The Energy Justice mix: Understanding people's diverging energy preferences in Belgium

Authors: Hanne Dallenes[1*], Robbe Geerts[1], Frédéric Vandermoere[1], Gerlinde Verbist[1]

[1]Department of Sociology, University of Antwerp, Sint-Jacobstraat 2, 2000 Antwerp, Belgium;
hanne.dallenes@uantwerpen.be, robbe.geerts@uantwerpen.be,frederic.vandermoere@uantwerpen.be,
Gerlinde.verbist@uantwerpen.be
*Corresponding Author

Introduction

While energy systems are typically depicted as technological and economic phenomena, they are fundamentally embedded into social structures (Miller et al., 2015). The contemporary focus on energy transitions reconfigures societies as it deeply impacts social realities. While energy transitions are often portrayed as positive, they can foster new injustices or worsen existing inequalities as they ignore the realities and interest of vulnerable people (James et al., 2022; Sovacool, Martiskainen, et al., 2019). This article aims to enhances the understanding of the interconnectedness between energy transitions and social equality by focusing on how social characteristics determine the composition of individuals' preferred energy mix.

Existing research about public energy preferences is mainly limited to the exploration of preferences for one energy system in isolation (e.g. nuclear energy or renewable energy technologies or fossil fuels). Hence, little is known about how various energy sources are combined into diverging **energy mixes** i.e., preferred combination of the different sources that are used to produce electricity. Furthermore, many studies apply a regression style design to identify the most important factors that influence energy preferences (Kácha et al., 2022). While these studies conclude that levels of climate change concerns, political orientation, socio-demographic and socio-economic characteristics influence public attitudes towards energy systems, they rarely combine predictors which reduces complexity and nuances (Kácha et al., 2022; Perlaviciute & Steg, 2014; Poortinga et al., 2006). Against this background, we use Belgian survey data from the European Social Survey (N=1766) to examine the diversity in preferred energy mixes of the Belgian population, and the social characteristics associated with these energy mixes. Belgium is an interesting case to investigate as the country has one of the lowest shares of renewables in energy consumption across the EU (Eurostat, 2020). At the time when the survey was conducted Belgium's energy mix consisted mainly of oil (51.5%), gas (22.6%) and nuclear energy (15.3%) (Ritchie et al., 2020). While Belgium endorses the EU target of carbon neutrality by 2050 and has adopted a long-term strategy for energy and climate, targets have not been clear and the IEA recommends and update of its strategy in order to make the commitment and the path towards it much clearer (IEA, 2022). In addition, Belgium faces a set a of major challenges such as rising energy prices, increasing number of households who live in energy poverty, high demand for energy, high dependence on energy imports, controverses about the planned nuclear phase out etc. These struggles make the question on how to account for a successful energy transition even more prominent.

A segmentation analysis (i.e. latent class analysis) is used as the primary analysis technique to investigate whether Belgian respondents could be divided into groups based on their preferred energy mix. By applying a segmentation analysis we are able the better understand the larger patterns lying behind attitudinal differences, which will provide a more holistic and nuanced framework (Metag & Schäfer, 2018). Exploring the heterogeneity of preferences about energy mixes across different social groups provides useful insight into how these groups perceive an energy transition from their own social reality and may be relevant for policy makers when designing future energy policy pathways.

Literature review: heterogeneity of energy preferences

Public preferences about energy resources vary widely, these variations are rooted in a diverse composition of socio-demographic variables, level of climate change concerns and political orientation (Poortinga et al., 2006; Perlaviciute & Steg, 2014). Therefore, it is expected that energy preferences are heterogenous. Findings concluded that **socio-demographic** variables such as age and gender influence attitudes towards energy preferences (Diamantopoulos et al., 2003; Noblet et al., 2015; Sütterlin et al., 2011). Especially, young females often have higher preferences for renewable energy as they generally prioritize environmental protection over security (Sütterlin et al., 2011). However, other studies found that men are more willing to pay for renewable energy (Noblet et al., 2015). Furthermore, existing research concluded that **climate change concerns** are positively related to preferences for renewable energy as it is perceived as the primary mitigation strategy (Culley et al., 2011; Karlstrøm & Ryghaug, 2014). Next to climate change concerns, **political orientation** also influences energy preferences. Individuals on the left side of the political spectrum are generally more in favour of environmental protection and sustainability (McCright et al., 2016; Pampel, 2011). Moreover, while right-wing parties are more supportive of laissez-faire markets, left-wing political parties favour government intervention which is perceived as necessary for a successful energy transition (Clulow et al., 2021). Hence, according to this view left-wing individuals are more likely to prefer renewable energy. However, the influence of political orientation is less polarized in the European Union then in the United Stated of America. According to Thonig et al. (2021) political ideology is only a minor factor in predicting citizens energy preferences in Europe. Other important factors that could explain diverging energy preferences among individuals are **educational attainment and income**. It is argued that individuals with a lower educational level and more financial insecurities are more inclined to prefer fossil fuels and nuclear energy as it is perceived as a better guarantee for meeting expected increases in energy demand (Pampel, 2011). Moreover, according to a study from Kosenius and Ollikainen (2013) there exists a positive relationship between income and renewable energy preferences. This may be due to the fact that low-income households face several barriers to invest in renewable energy technologies such as a lack of financial resources, no home ownership and a relatively higher general energy burden (Durkay, 2017). According to Carfagna et al. (2014), individuals with low income and a low educational level often experience frustration or alienation towards environmental policies or certain types of pro-environmental consumption patterns. While these individuals are very concerned about climate change they do not have the resources (e.g. time, money, education) to engage in the 'ideal mode' of environmental protection that is defined by the more powerful, elite class (Carfagna et al., 2014; Thijs, 2021). This frustration is rooted in the power imbalances created by renewable energy technology and transition policies which makes renewable energy not accessible for everyone. While energy transitions are often portrayed as positive, they can foster new injustices or worsen existing inequalities as they ignore the realities and interest of vulnerable people (James et al., 2022; Sovacool, Martiskainen, et al., 2019). Individuals remain major stakeholders in the accomplishment of a successful energy transition. Through the complex relationship between individuals' preferred energy mix and their social characteristics a more nuanced image could emerge.

Methodology

The statistical analysis is conducted using secondary data from the European Social Survey (ESS8) – public attitudes to climate change (2016). While the survey is conducted in 38 European countries, our analysis is limited to the data about Belgium (N = 1766). In this paper we built on the idea of heterogeneity among energy preferences to define distinct groups. Heterogeneity will be explored by applying a three-step latent class analysis (LCA). LCA is a statistical method that identifies unobserved groups which contain individuals who share a particular criteria i.e., expressed energy preferences (Rhead et al., 2018). To identify these distinct groups, we included seven 5-point Likert scale items regarding energy preferences on coal, natural gas, nuclear energy, solar power, wind power, biomass and hydroelectricity. More specifically, respondents were asked to answer the following question; 'how much of the electricity in Belgium should be generated from …?'. The respondents had to reply on a scale from 1 (A very large amount) to 5 (none at all). The three-step LCA method firstly defines the optimal class model on the basis of a set of indicators. Secondly, it assigns subjects to latent classes based on their posterior class membership probabilities (Asparouhov & Muthén, 2014; Vermunt, 2010). Lastly, a multinominal logistic regression is estimated by adding covariates. The added covariates are used to explain group differences and contain variables such as gender, level of climate change concern, financial stability, educational level etc.

Results

The optimal class model was defined based on the comparison of several fit indices (BIC,AIC, adj. BIC) of models with 1 to 6 classes. The model with four classes appeared to be the optimal solution both statistically and theoretically. The Belgian population is subdivided into four clearly distinct groups as regards of preferred energy mixes, namely: the business as usual energy mix, the green energy mix, the incremental change energy mix and the vulnerable energy mix. Figure 1 (see appendix) represents the item response probability of energy preferences for the identified classes. The results support the findings in earlier studies about the heterogeneity of energy preferences. In general, the most preferred energy sources for all classes are renewables, especially solar and wind power. However, looking more in detail, differences over the four classes can be observed.

Class 1: The business as usual energy mix (12%)

The business as usual energy mix appears to represent the smallest group. Compared to all other groups, individuals in this class have the lowest preferences for renewable energy sources such as wind energy, solar power, biomass and hydroelectric. At the same time, they attribute relatively large preferences to natural gas and nuclear energy. Looking at the characteristics, which are presented below in table 1, we can observe that this group mainly consists of elderly people who are not really concerned about climate change (est. = -0,767 $p \leq 0.001$).

Class 2: The green energy mix (20%)

This group consists of individuals who prefer a renewable energy mix as they show high preferences for renewable energy sources together with low preferences for coal, natural gas and nuclear energy. The results presented in table 1 reveal a significant and negative effect of financial difficulties (est. = -0,919, $p \leq 0.010$) on the membership of the green energy mix compared the reference group (class 4). This suggest that individuals in this group do not experience any financial difficulties. Furthermore, the individuals in this group are highly educated as there exists a positive and significant impact of education (est. = 1,265 $p \leq 0.01$) on class membership.

Class 3: The incremental change energy mix (32%)

In contrast to the other classes, individuals belonging to the incremental change group show the highest preferences for coal, natural gas and nuclear energy. However, compared to the business as usual group, they also have relative high preferences for renewable energy. Individuals in this group propose a hybrid energy mix that relies both on non-renewable and renewable energy. Compared to the reference group, individuals in this class are less concerned about climate change (est. = -0,325 $p \leq 0.001$). While individuals in this group are not highly educated, they do have a lot of economic resources. Moreover, the results indicate a positive and significant effect of political orientation on the membership of this group (est. = 0,108 $p \leq 0.010$), compared to the fourth group (vulnerable energy mix). This suggest that individuals in this class identify with a right-wing political ideology.

Class 4: The vulnerable energy mix (36%)

The largest group can be situated in what we call 'the vulnerable energy mix' . Individuals in this class have very high preferences for renewable energy. However, in contrast to the green energy mix, this class does not fully reject fossil fuels and nuclear energy. Just as the incremental change class, this class proposes a hybrid energy mix. However, in contrast to the incremental change energy mix, this group is characterized by individuals who are very concerned about climate change. Due to their low economic capital they are not able to completely switch to renewables. Therefore they do not fully reject the use of fossil fuels and nuclear energy. Hence, the main difference between the incremental change energy mix and the vulnerable energy mix has been found in the composition of climate change concerns, educational attainment and financial stability. While individuals in this group are the most concerned about climate change, they have a lower socio-economic status which makes them more vulnerable.

	Class 1: Business as usual energy mix (12%)		Class 2: Green Energy mix (20%)		Class 3: Incremental change energy mix (32%)	
	Est.	sig	Est.	sig	Est.	sig
Gender (female)	0,006	(0,977)	**-0,396**	**(0,029)**	**0,452**	**(0,004)**
Age	**0,027**	**(0,000)**	**0,024**	**(0,000)**	-0,001	(0,811)
Education						
Low	Ref.		Ref.		Ref.	
Middle	0,295	(0,406)	**1,025**	**(0,024)**	0,048	(0,858)
High	0,345	(0,372)	**1,265**	**(0,006)**	-0,512	(0,077)
Fin.Diff.	-0,054	(0,834)	**-0,919**	**(0,004)**	-0,178	(0,375)
CC. Conc.	**-0,767**	**(0,000)**	-0,169	(0,094)	**-0,325**	**(0,000)**
Lrscale	0,074	(0,119)	0,053	(0,241)	**0,108**	**(0,007)**

Table 1 : *Results multinominal logistic Regression (ref class 4: vulnerable energy mix)*

Discussion and conclusions

Exploring energy preferences of diverse social groups provides useful insights into the perceptions of a carbon free energy transition and the often overlooked justice dimensions behind this transition. In the current study, we investigate the role of social characteristics in individuals' preferred energy mixes. By exploring the preferred energy mixes of different audiences a more complex and nuanced image emerged. Firstly, the results confirm that energy preferences are divers among the Belgian population. While there is a general high acceptance for renewable energy, looking more in depth, several inconsistencies and trade-off's emerge. More concretely, the results suggest that vulnerable, low-income groups are confronted with a continuous conflict between environmental protection and financial stability. Although they can be deeply concerned about climate change and want to participate in an energy transition towards a low carbon society, they face several structural barriers that prevent them from denouncing unsustainable energy sources such as fossil fuels.

Secondly, because income and education play a role, we suspect that preferences around the energy mix are in part influenced by structural and social inequality. New, green energy technologies can be disempowering or alienating for these specific groups (e.g. financially insecure, low-educated, older individuals) (Sovacool, Kester, et al., 2019). By exploring which groups have a vulnerability in the establishment of a green energy transition, we made recognition injustices visible. The occurrence of trade-offs highlights the misrecognition of individuals who are financially insecure. Next to the occurrences of trade-offs, we found that preferences for a renewable energy mix may be linked to high-class practices. This is illustrated by the 'green energy mix' class which consists of high-educated, financially secure men.

Thirdly, these results further support the importance of a conflict-based approach within energy research and policy. In accordance to Marx's distinction between the haves (i.e. the bourgeoisie) and the have nots (i.e. the proletariat), we argue that there also exist multiple groups who have varying access to energy resources (e.g. vulnerable energy mix versus green energy mix). In the context of our study, access relates to varying aspects, such as access to information, participation, recognition, etc. Applying a conflict-based approach in energy research reveals that energy policies are often (unconsciously) designed in accordance with the more powerful, wealthy social class which increases inequalities.

In conclusion, our study contributed to a more nuanced understanding of the social dimension of the energy transition by examining the varying preferences for energy mixes in different social strata. While most of the Belgian respondents are positive about a sustainable energy transition, many respondents face structural barriers that prevent them from denouncing fossil fuels and nuclear energy. This highlights the importance of focusing on energy mixes from a conflict-based stance as it is an excellent tool to uncover trade-offs within the energy system. Moreover, it provides a fuller understanding of the interconnectedness of energy transitions and social inequality and could inspire policy makers to design socially just and inclusive energy policies

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Appendix: Figure 1: How much electricity should be generated from … ?