Understanding Citizens' Attitudes Towards Energy and Climate Issues. A Comprehensive Survey Analysis

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Abstract

Understanding public attitudes becomes crucial in the current context, which is defined by climate change and a critical need for sustainable solutions for energy sources. A questionnaire by the Pew Research Center, conducted through the American Trends Panel (ATP), explores the public's opinions on various emerging energy technologies, preferred energy sources, knowledge of the nation's energy dependence and attitudes toward environmental policies and climate change. The findings offer an insightful perspective on the interests and people's concerns and may influence future innovations and policies in the energy sector.

Key words: climate change, energy alternatives, survey data analytics, attitude, awareness
J.E.L. classification: P18, C83, Q54

1. Introduction

People's attitudes towards energy and climate issues are shaped by a variety of factors, including personal values, economic considerations, political ideologies and cultural contexts. Many individuals are increasingly concerned about climate change and its impacts, such as extreme weather events, rising sea levels and biodiversity loss (Liu, Shryane and Elliot, 2022). This concern often translates into support for Renewable Energy Sources (RES) or nuclear energy (Muellner et al., 2021) and policies aimed at reducing carbon emissions (Karaeva et al., 2022). Economic considerations play a significant role in shaping attitudes. Some people prioritize economic growth and energy affordability over environmental concerns, which can lead to support for continuing the use of fossil fuels, especially in regions where these industries are major employers. On the other hand, energy poverty is another trigger that may lead to a pro RES attitude.

In many countries, there is a political divide on the issue of climate change and energy policy. Generally, left-leaning individuals are more likely to support aggressive climate action and RES development, while right-leaning individuals might be skeptical of the impacts of climate change or prioritize economic impacts of energy policy changes. Moreover, higher levels of awareness and education about climate science and energy issues tend to correlate with a greater concern for the impacts of climate change and a stronger support for sustainable energy policies (Braunreiter, Stauffacher and Blumer, 2020).

Younger generations, such as Millennials and Gen Z, tend to be more concerned about climate change and more supportive of RES than older generations. This is often attributed to the long-term nature of climate impacts and the fact that younger people will live with the consequences of current policies. Attitudes can also vary significantly by region. For instance, individuals in countries that have experienced severe impacts of climate change might be more supportive of climate action. Conversely, in countries where economic development is still heavily reliant on

fossil fuels, there might be less support for policies that would restrict their use. Personal experiences with climate-related phenomena (like hurricanes, wildfires or droughts) can also dramatically shift people's attitudes and perceptions about the urgency of climate action. Understanding these diverse attitudes is crucial to promote energy transition and climate mitigation efforts that are socially acceptable and politically feasible (Kácha, Vintr and Brick, 2022).

2. Literature review

(Iyke, 2024) investigated the effects of climate change on energy security risk and assesses how investments in clean energy can mitigate these effects. Using a newly developed dataset on historical energy security risk, alongside datasets on climate change and clean energy investments, the researchers found that climate change increases energy security risks. However, investments in clean energy have been shown to lessen these risks. The effectiveness of clean energy investments in mitigating climate change impacts on energy security were more noticeable in countries with lower population growth rates, substantial investments in robust energy infrastructures and minimal corruption. To maximize the benefits of clean energy investments in counteracting climate change effects, it is essential to develop strong energy infrastructures, control population growth, adhere to high environmental standards, and curb corruption, among other strategies.

Global temperature changes are expected to alter energy consumption and electricity production capacities (Ucal and Xydis, 2020). This study explored the connection between climate change and energy resource utilization, noting that temperature variations and the severity and frequency of extreme weather events would influence energy production and consumption. Positioned at the core of climate action, the green economy and green growth are integral for sustainable development. This paper examined the complex interactions between climate change, energy resources and sustainable development, emphasizing a green economic approach through a techno-economic analysis. This analysis was applied in a case study that considers various factors, including the needs of hydroponic units, product prices, and the energy demands of a wind farm, demonstrating that smaller investments, such as those of 2 MW, were often more effective than larger ones, like 18 MW projects. However, the optimal investment size depended on the local societal impacts.

Statistical limitations often led researchers to rely on outdated databases for analyzing the impacts of energy and climate policies into the future, up to 2050 or 2100 (Nong and Simshauser, 2020). This research explored how baselines are projected forward and the significant effect this process can have on evaluating the effectiveness of energy or climate policies. They employed the GTAP-E-Power, a detailed global electricity model, to test these hypotheses. They further assessed the impact of a global carbon tax ($50/ton of CO2 equivalent) using three different baseline scenarios, which vary in their macroeconomic projections and sector-specific details. Their findings indicated that the impact on different sectors and the overall economic effects vary significantly across countries depending on the baseline used. For instance, in scenarios with a strong focus on renewable energy and technological advancements, the costs associated with climate change mitigation policies were substantially lower.

3. Research methodology

The Pew Research Center's American Trends Panel (ATP), operated by Ipsos, is a nationwide platform that includes a representative panel of randomly selected adults in the United States. Panelists participate in self-administered web surveys, available in both English and Spanish, providing vital data for a variety of studies. The data used in this report was collected from a panel wave conducted between May 2 and May 8, 2022. Since its inception in 2014, ATP has evolved its recruitment strategy, shifting from address-based methods to random-digit-dial countrywide polls in 2018. This modification has resulted in a more representative and diverse panel. All study respondents received post-payment incentives, with amounts varying based on response accessibility, ensuring equitable and representative participation.

The survey's field session was scheduled from May 2 to May 8, 2022. Postal notices were issued to all panelists with known addresses, and invitations were sent out in two stages: a soft launch and a full launch. Reminders were sent as needed to ensure optimal response rates. Strict checks were conducted to ensure data quality, and responses indicative of satisficing behavior-carelessly answering questions-were eliminated. Consequently, three respondents were removed from the final data set. ATP statistics are weighted using a multi-step process to reflect the demographic distribution of the adult population in the United States. Initially, base weights are calculated to account for the varying probability of selection and non-response. Subsequently, the weights are recalibrated to match Census Bureau demographic criteria, ensuring that the sample is representative of the nation as a whole. The survey examined various indicators to determine how Americans feel about energy and climate change. These indicators include opinions on the diversification of energy sources, awareness of the United States' energy needs and dependencies, and perspectives on environmental regulations and global warming.

To aid in analysis, questions were coded according to the following scheme:

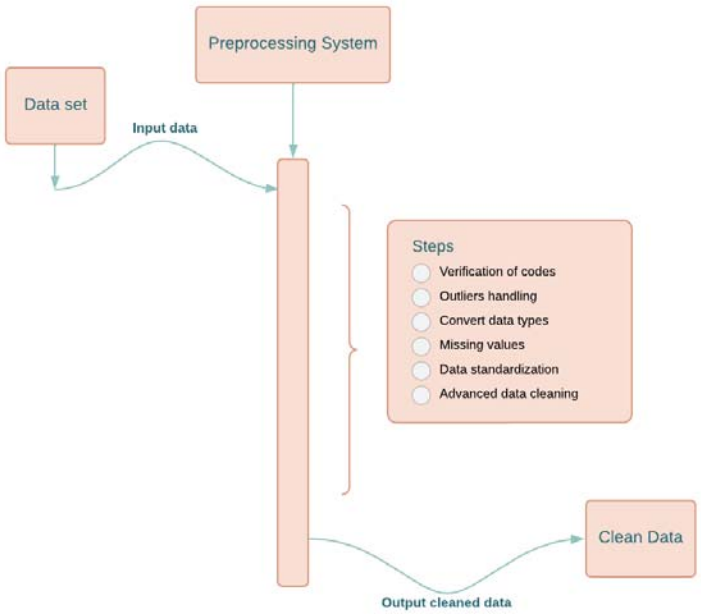
Table no. 1. Overview of Data Set Representing Citizens' Attitudes Towards Energy Sources and Environmental Policies, as Explored in a Comprehensive Survey Analysis

Section	Subsection	Details	Response Coding
Choices with Respect to Energy Sources	Oil and Gas drilling offshore	Favor, Oppose	1,2
	Expansion of nuclear power plants	Favor, Oppose	1,2
	Coal mining expansion	Favor, Oppose	1,2
	Expansion of solar parks	Favor, Oppose	1,2
	Hydraulic fracturing for oil and gas	Favor, Oppose	1,2
	Expansion of wind parks	Favor, Oppose	1,2
	Expansion of wind parks	Favor, Oppose	1,2
Understanding of Energy and Dependencies	Energy Needs of the U.S.	Produce most energy domestically, Import most energy, Balances domestic production and imports, Not sure	1,2,3,4
	Dependency on Energy Sources	Fossil fuel energy: oil, coal, and natural gas, Renewable energy sources: wind and solar, Nuclear power, Not sure	1,2,3,4
Priorities for America's Energy Supply	Priorities	Develop alternative energy: wind, solar and hydrogen, Expand fossil fuel exploration and production	1,2
Considerations for Environmental Policies	Natural Gas Exports and Climate Impact	Major consideration, Minor consideration, Not a consideration	1,2,3
	Federal Government Actions on Climate Change	Doing: Too much, Too little, About the right amount	1,2,3
Opinions on Environmental Policies	Policies and Responses (Planting trees, taxing emissions, carbon capture, renewable energy)	Favor, Oppose	1,2
Demographic Analysis	Age Categories	18-29, 30-49, 50-64, 65+	1,2,3,4
	Gender	A man, A woman, In some other way	1,2,3
	Education Level	College grad+, Some college, HS or less	1,2,3
	Marital Status	Married, Partner, Divorced, Separated, Widowed, Never married	1 to 6
	Family Income	Income brackets from < $30,000 to $100,000 or more	1 to 9

Source: Adapted from "2022 PEW Research Center's American Trends Panel Wave 108, May 2022".

Special attention was given to the data cleaning procedure in this study, as it was recognized to be crucial for the precision and quality of the analyses that followed. Preparing the data for in-depth analysis required several critical steps, as the data set had already been pre-coded.

Figure no. 1. Data Preprocessing System, detailing the steps from raw data input to clean data output



Source: Diagram created by authors using Lucidchart

We began by verifying that the codes assigned to each variable were applied accurately according to the original definitions. For instance, we checked the consistency and accuracy of the codes for responses such as "Favor (1)" and "Oppose (2)."

Identifying and **handling outliers** was also crucial; some codes, like "99," which denote a refusal to respond, required further consideration. We assessed each case in light of the specific question and its potential impact on the study, deciding to omit or impute data based on the needs of the methodology.

Converting data types was another essential step. To prevent misunderstandings as continuous variables, we ensured that all numerically coded values were treated correctly as factors or nominal variables.

We also addressed the issue of **missing values**, evaluating how they affected the study and applying statistical imputation techniques such as mean or median imputation, or removing them entirely based on their prevalence and significance.

In terms of **data standardization**, we performed normalization as needed to facilitate comparisons and further analyses for variables with answers that were on a broad scale, such as income or other continuous measurements.

Advanced data cleaning techniques were also employed. We discovered that the inclusion of space characters could obscure missing values, interfering with accurate recognition. To address this issue and ensure that all missing values were consistently identified and handled in subsequent analyses, we replaced all sequences of spaces with **pd.NA** using the replace function in the **Pandas** library.

Moreover, we assessed each variable's applicability to the overall study, removing any redundant or **unnecessary variables**-such as respondents' unique identifiers or other factors that do not add any information to the comparative analysis or exhibit appreciable variance. By removing these factors from the data collection, processing, and analysis were streamlined, focusing on the essential information.

These advanced cleaning techniques enhanced the data set's quality and ensured that any further analysis would be conducted on a clear, well-structured and relevant set aligned with the study's goals. This rigorous approach minimizes the risks of interpretation errors and maximizes the accuracy and relevance of analytical findings.

4. Findings

A comprehensive understanding of public opinion about different energy sources and climate change measures is necessary given the current environmental and energy scenario. Through this investigation, we aim to determine the current patterns in public support for various environmental policies and preferences for conventional energy technology over renewable sources.

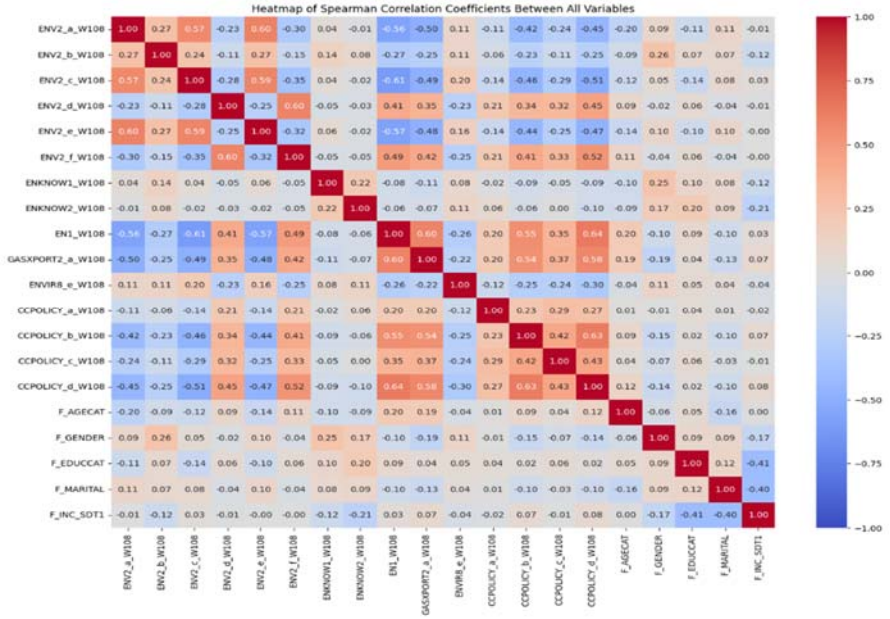
To assess the correlations between variables such as gender, opinions on energy policy, family income, and awareness of the U.S.'s reliance on specific energy sources, we applied Spearman and Kendall correlation coefficients. These coefficients are appropriate for data that may contain extreme values, which is why we included them.

To ensure consistency in analysis, we cleaned up errors in the data, filled in missing data, and performed normalization. For example, we discovered a moderate association (coefficient of 0.26) between views on the growth of nuclear power plants and gender, suggesting that men and women may have distinctly different perspectives on nuclear energy, possibly due to differing perceptions of risk.

Additionally, we found a weak negative association (coefficient of -0.21) between family income and knowledge of energy sources, indicating that individuals from lower-income households tend to know less about energy sources. This disparity could result from varying access to education or information sources.

These results highlight the importance of understanding how demographic factors, such as income and gender, influence perceptions and understanding of energy-related policy. This information may be crucial for crafting adequate policies that are effective and for creating awareness campaigns that reach diverse target audiences.

Figure no. 2 Heatmap of Spearman Correlation Coefficients Between All Variables



Source: Chart created using Python

This section of the research aims to provide perspective on how various American demographic groups perceive and evaluate energy technologies and environmental regulations. We have organized the results to highlight both specific differences between respondent categories and general preferences by utilizing advanced statistical methods.

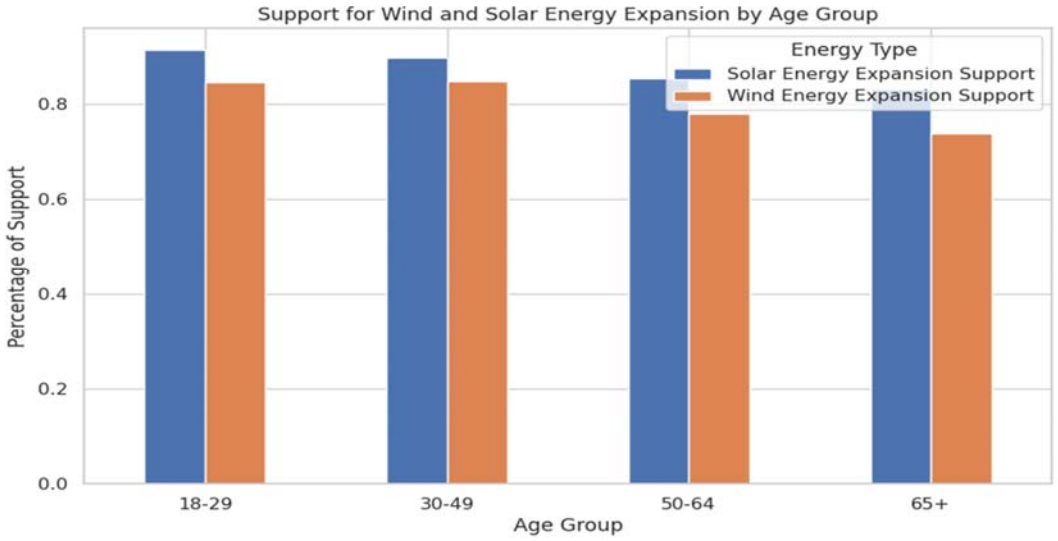
As part of the comparative analysis, we analyzed opinions regarding the development of various energy technologies-like coal mining, nuclear power plants, oil and gas drilling and the construction of solar and wind parks. We also examined opinions on other environmental policies, such as taxes on carbon emissions, encouragement of carbon capture technologies and regulations regarding the consumption of renewable energy sources. Furthermore, we investigated the respondents' awareness of the energy sources that the U.S. imports and produces, as well as their reliance on different types of energy.

Demographic factors including age, gender, marital status and education levels are used to present the results, creating an understanding of the dynamics of public perceptions. With the application of this methodical approach, we are able to recognize not only the dominant patterns but also the nuances that may impact how public policies related to energy and environmental conservation are formulated.

Analysis of age-group preferences for the expansion of wind and solar energy

Current research investigates the perceptions of various age groups regarding the growth of solar and wind energy. Our goal is to understand the level of support and acceptability for these renewable energy sources, emphasizing differences in preferences that may be influenced by specific demographic factors. This segment of the analysis is critical for identifying potential and obstacles in the promotion of renewable energy among different age groups.

Figure no. 3. Support for Wind and Solar Energy Expansion by Age Group



Source: Chart created using Python

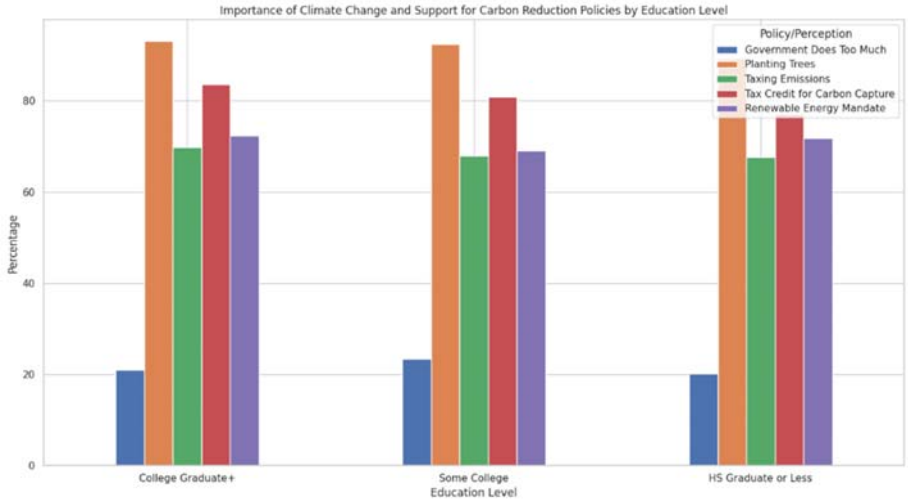
The demographic most in favor of expanding solar energy (91.37%) and wind energy (84.53%) is young people (ages 18–29). Support for both renewable energy sources appears to decline modestly with age, with the lowest proportion of support (83.03% for solar and 73.79% for wind) among those aged 65 and older.

Analysis of the importance of climate change and support for carbon emission reduction policies by education level

This part focuses on evaluating the relationship between an individual's education level and their views of climate change and support for different carbon emission-reduction initiatives. The research intends to demonstrate the relationship between civic participation in environmental issues and educational attainment by comparing responses across different educational levels. This will highlight the need for tailored communication strategies that will enhance the effectiveness of public policies.

All educational levels tend to support the requirement for renewable energy and the planting of trees for carbon absorption, especially among college graduates Support for taxing emissions and tax incentives for carbon capture generally increases with education level. Compared to those with less formal education, individuals with university degrees seem to be more inclined to support proactive measures against climate change across all stated policies.

Figure no. 4. Importance of Climate Change and Support for Carbon Reduction Policies by Education Level

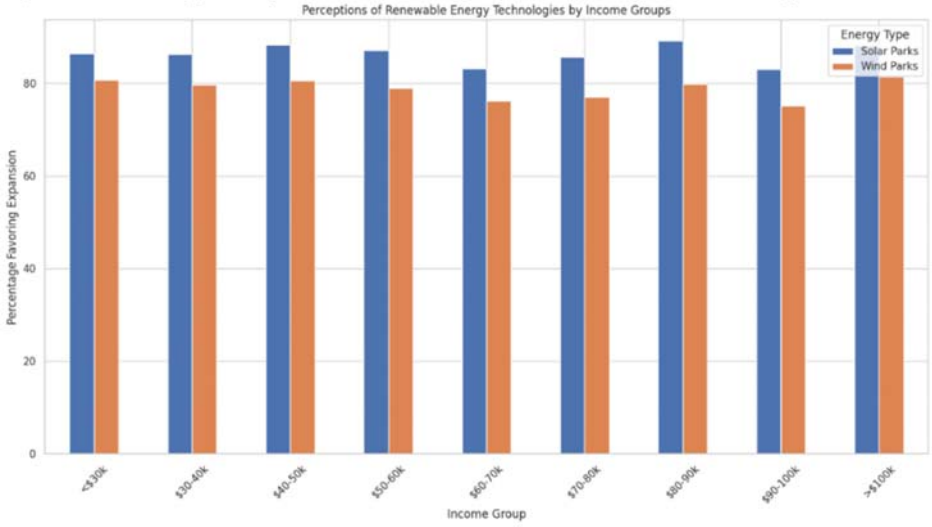


Source: Chart created using Python

Analysis of the perception of renewable energy technologies by income groups

Moreover, the research examines how different income levels influence perceptions of renewable energy technologies. Our research explores the economic factors that could impact the adoption and support of renewable technology. Specifically, we aim to identify similarities and differences in perspectives that may inform energy policy decisions and sustainability initiatives across various socioeconomic groups.

Figure no. 5. Perceptions of Renewable Energy Technologies by Income Groups



Source: Chart created using Python

All income levels consistently show strong support for wind and solar energy, demonstrating the general public's inclination towards renewable energy sources. Higher income groups seem to exhibit a slightly greater support for these technologies, particularly those earning $90,000 or more. This suggests that individuals with higher incomes are more exposed to, or value, sustainability initiatives more.

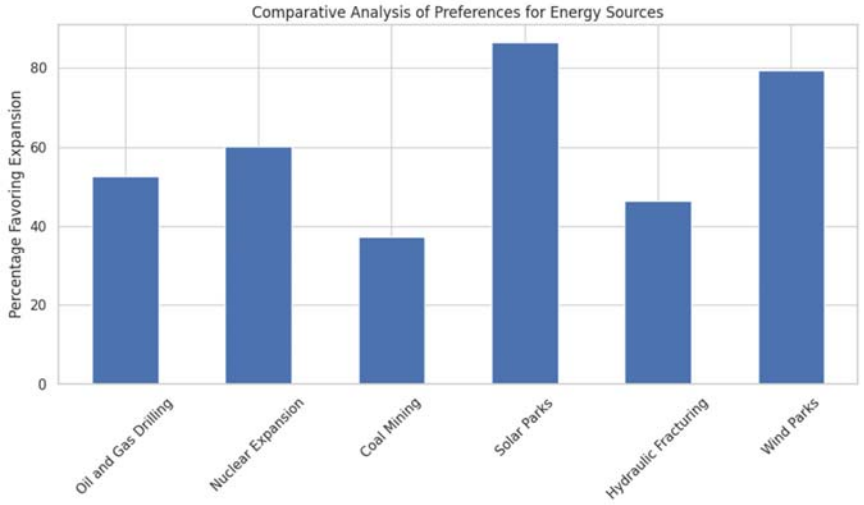
Comparative analysis of preferences for energy sources

Furthermore, this section provides a detailed comparison of public preferences for fossil fuels and renewable energy sources. The goal of the analysis is to offer a comprehensive view of the patterns and shifts in public support for various energy technologies. This will serve as a vital resource for energy planning and the creation of environmental laws that reflect public preferences.

Among all energy sources, solar and wind parks are the most favored, indicating a strong preference for renewable energy. There are moderate levels of support for both nuclear expansion and hydraulic fracturing, which show more divergent views.

The least popular sectors include oil and gas drilling, and particularly coal mining. This is mainly due to the adverse environmental impacts associated with coal mining.

Figure no. 6. Comparative Analysis of Preferences for Energy Sources

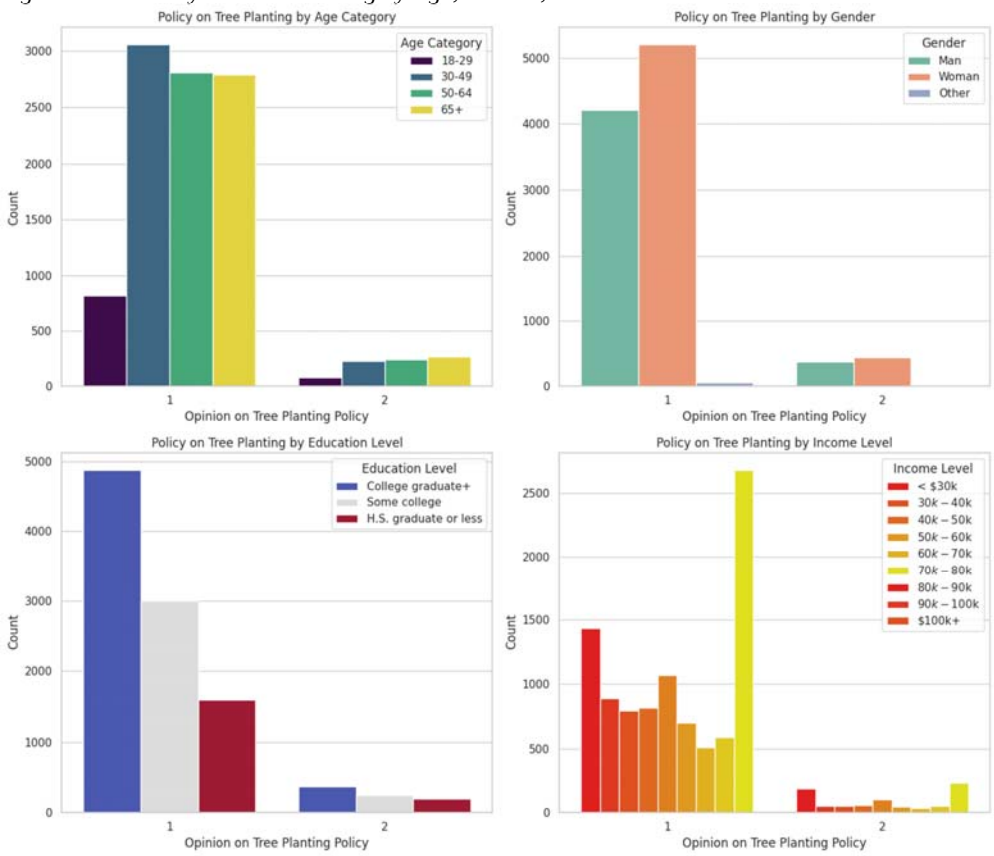


Source: Chart created using Python

Analysis of perceptions on climate change and government actions, integrating these perspectives with demographic variables

The main focus of this investigation is on perceptions of climate change and the assessment of government initiatives in this area, incorporating these perspectives alongside a variety of demographic factors such as gender, age, income and education. The goal is to gain crucial insights to enhance environmental policies and strategies by understanding the views of different demographic groups on the effectiveness of government responses to the climate crisis.

Figure no. 7. Policy on Tree Planting by Age, Gender, Education Level and Income Level



Source: Chart created using Python

There is strong support for the tree planting policy across all age groups, indicating a generational consensus. Unlike other age groups, the youngest group-those between the ages of 18 and 29-appears to have a slightly higher proportion of support.

The policy is highly supported by both men and women, with very little variation between genders. This implies that beneficial environmental initiatives, such as tree planting, are supported by people of all genders.

Individuals from various educational backgrounds also show strong support for this policy. There is a slight trend towards higher support among college graduates compared to those with less formal education, which may indicate that individuals with higher education levels are more aware of or value environmental solutions.

Support for tree planting increases with income. Individuals with higher incomes seem more in favor of this policy. This could be explained by greater access to information and resources, possibly higher levels of education, and a strong personal commitment to environmental causes.

Based on the data, it appears that the strategy of planting trees to reduce carbon emissions is broadly supported, with only minor variations observed among different demographic groups. This indicates that most people, regardless of age, gender, income, or educational level, have a generally positive view of this specific environmental effort.

5. Conclusions

A comprehensive analysis of the public's attitudes toward energy and climate-related concerns provides important new insights into the opinions and interests of the general population. The study has identified various patterns that demonstrate the complexity of public perceptions regarding energy and environmental policies by utilizing comparative analysis and correlations.

The viewpoints of the public on energy sources and climate change are greatly influenced by demographic characteristics. A moderate relationship has been found between gender and opinions regarding the expansion of nuclear power, suggesting that men and women may perceive the risks associated with nuclear energy differently. People's knowledge of energy sources is also impacted by variations in income; those with lower incomes generally know less, presumably because they have fewer access to educational resources. Regarding public preferences for energy technology, it is clear that younger individuals, in particular, prefer renewable energy sources like solar and wind energy. On the other hand, the popularity of fossil fuels, such as coal, is decreasing mostly because of their negative environmental impacts.

Support for initiatives that focus on minimizing climate change is also influenced by education. More highly educated individuals are more likely to support policies that encourage the use of renewable energy and reduce carbon emissions, indicating a deeper awareness of environmental issues. Additionally, higher income groups are more likely to strongly support renewable energy, probably as a result of being exposed to sustainability campaigns and placing a higher value on environmental preservation efforts. People from a wide range of demographic backgrounds strongly support government initiatives like planting trees to mitigate the consequences of climate change. This consensus shows that there is a general agreement on the importance of implementing effective environmental policies. This broad support underscores the necessity of aligning public opinion with government actions to maximize the efficacy of climate change initiatives.

The primary disadvantage of this study is its reliance on self-reported data, which is subject to memory errors and the propensity for responses that are socially acceptable. Furthermore, because the study only looks at one country, it may be difficult to extrapolate the findings to other political or cultural contexts. Expanding the study to more nations in the future might be beneficial for examining cultural and political variations in attitudes about energy and climate change.

Future research should use longitudinal methodologies that monitor changes in views over time to overcome current constraints and expand understanding of the dynamics of attitudes toward energy and climate challenges. Additionally, including data from social networks and using advanced predictive algorithms may provide innovative and comprehensive views on how public opinion evolves in the digital era. This deeper approach may greatly improve our capacity to create policies that successfully address the urgent issues of energy sustainability and climate change.

6. Acknowledgement

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