Guiding Policy Communication: Tailoring Energy Education to Diverse Public Sentiments

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Abstract

Existing research has manifested the significant role of public sentiments in the effectiveness of energy policies. However, there is a discernible gap in how these sentiments are addressed in policy design. Traditional policy approaches often rely on a generalized, one-size-fits-all methodology, neglecting the varied impacts on different demographics and communities. This results in a limited and often polarized representation of public sentiments, particularly in online social networks. Our research seeks to fill this gap by focusing on the design of education programs, as part of energy policies, through sentiment based tailored energy education, recognizing the need for a more nuanced and inclusive approach that resonates with diverse audience groups.

Therefore, this study examines the integration of public sentiments on the energy and climate crises into energy education, utilizing data from a weekly panel study on energy and climate sentiments, with a focus on Germany. Our methodology merges quantitative panel data analysis with qualitative insights from an interactive workshop with policy experts, aiming to inform energy education. For further research, we sought insights from the interactive workshop to gather requirements for an educational dashboard aimed at policymakers. The goal of the overarching study is to improve understanding of diverse group sentiments on energy transition, ultimately enhancing policy relevance and effectiveness. Preliminary findings from these sessions provide essential feedback on policymakers' needs for data representation, informing the development of a real-time public sentiment dashboard.

Keywords: sentiment analysis; policy communication; energy crisis; tailored education.

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1. Introduction

Many studies have underscored the influence of public attitudes and beliefs about climate change risks on their engagement and support for climate change adaptation and mitigation strategies (Liu et al., 2022; Wang et al., 2023). A pivotal strategy is the transition to renewable energy, which necessitates significant techno-economic transformations, potentially straining public support due to factors like increased electricity costs and additional land use (Huh et al., 2015). Therefore, the success of political initiatives for a socially equitable energy transition is deeply intertwined with public advocacy (Li et al., 2019).

In regards to public advocacy, a critical gap exists in the current approach to policy design: policies often adopt a one-size-fits-all methodology, failing to account for the diverse impacts these policies have on different localities and individuals (Grossmann, 2019). This leads to a spectrum of public sentiments regarding changes in renewable energy related policies, hereafter refered to as energy policies, which are often overlooked as many studies tend to view public sentiments as a homogeneous entity (Liu et al., 2022). Additionally, public sentiments towards the transition to renewable energy is often depicted through social network sentiments (Li et al., 2019). The amplification of polarization on these critical issues, especially evident in the realms of online social networks (OSN), raises concerns about the accuracy of these networks as a representation of the actual sentiments within the population.

Efforts in tailoring energy policies to specific income groups already present a willingness of policymakers to break out of the one-size-fits-all methodology. However, low take-up rates of energy assistance programs (Chlonde et al., 2022) show that targeted policies do not necessarily translate into policy success. Moreover, for energy policy success, especially on municipal level, policies in form of incentives or regulations need to be accompanied by education programms (Azevedo et al., 2013). Understanding the varied sentiments across different demographic and socio-economic groups could therefore help to achieve targeted energy education and, ultimately, reach robust public support for energy policies (García-García, 2023). Thus, our research question evolves: *How can we harness diverse public sentiments to enhance energy policy in its energy education, ensuring effective energy policies' conveyance for various audiences?*

As a pilot study, our paper explores how public sentiments regarding the energy and climate crises can be integrated into the communication of energy policies. We utilize data from a bi-weekly panel study focused on energy and climate sentiments in Germany. Additionally, we engage with policy experts in an interactive workshop to gather requirements for the future development of a dashboard tailored for policymakers. This tool aims to enhance policymakers' understanding of diverse public sentiments related to the energy transition, thereby helping to increase the relevance and effectiveness of policies through energy

education. The initial findings from these workshops offer insights into policymakers' data representation needs, guiding the development of a dashboard that provides bi-weekly insights into public sentiments on energy and climate crises.

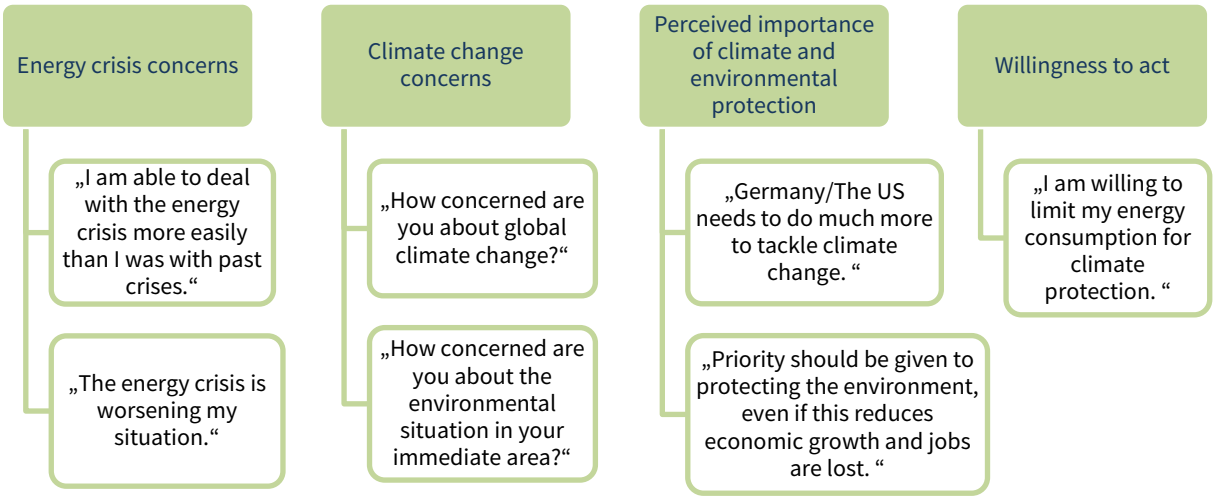
2. Methods

This work uses a structured process to taylor energy education to heterogenous groups, based on their sentiments towards energy and climate crises, which consists of four steps: (1) data collection, (2) identification of heterogenous groups within the data, (3) analysis of groups to determine suitable topics of energy education as well as communication channels, (4) evaluation through an interactive workshop with policy experts.

2.1 Data Collection

The database for our analysis is a panel study on social sentiments. The aim of this study is to investigate the extent to which events, actions, and communication measures influence social sentiment in the wake of a current crisis (e.g., the energy crisis, the climate crisis). The project intends to use the experience sampling method from psychology (Hektner et al., 2007) with a bi-weekly representative panel to continuously inquire about sentiment – simply and accessibly through a web application that poses the same questionnaire (starting November 2022) to study participants. Conclusions should be drawn from a comparison of the answers with events in time, based on participant's changing social sentiment responses. Questions on demographics as well as trust in institutions, media consumption, and political orientation allow for identifying differences in various social groups.

Fig. 1 – Energy- and climate-related questions in the panel study



Source: Own elaboration

Within this study, 4.500 participants – 1.500 in Germany and 3.000 in the USA – are subjected to the bi-weekly questionnaire. Previous work suggests that sentiments on climate change and advocacy for climate change mitigation strategies, such as energy-related policy, are correlated (Liu et al., 2022) as well as pre-studies on this dataset suggest. Therefore, we focus our analysis on climate related questions (i.e., climate change concerns, perceived importance of climate and environmental protection) and energy related questions (i.e., energy crisis concerns, willingness to act), as shown in *Figure 1*, answered on a Likert Scale.

2.2 Identification of Heterogenous Groups

To participants' answers on the questions described in *Figure 1*, we carry out a k-means cluster analysis for one week of data. We focus our analysis on one week's data as a snapshot of the data collection at the time. To determine the optimal number of clusters, we use the number of clusters corresponding to the first non-linear inflection point when plotting the within-cluster sums-of-squares in order of size, also employed in (Liu et al., 2022). Further, we employ the silhouette method to validate consistency within the clusters (Rousseeuw, 1987). As a result, we obtain four clusters within the German panel data. This clustering allows us to categorize respondents into heterogenous groups based on similar sentiments, providing a nuanced understanding of diverse perspectives within the German and U.S. populations.

2.3 Group Analysis

The diverse perspectives of each group inform about the needs in energy education, giving us indications on the topics of education. We further explore the characteristics of each cluster by analyzing participants' media consumption habits. Thereby, we determine suitable communication strategies.

2.4 Evaluation through an Interactive Workshop with Policy Experts

To refine our insights, a workshop is conducted with a group of policy experts of a responsible Federal Ministry in Germany, where we present our analysis results. The workshop is structured in (a) a pre-workshop Q&A on participants' current knowledge and topics of interest, (b) cluster analysis presentation, (c) interactive group discussions to brainstorm further questions of interest, (d) reflection session on how participants plan to apply these insights.

3. Preliminary Results

3.1 Dataset Description

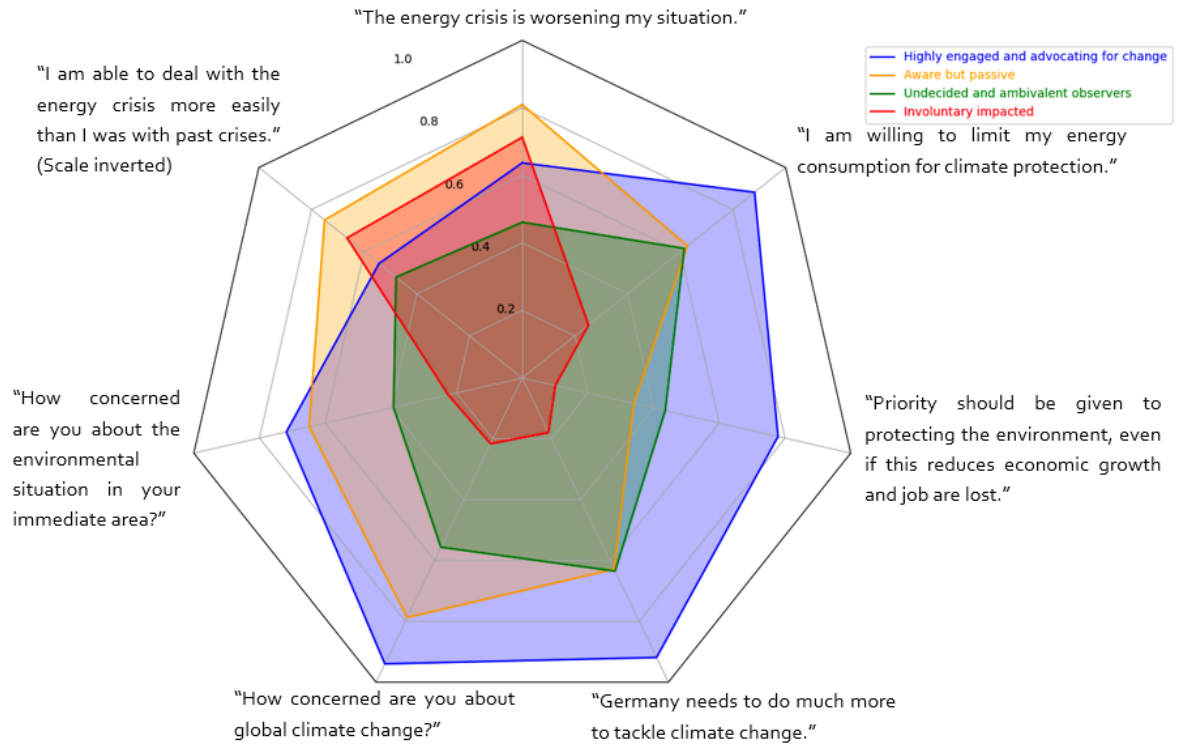
Our analysis focuses on the German population, as for the scope of this paper, only German policy experts were asked to participate at our interactive workshop. The German clustering dataset of one week's panel data included 1590 participants, with 53% males and 47%

females and an average age of 49 years. The mean household income for the sample fell within the range of €2200-€2600.

3.2 Heterogenous Group Description

From the k-means clustering approach described in *Section 2.2*, we could identify four clusters with a size ranging from 14-33 of the sample. In *Figure 2*, the clusters are visually represented through their averaged answers to the questions presented in *Figure 1*.

Fig. 2 – Average results for all energy and climate questions per cluster (0 = Completely disagree/Not concerned at all - 1 = Completely agree/Very concerned)



Source: Own elaboration

In *Table 1*, we describe the profiles of each cluster according to the clustering variables and their demographic characteristics in more detail, aligning with the profiling approach by Hall et al. (2021).

Table 1 – Summary profiles of each cluster based on answers from the panel questionnaire

	Summary Profile
Highly engaged and advocating for change (33%)	• These individuals are deeply concerned about both global and local climate change. They believe the government should intensify efforts in climate protection, prioritize environmental conservation over economic growth and job security, and are willing to reduce energy consumption to address climate change. • Compared to other clusters, they express the highest concern for climate change and strongly support climate protection measures. However, opinions within this cluster vary regarding the impact of the energy crisis on their situation. • They have the tendency to be older and to be childless. They have a high level of education, are employed in middle or high-level jobs, and are in education or retired. They live in one or two-person households and have an average household income within the cluster data.
Undecided and ambivalent observers (29%)	• People in this cluster are mostly undecided when it comes to concerns about climate change, the energy crisis or their willingness to support public or individual climate protection measures. • They are the oldest with an average of 61 years and have the tendency to be male, childless and living in a two-person household. They have the highest number of retired people and the highest household income.
Aware but passive (24%)	• Concerned about local and global climate change, this group is severely impacted by the energy crisis, finding it more challenging than other crises. However, they do not prioritize environmental protection over jobs and are undecided as to whether the state must do more to combat climate change or whether they are willing to reduce their energy use to do so. • Tendency to be female, middle-aged, intermediate school education, low household income, married or divorced with one or two children.
Involuntary impacted (14%)	• People in this cluster are not concerned about climate change but experience a significant deterioration in their situation due to the energy crisis, struggling to cope with its challenges. They do not believe that Germany needs to intensify efforts to combat climate change and are unwilling to reduce their energy consumption for climate protection. They reject the idea of prioritizing environmental protection over jobs. • They have the tendency to be male, middle-aged, married and to have children. They tend to work in full-time jobs in offices on the middle-management level or in technical or craft professions with an average household income within the cluster data.

Source: Own elaboration

3.3 Group Analysis Results

We focus on the "undecided and ambivalent observers", as being the group least concerned about the energy crisis, shown in *Figure 2*. By analyzing their answers to energy-related questions, we gain valuable insights shaping a possible educational strategy. Further, we

observe the possible accessibility of people in this cluster, defined through their trust in institutions and media consumption habits. The aim is to effectively engage them on energy-related issues, as they are a group with moderate willingness to act, as shown in *Figure 2*. Therefore, they could benefit from educational content highlighting the crucial role of households in the expansion of renewable energies.

Participants indicated their trust in different media types using a 5-point Likert scale (1 = A lot of trust to 5 = No trust at all) and the frequency of their media use. Notably, the "undecided and ambivalent observers" express high trust in public television, press, newspapers and classic news sites on the internet (all averages around 2.5), while having least trust in social media (4.0 in average), aligning with their media usage behaviour. They get news from public media institutions 3-4 times a week and from alternative source as social media only 1-2 times a month. Overall, the "undecided and ambivalent observers" display significantly higher media usage levels compared to other clusters.

3.4 Interactive Workshop Results

The interactive workshop took place with eight participants in November 2023. One general response, in which all participants agreed, was the complementing methodology of clustering surveys by relevant questions, in addition to the common clustering approach by demographics. This way assumptions made by demographic clustering don't result in common biases. Moreover, clustering into groups of common sentiments towards the energy crisis enables well-founded and targeted education strategies towards these energy-related conceptions per heterogenous group.

Further, a significant insight was the necessity of long-term observations in our data visualisation. Tracking changes in public opinion over time is crucial for assessing the impact of policy interventions (e.g., with energy education) and adapting to evolving societal engagement with renewable energy issues. However, the workshop emphasized the importance of local discourse, particularly through an East-West and urban-rural setting comparative analysis for the German sample, to understand regional differences in attitudes and tailor policies, especially in educational programms accordingly. Moreover, participants stated the need for easily integrating external data points to enrich sentiment data with further data such as OSN data like Telegram.

4. Outlook

We contributed to a first understanding of different sentiments, especially concerning the energy crisis. We identified a key demographic, the "undecided and ambivalent observers," who are notably least concerned of the energy crisis and, therefore, do not see high needs for change. This group's current observer role raises potential for engagement through energy

education. Additionally, our analysis revealed a general low trust in media across populations, suggesting an urgent need for innovative communication strategies in energy policy dissemination. Further, the feedback from the interactive workshop underscores the necessity of a tool in aiding policymakers to make informed decisions, based on public sentiment, and educate for policy conveyance.

Our research proposes a method to harness diverse public sentiments towards energy-related issues for more tailored policies in the form of energy education. Our approach emphasizes the need for policymakers to be well-versed in societal sentiments, ensuring that policies are not only well-informed but also inclusive and reflective of public sentiment.

However, the reliance on feedback from a single federal ministry may not fully capture the diverse perspectives necessary for a comprehensive need in public sentiment data for policy design. Additionally, our analysis currently lacks a long-term perspective on sentiment changes, particularly in response to specific energy legislation. This limitation points to the need for a more longitudinal approach in future research.

Looking ahead, this would enable a more detailed analysis of how public opinion evolves over time and in response to policy changes. Moreover, the methodology and communication strategies developed for the German context could be adapted and applied to data from the United States, offering a comparative perspective and potentially revealing unique insights into different societal responses to energy policies. Such cross-cultural analysis could enrich our understanding of global public sentiment towards energy issues.

In conclusion, our study lays the groundwork for more targeted and effective energy education, tailored to the nuanced needs and perspectives of diverse societal groups. By continuing to develop tools and strategies that capture and respond to these sentiments, we can contribute to a more sustainable and inclusive approach to energy policy and education.

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Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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