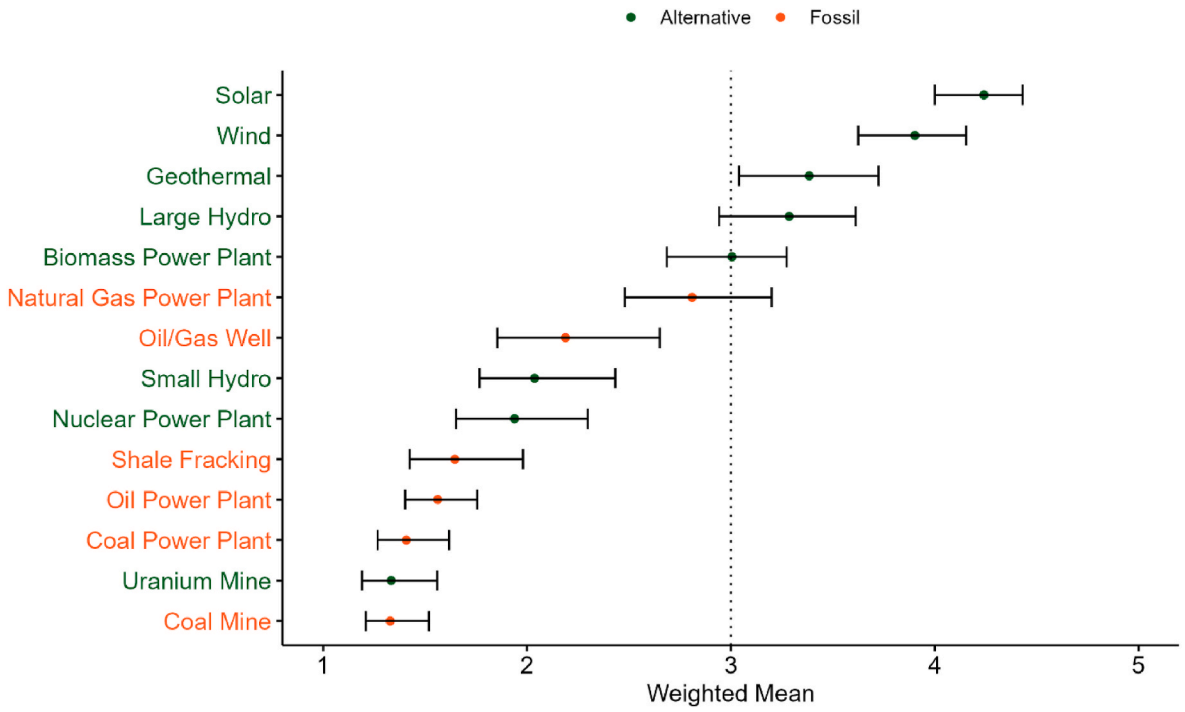

Fig. 3. The degree to which the responses agreed to have various energy capacities built in their municipality.

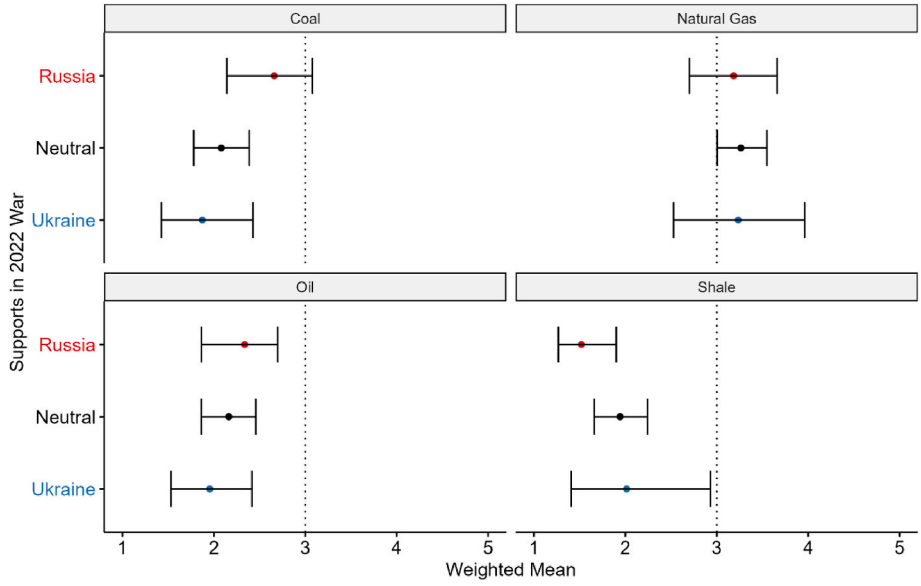

Fig. 4. Support for fossil energy sources by the support for the ongoing 2022 Russia – Ukraine War.

they are very slight, with College-educated individuals having significantly lower scores compared to those with Advanced and Bachelor. When it comes to the second NIMBY component (alternative component), there is a negative correlation approaching significance with age ($\rho = -0.198$, 95% BCa CI [-0.460, 0.017]), meaning that the older a responded was, the less likely they were to express NIMBY attitudes toward alternative energy sources. Consequently, while certain associations exist between the first NIMBY component and education, and the second component and age, these are either marginal or statistically insignificant. This leads to the conclusion that socio-demographic variables may not significantly influence NIMBY sentiments in this study.

The difference in preferences for energy between sexes was also analyzed to discern any patterns. The analysis reveals that significant disparities exist only in two instances regarding support for various energy sources or infrastructure development. Specifically, there is a marked difference in preferences between men and women for nuclear and geothermal energies. Men show a significantly higher preference for nuclear ($\chi^2(262) = 3.647$, $p < 0.001$) and for geothermal energy ($\chi^2(262) = 2.653$, $p < 0.008$). However, for the rest of the energy sources tested, the differences between sexes are statistically insignificant, suggesting a broad alignment in attitudes across genders. See Supplementary materials for more details.

H6. NIMBY sentiments seem to be largely uncorrelated with nationalist sentiments. When it comes to the first NIMBY component (Fossil component), there is a slight negative correlation approaching significance ($\rho = -0.135$, 95% BCa CI [-0.353, 0.099]). In contrast, the second

NIMBY component (Alternative component) seems to be completely orthogonal ($\rho = -0.016$, 95% BCa CI [-0.232, 0.239]) to the nationalist sentiments represented by the NOS.

4. Discussion

4.1. Public's preference for energy sources

The clear preference for alternative energy sources over fossil fuels underscores a possible progressive attitude toward sustainable energy choices, aligning with global trends regarding renewables (Budeanu, 2007). Solar and wind energy emerged as the most favored in Serbia. Interestingly, despite the general aversion towards fossil fuels, the support for natural gas could suggest that it is viewed as a potential transitional fuel, acting as a "bridge" during the shift from coal to renewables (Budeanu, 2007; Levi, 2013). Conversely, the lack of support for nuclear energy might be rooted in concerns regarding safety, environmental impacts, or the complexity of nuclear waste management. Regulatory constraints currently limit Serbia's potential to harness nuclear energy. Serbia currently has a moratorium on constructing nuclear power plants, which was established in 1989 during the Yugoslav era (Pesic and Nikolic, 2005). Therefore, capitalizing on this energy source, which demands significant initial investments, hinges upon the moratorium's eventual repeal. Anti-nuclear sentiment and NIMBY towards nuclear likely stem from the widely held belief that depleted uranium anti-tank munitions used in the 1999 NATO campaign against Yugoslavia caused increased cancer rates in Serbia (Svetoka, 2021).

4.2. NIMBY & YIMBY

The findings show the Serbian public's willingness to accept specific energy capacities near their homes. There is a pronounced preference for solar energy, demonstrating a reverse NIMBY effect, or YIMBY effect, first described by Lake (1993). This might be a result of its perceived low environmental and aesthetic impact.

On the other hand, the significant NIMBY effect on SHP capacities and coal-based installations highlights potential local environmental and health concerns. The ambiguity surrounding wind and geothermal capacities suggests that while some respondents might appreciate the green aspect, others may doubt noise or aesthetic impacts. The strong NIMBY effect for wind energy installations has been observed in Romania. This country shares a long border with Serbia, where concerns around noise and annoyance, landscape impact, fauna and flora damage, shadow flickering, health issues, lack of community involvement, and negative impact on local properties prevail (Maassen, 2019).

The apparent neutrality on nuclear energy, evident in the results, represents the alignment between the general support for nuclear energy and the reluctance of the general public in Serbia to have those capacities in its vicinity.

PCA of the NIMBY attitudes revealed a clear delineation between attitudes towards fossil fuel energy sources and those towards alternative energy sources, with these categories being uncorrelated. This suggests that public sentiment towards these two broad categories of energy sources is, to some degree, distinct, reflecting differing underlying concerns and values. Future research could explore the specific factors that contribute to the distinction between fossil and alternative energy NIMBY attitudes. The variation in NIMBY sentiment across different energy sources underscores the importance of tailored communication and engagement strategies that address specific concerns associated with each type of energy infrastructure.

4.3. Nationalist orientation and energy preferences

The inconclusive results between NOS scores and fossil fuel support indicate that nationalism might not strongly predict energy preferences in Serbia. Skepticism towards climate change (and therefore the impact of fossil fuels) is more linked to nationalist ideology in Western Europe than in Eastern and Central European countries (Kulin et al., 2021), which are more similar to Serbia. It is positive that renewables are seen in a much more favorable light. While the relationship between ideology and public attitudes toward constructing new fossil energy capacities in the U.S. is well established (Zanocco et al., 2020), the same cannot be said for Serbia. Despite coal being among Serbia's least favored energy sources, our results suggest a potential positive correlation between NOS scores and a preference for coal. This inclination might be influenced by the portrayal of coal miners as icons in right-wing populist economic narratives (Lockwood, 2018) and coal's long-standing role as a traditional energy source in Serbia. A potential negative correlation between preference for shale and NOS could be interpreted as shale extraction being perceived as a US-lead technology, stemming from the anti-American sentiments for people high on the NOS scale in Serbia. A study in Norway found that positive attitudes toward energy installations correlate with support for political parties that emphasize environmental values (Karlstrøm & Ryghaug, 2014). Over the years, the overwhelming support for renewables in Serbia could translate into political support for environmentalism.

4.4. Pro-Russian attitudes and fossil energy support

Russia has significant power over Serbia, especially in the energy sector. However, it is not dominant or decisive in other domains, where it faces competition from the EU, the US, NATO, and China (Reid, 2021). Despite the potential geopolitical repercussions, the sentiments of the Serbian populace towards the Russia-Ukraine conflict do not appear to play a decisive role in their preferences for specific fossil energy sources. Such an observation implies that the Serbian public either differentiates between their geopolitical sympathies and energy choices or that other sociopolitical considerations overshadow the implications of the Russia-Ukraine war.

4.5. Socio-demographic variables and NIMBY

The minor association between age and NIMBY around fossil sources might indicate shifting generational values or differential exposure to information about energy sources. Nevertheless, the limited influence of socio-demographic variables suggests that other factors, such as personal experiences, community narratives, or exposure to specific information sources, might be stronger determinants of the NIMBY sentiment.

Research has shown that various socio-demographic factors can shape the receptivity towards land uses and technological endeavors. For instance, the acceptability of projects like waste isolation plants is influenced by income, education, age, and gender (Jenkins-Smith et al., 2011). Similarly, one's educational background also affects the perception of power lines (Devine-Wright, 2013). In studies on hydrogen fuel stations in Norway men were more supportive than women (Thesen and Langhelle, 2008). In contrast, the hydrogen storage facility in London faced opposition, particularly from those with lower incomes and the elderly, compared to their higher-earning and younger counterparts (O'Garra et al., 2008). While education and homeownership could influence acceptability, the direction of their impact remains to be determined (Huijts and Van Wee, 2015).

Surveys from various regions indicate that older individuals have a heightened awareness and resistance towards renewable energy. Conversely, some surveys showed that younger and older groups exhibited lower awareness and opposition levels than middle-aged groups. When considering nuclear energy, the older population is more supportive than the younger generation (Devine-Wright, 2007).

4.6. Sex differences in energy preferences

While most energy preferences remained consistent across sexes, the

divergence in attitudes toward nuclear and geothermal energies is intriguing. Higher support for nuclear energy among men is consistent with what has been well-known in the literature (Melber et al., 1977; Solomon et al., 1989; Sundström and McCright, 2016). The gender gap in geothermal has also been observed before and seems to stem from the case that men are generally more informed about this energy source than women (Karytsas and Theodoropoulou, 2014). Such differences might be rooted in varying perceptions of risk, socio-cultural narratives, or even differential access to information. Further qualitative research may be needed to unpack the reasons behind these differences in Serbia.

5. Limitations

Our study employed convenience sampling, which inherently brings forth issues of representativeness. While we have attempted to counteract this by poststratification weighting, the method does not fully compensate for the non-randomness of our sample selection. It is possible that specific subgroups within the Serbian population were either over or underrepresented. As our survey was conducted online and primarily reached through social media advertising, selection bias is possible. Those who are more digitally literate or active on social media platforms are more likely to be represented, potentially excluding some older demographics or those without internet access. The data is based on self-reported attitudes, which may be subject to various biases, such as social desirability bias.

Furthermore, the relatively low response rate of 10.4% might have introduced non-response bias. While we attempted to mitigate this through poststratification weighting, non-respondents views could systematically differ from those who participated in the study. Given the political sensitivities surrounding Russia-Ukraine relations and items in the NOS, it is possible that some respondents may not have been entirely forthright about their opinions or even offended thus never completing the survey, introducing another bias. Another limitation of our study is its cross-sectional design, which offers a snapshot of attitudes at a particular point in time, albeit a salient one.

6. Conclusion and policy implications

Our study found that the Serbian public strongly prefers renewable energy sources, particularly solar and wind power. The Serbian public entirely dismisses nuclear energy as an option. Given the ongoing moratorium and the lack of plans for its utilization, nuclear energy should remain excluded from Serbia's energy strategy. There is also a strong opposition to building additional coal and SHP capacities. Therefore, policy should prioritize the development of renewable energy sources over coal and SHP projects, aligning with public sentiment.

Interestingly, nationalist views in Serbia do not correlate significantly with a preference for fossil fuels, unlike in Western Europe. This suggests that the relationship between national identity and energy choices in Serbia is more related to Eastern and Central Europe or even unique and deserves further study. The only notable correlation was a preference for coal among individuals with higher NOS scores. This could indicate the historical significance of coal in Serbia. Geopolitical factors, especially Serbia's relationship with Russia, do not strongly influence public opinion on energy sources. This suggests that individual choices are influenced more by local and environmental factors than by international politics.

6.1. Foreign policy and energy policy of Serbia

Serbia has inextricably tied its energy policy with foreign policy once it decided to sell half of its national oil company to a Russian state-owned oil and gas company. This link between energy policy and foreign policy makes the usual geopolitics of energy even more geopolitical in the case of Serbia. There is tension between E.U. accession and strong ties to Russia that persists even in the aftermath of the Russian invasion of Ukraine. Our findings indicate that Serbian public's support for Russia does not translate to the preference of fossil fuels that Russian state companies export to or extract in Serbia. This may create an opening for Serbian policymakers to change course regarding new energy and foreign policy. Renegotiating the deal under which Serbia sold a 50% stake in its national oil company to Russian state-owned Gazprom, with the Russian side promising the South Stream project will pass through Serbia. As the South Stream project was canceled, there is space to renegotiate the deal with Russia, which would see a partial return of the stake to Serbia. Renationalizing NIS is an additional option that is being mentioned (Savković, 2020). As a shift to renewables would greatly reduce the dependence on imports of Russian oil and gas, there is an opportunity to both decrease dependence and enable a foreign policy shift that could hasten the E.U. accession, which in itself would have positive downstream effects on energy, such as more access to E.U. funds for funding or subsidizing future energy-related projects.

6.2. Avoiding politicization of energy

Given the lack of a clear correlation between nationalist orientation and preference for specific energy sources, policy implications should steer clear of politicizing energy choices based on nationalist sentiments. Instead, energy policy should focus on technical, economic, and environmental benefits that transcend political ideologies. This approach could help unify diverse segments of the population around common energy goals. Future politicization of energy risks placing this broadly consensual topic into the existing cleavages in Serbian society.

6.3. Shifting political ecosystem and energy policy of Serbia

Recent shifts in Serbia's political ecosystem, characterized by the rise of green movements and the entry of the first green political party into parliament, underscore the nation's evolving environmental consciousness. This emergence and the growth trajectory of green initiatives signal a critical juncture in Serbia's political and environmental discourse. Our findings reveal a substantial endorsement for renewable energy sources, a sentiment that remarkably transcends the deep-seated nationalism divide prevalent in Serbian society. This unanimous support for green energy highlights a rare consensual domain within Serbia's polarized political landscape. It suggests the potential for renewable energy advocacy to unite diverse voter bases, fostering the expansion of environmental political movements. Given this context, policymakers and stakeholders must integrate this burgeoning environmental enthusiasm into formulating and implementing future energy policies. Recognizing and harnessing this consensus on renewable energy can guide Serbia towards more sustainable energy solutions and bolster the growth and influence of green politics within the country, shaping a more unified and environmentally conscious political dialogue.

6.4. Seizing the moment for renewable energy policy in Serbia

Policymakers must heed public sentiment in determining Serbia's energy trajectory. The evident public inclination towards renewable energy sources, transcending the typical ideological divides in the nation, underscores an urgent call for increased investments in renewable energy projects. However, this favorable disposition could evolve, aligning with the NIMBY perspectives prevalent in Western Europe, especially concerning the frequently debated wind power capacities. This potential shift emphasizes the importance of proactive and considerate energy policy planning that respects current public preferences. It anticipates future shifts in attitudes, ensuring sustainable and broadly supported energy solutions for Serbia.

Data statement

Data are available in a publicly accessible repository with a

persistent identifier (DOI or accession number).

CRediT authorship contribution statement

Marko Galjak: Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Marina Budić:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Investigation, Funding acquisition, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

While preparing this work, the authors used ChatGPT-4 to improve the language. After using this tool/service, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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Data availability

Data are available in a publicly accessible repository with a persistent identifier (DOI or accession number).

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Appendix A. Supplementary data

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