Czech University of Life Science Prague.

Faculty of Economics and Management

Department of Economics

Bachelor Thesis

Statistical analysis of opinion on climate change and energy measures in Poland.

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BACHELOR THESIS ASSIGNMENT

Deepshikha Thapa

Business Administration

Thesis title

Statistical analysis of opinions on climate change and energy measures in Poland

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Objectives of thesis

This thesis aims to analysis of opinion on climate change and energy measures in Poland . The research aims to determine the differences in view of various socio-demographic groups view climate change and energy measures. The findings of this research will help to inform policy makers, industry stakeholders and environmental organizations in their efforts to develop targeted strategies for reducing energy consumption and mitigation climate change.

Methodology

This thesis consists of two parts. Theoretical and practical part.

For the qualitative part, data sources such as scientific literature, academic journal and online library will be used.

For quantitative part, descriptive statistics will be used to summarize the data and identify differences in on the opinion of different groups like age, gender, education.

Inferential statistics will then be used to test the hypothesis that there are:

1.Are there differences in opinions on energy measures in between different age groups? (How likely, large numbers of people limit energy use & imagine large numbers of people limit energy use, how likely reduce climate change)

2. Females are more concerned than males about the climate change.

(To what extent feel personal responsibility to reduce climate change &

How worried about climate change)

3.People with higher education have positive response towards nature and environment. (Important to care for nature and environment)

The analysis will be done with the help of SPSS.

The proposed extent of the thesis

40-50 pages without annexes

Keywords

climate change; enegy-saving measures; Poland; public opinion

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Recommended information sources

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The Bachelor Thesis Supervisor

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Dean

Prague on 11. 03. 2024

Declaration

I declared that I have worked on this bachelor thesis “Statistical Analysis of opinion on Climate Change and energy measures in Poland” and I have used only the sources mentioned at the end of this thesis. As the author of this thesis, I declare that this thesis does not break any copyright of any person.

In Prague on 15th of March 2024

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Abstract

Climate change is a major issue worldwide. In the case of Poland, it faces special issues with climate change due to its heavy reliance on coal. This results in high greenhouse emissions. There is an urgent need to switch to cleaner, renewable energy sources to mitigate these emissions. The transition to climate change in Poland is complex. Socioeconomics, public opinion, or policy factors can influence it. The objective of this thesis is to provide readers with an analysis of the opinion about climate change and energy measures in Poland. The study uses surveys from the European Social Survey to understand people's opinions. In the literature review, a brief overview of climate change, its impacts, and energy measures in Poland. Furthermore, socio-demographic factors influencing opinions related to these topics are discussed too. In the methodology part, descriptive statistics are used to analyze the respondents' opinions. Also, few hypotheses are formed relating to these topics. SPSS will be needed to analyze the data and perform hypotheses. Then, we will know if the hypotheses are accepted or rejected based on the results of the p-value.

Keywords: Climate change, energy measures, Poland, opinions, socio-demographic, p-value

Souhrn.

Klimatické změny jsou celosvětově velkým problémem. V případě Polska čelí zvláštním problémům se změnou klimatu kvůli jeho velké závislosti na uhlí. To má za následek vysoké emise skleníkových plynů. Ke zmírnění těchto emisí je naléhavě nutné přejít na čistší obnovitelné zdroje energie. Přechod ke změně klimatu v Polsku je složitý. Mohou to ovlivnit socioekonomie, veřejné mínění nebo politické faktory. Cílem této práce je poskytnout čtenářům analýzu názoru na klimatické změny a energetická opatření v Polsku. Studie využívá průzkumy Evropského sociálního průzkumu, aby pochopila názory lidí. V přehledu literatury stručný přehled klimatických změn, jejich dopady, energetická opatření v Polsku. Dále jsou diskutovány sociodemografické faktory ovlivňující názory na tato témata. V metodické části jsou k analýze názorů respondentů použity deskriptivní statistiky. K těmto tématům se také vytváří několik hypotéz. SPSS bude zapotřebí k analýze dat a provádění hypotéz. Potom budeme vědět, zda jsou hypotézy přijaty nebo zamítnuty na základě výsledků p-hodnoty.

Klíčová slova: Změna klimatu, energetická opatření, Polsko, názory, sociodemografické, p-hodnota

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1. Introduction.

Climate change is a global challenge that demands urgent attention and collective action. To address this challenge, it is important to understand what people think about climate change and energy measures. The importance of public opinion in shaping policies and initiatives related to climate change and energy cannot be overstated. Different socio-demographic groups may hold diverse views, priorities, and concerns regarding these issues. Understanding opinions public opinions on climate change and energy measures is crucial for informed decision-making and the development of effective strategies.

In context the of Poland, a country facing unique challenges due to its energy mix and environmental concerns, it is crucial to explore how different socio-demographic groups perceive climate change and energy-saving measures. Poland as a country with a diverse energy mix heavily reliant on coal, faces unique challenges in addressing climate change and transitioning to sustainable energy sources. The dependence on coal has posed environmental challenges, including high levels of greenhouse gas emissions and air pollution. However, in recent years, Poland has recognized the need for a transition towards cleaner and more sustainable energy sources.

Statistical analysis allows us to examine the relationships between different variables and identify significant patterns and trends. Inferential statistics will be employed to test hypotheses and examine the relationships between variables. It will also shed light on the level of awareness, attitudes, and behaviors related to climate change and energy-saving measures in Poland. The findings of this research will have practical implications for policymakers, industries, and environmental organizations. By gaining insights into public opinions, stakeholders can tailor their policies, initiatives, and communication strategies to engage and address the concerns of different socio-demographic groups effectively.

2. Objectives and Methodology.

2.1 Objectives

This thesis aims to the analysis of opinions on climate change and energy measures in Poland. The research aims to determine the differences in the views of various socio-demographic groups regarding climate change and energy measures.

Specific objectives are:

- Analysis of the output of the survey.
- Determine whether hypotheses are statistically significant by using chi-square.

2.2 Methodology.

This thesis will examine the topic using various research methods and include a literature review and a practical part. Scientific literature, academic publications, and internet libraries were used in this thesis analysis. This will help to offer an overview of the topic and to formulate a hypothesis.

The data is used from the European Social Survey 2020 (ESS round 10SC-2020) to assess the overview of the opinion about climate change and energy saving. The second part consists of data analysis of opinions about climate change and energy-saving of different socio-demographic groups. Chi-square will be used to test the following hypotheses:

H1: Are there differences in opinions on energy measures between different age groups?
H2: Females are more concerned than males about climate change.
H3: People with higher education have positive responses towards nature and the environment.

The analysis will be done in SPSS statistical software.

2.2.1 Categorical Data Analysis.

“A categorical variable has a measurement scale consisting of a set of categories” (Tomáš Hlavsa & Zuzana Pacáková, 2020)

Research investigations in the social and biomedical sciences sparked the creation of categorical variable methodologies. In the social sciences, categorical scales are often used to assess attitudes and beliefs. In the biomedical sciences, categorical scales are used to evaluate outcomes, such as the efficacy of a medical intervention.

Ordinal and nominal categorical variables are the two types of categorical variables. Ordinal variables are those in which the outcomes are determined by the order category, such as age or income. On the other hand, nominal variables are variables in which outcomes have the same importance and do not have a natural order. Some examples are nationality, gender, agree/disagree, and so on,

The way that a variable determines its classification. For example, consider a survey that asks individuals to rate their satisfaction with a product using the options "very satisfied," "satisfied," "neutral," "dissatisfied," and "very dissatisfied." In this case, the data collected can be treated as ordinal because there is an inherent order or ranking among the categories.

However, if the same set of responses is aggregated to analyze the overall satisfaction level of a population without considering the specific ordering, the data can be treated as nominal. It would then represent categories or groups such as "satisfied," "neutral," and "dissatisfied" without any order.

So, the same data can be treated as ordinal or nominal depending on the context or the analysis being performed.

2.2.2. Test of independence in a two-way contingency table.

In statistics, a contingency table is a particular kind of table with at least two rows and two columns that are used to arrange data and assess the relationship between two or more variables. The two are as follows: Classical contingency tables (2x3 or 3x3, etc.) and two-way contingency tables (2x2). The test of independence is sometimes referred to as a contingency table test. (Tomáš Hlavsa & Zuzana Pacáková, 2020)

There are four steps to test the dependency of categorical variables in a two-way contingency table:

1. First, set null hypothesis H0 claiming that there is no relationship between two variables. Then, set an alternative hypothesis HA, claiming that there is a relationship between two variables.

2. Then, define the significance level α, commonly used value is α = 0.05.
3. Determine if we can use the t Chi-square test as a test criterion based on the following conditions:
    a. If sample size n> 40, then we can use the chi-square test $\chi 2$
    b. If the sample size is $20 \leq n \leq 40$, then the value of expected frequencies should be checked. If all of them are greater than 5, then $\chi 2$ is used. If any one of them has a value less than 5, then we need to use Fisher's factorial test.
    c. If sample size n>20, we use Fisher's factorial test. (Tomáš Hlavsa & Zuzana Pacáková, 2020)

VarA/VarB	**B1**	**B2**	Total
A1	a	b	a+b
A2	b	d	c+d
Total	a+c	b+d	n

Table 1Contigency table (2x2)

Calculation of Excepted Frequencies.

$a_0 = \frac{(a+b)(a+c)}{n}$

$b_0 = \frac{(a+b)(b+d)}{n}$

$c_0 = \frac{(c+d)(a+c)}{n}$

$d_0 = \frac{(c+d)(b+d)}{n}$

The formula for test criterion χ^2 is

$$\chi^2 = \frac{n(ad-bc)^2}{(a+b).(a+c).(b+d).(c+d)}$$

4. Decision: if $\chi 2 > X2_\alpha$ then H0 is rejected - there is no relationship between the two variables.

If the p-value is < α then H0 is rejected - there is no relationship between the two variables.

Fisher's Factorial test

The procedure for this test includes:

- Formulate the null hypothesis H0 : there is no relationship between variables and alternative hypothesis HA: there is relationship .
- Calculate the marginal totals, and compute row and column totals for the contingency table.
- Calculate the probability for each table.

The formula used to calculate the probability of Fisher's factorial test is.

$$p_i = \frac{(a+b)!(c+d)!(a+c)!(b+d)!}{n!a!b!c!d!}$$

Decision: if ∑pi> 0,05 — H0 is accepted, there is a relationship between the two variables. (Tomáš Hlavsa & Zuzana Pacáková, 2020)

2.2.3 Test of independence in the classical contingency table.

There are four steps to test the dependency of categorical variables in classical contingency table (RXC) :

1. Formulate the null hypothesis H0 claiming there is no relationship between 2 variables and alternative hypothesis HA claiming there is a relationship between 2 variables.
2. Significance value α.
3. To determine if we can use the Chi-square test for the hypothesis, there are two conditions:
    a. Maximum 20% of expected frequency is < 5.
    b. No expected frequency is less than 1.

Var A/Var B	B1	B2	…	Bj	Total
A1	n11	n12	….	n1j	n1
A2	n21	n22	…	n21	n2

…	…	…	…	…	….
Ai	**ni1**	**ni2**	**…**	**nij**	**ni.**
Total	**n.1**	**n.2**	**…**	**n.j**	**n**

Table 2 Classical Contingency Tables

Calculation of expected frequencies:

$$n_{oj} = \frac{n.j \, .n_i}{n}$$

$$n_{oi} = \frac{n._1 \, . n_1}{n}$$

The formula for test criterion $\chi 2$ is

$$chi - squaredchi - squared\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{\left(n_{ij} - e_{ij}\right)^2}{e_{ij}}$$

4. Decision: if $\chi 2 < \chi 2_{\alpha\,(4),}$ then H0 is accepted at $\alpha = 0.05$. (Tomáš Hlavsa & Zuzana Pacáková, 2020)

2.2.4 Strength of Dependency.

Pearson's Contingency Coefficient.

In a contingency table, this statistic is used to measure the strength and direction of association between two categorical variables. It expresses how dependent two categorical variables are on each other.

The formula can be stated as $C = \sqrt{\frac{\chi^2}{n+\chi^2}}$

The resulting value of C ranges from 0 to 1. C value of 0 indicates no association or independence between variables, while a C value of 1 indicates a perfect association or complete dependency between the variables. Larger C values represent stronger associations between the variables. It is more useful when dealing with contingency tables of more than 2x2 cells.

Cramer's Coefficient V.

It is used to measure the strength and direction of association between two categorical variables in a contingency table. It can be used for both nominal and ordinal categorical variables.

The formula for classical contingency table(rxc)

$$V = \sqrt{\frac{\chi^2}{n(h-1)}}$$ h is min(c;r)

The formula for the 2x2 contingency table

$$V = \frac{a.d-b.c}{\sqrt{(a+b)(c+d)(a+c)(b+d)}}$$

It ranges from 0 to 1. A value of 0 indicates no association between variables, while a value of 1 indicates complete dependency between variables. Large values represent stronger associations between the variables. Cramer's V is a standardized measure for categorical variables, suitable for nominal and ordinal data types. However, Kendall's Tau-b or Kendall's ordinal correlation may be more suitable if the ordinal nature of the variables is of particular interest. (Ing. Zuzana Pacakova, 2023)

3. Literature Review

3.1 Introduction to Climate Change.

Climate change is a shift in a location's typical weather patterns. This could differ in how much rain a location receives in a year. It can also refer to a variation in a location's usual temperature over a month or season. It could also be a change in where rain and snowfall on Earth. Climate change is occurring as the earth warms. The majority of Earth's warming is caused by human activity. To generate energy, people burn fossil fuels such as coal, oil, and gas. Gases are released into the atmosphere when these fuels are burned. These gasses trap heat from the sun, warming the Earth. This effect is known as the greenhouse effect.
The greenhouse effect is natural, but it is becoming stronger as the number of gases in the atmosphere increases. Climate change begins as the Earth warms. So, climate change is primarily concerned with how the Earth's temperature is rising.

There is another method of studying climatic change, Dendroclimatological. It is the study of past climate change through examination of tree ring growth. Scientists compare the tree growth records to local weather records. It was first used by Andrew Ellicott Douglass from the University of Arizona. It was used in the early 1900s. (Falarz, 2021)

3.2 Impacts of Climate change

Climate change has an impact not only on the environment but also on another sector like health, economic, social, and so on. Some of the noticeable impacts are:

i. Environmental Impacts

Climate change has a deep impact on the environment, influencing ecosystems, and weather patterns. Global temperatures rise due to increased greenhouse gas concentrations. We see more frequent and severe weather events like hurricanes, floods, and droughts. The global average temperature has risen, resulting in hotter days and more frequent and severe heatwaves. The Arctic is heating up twice as quickly as anywhere else on the planet, resulting in the rapid melting of glaciers and polar ice sheets, which store vast amounts of water. Coastal flooding caused by sea level rise, and climate change affects snowmelt and heavy rain, both of which induce interior and urban floods. The amount of marine heat waves has increased by more than one-third. These spikes have caused massive extinctions of plankton and marine creatures (Lindwall, 2022). Additionally, warmer temperatures may also increase air pollution.

ii. Health Impacts.

As the temperature rises, it can expand the range of many infectious agents as they cause infections. For example, mosquitoes are increasing the spread of diseases like malaria and dengue fever. Higher temperatures can increase the risk of heart stroke and other heart-related illnesses. Climate change has the potential to degrade air quality by increasing pollution and allergens such as pollen, which can have an impact on respiratory health (Kathrin Reinmuth-Selzle, 2017). Every year, thousands of people are injured, sick, or killed because of extreme weather. An estimated one billion people will be at risk of heat stress if global average temperatures climb by two degrees Celsius. Thousands of people died in record-breaking heat waves across Europe during the summer of 2022. Weeks later, record-breaking urban flooding killed scores in the United States and South Korea, while more than 1,500 people died in Pakistan, where stagnant water and unclean conditions pose an even greater threat. (Lindwall, 2022).

iii. Economic Impacts

Temperature changes can have an impact on crops, resulting in food shortages and higher costs. This was seen during the 2010 Russian heatwave, which resulted in a large drop in wheat production. And there was an increase in wheat prices. Extreme weather can cause infrastructure damage resulting in considerable economic expenses for repair and rebuilding. Changes in weather patterns can have an impact on renewable energy sources such as hydroelectric power as well as increasing energy demand for cooling during hot seasons.

iv. Social Impacts

Rising sea levels and extreme weather can displace communities, leading to internal and external migration. Climate change often has a major effect on the poorest communities, worsening existing social and economic inequalities.

3.4 Climate change in Poland.

In Poland, the earliest mention of conducting dendroclimatological research was in 1914. Although it started after the Second World War. In 1952, after the end of World War II, the measurement of solar radiation on a larger scale began in Poland. It was difficult to carry out the analysis of the components of the radiation budget, which plays an important role in determining many atmospheric, oceanic, and land surface processes and effects on the Earth's climate system. It was because of insufficient stations (Falarz, 2021). For almost a century, meteorological stations in Poland have been monitoring climate change. There has been an

increase in the number of days with heavy rainfall, a decrease in the number of days with snow cover, and an increase in the severity of hurricanes, thunderstorms, and other meteorological events over the last several decades. Floods and droughts are the most serious weather-related difficulties that Poland faces, and they are likely to grow more frequent and intense in many scenarios as climate change progresses. Poland has a long history of involvement in climate research, but it currently faces difficulties in reducing the effects of climate change and making the switch to sustainable energy sources.

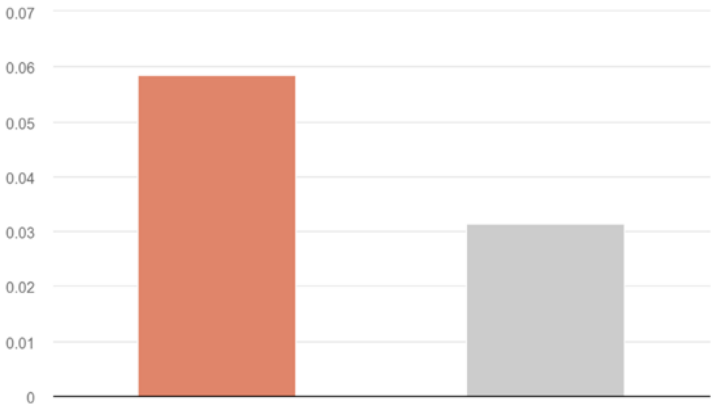


Figure 1 Level of warming in Poland.

Source (Lea 50, 2022) *IEA, Level of warming in Poland, 2000-2020.*

From 1951 to 2020, Poland's average temperature increased by more than 2°C. In the previous 20 years, Poland has warmed up quicker (0.0586°C per year) than the global average (0.0313°C per year). Warming did not occur uniformly throughout Poland; between 1981 and 2010, the east and west warmed three times more (0.3°C every ten years) than the middle (0.1°C every ten years). During the same time (1981-2010), Poland experienced fewer cold days (2 to 3 days per decade) and more hot days (6 days per decade). With the average temperature rising, fewer days required heating. (Lea 50, 2022)

Climate consequences are unevenly distributed. Global warming has been linked to heat waves. Global warming has been linked to heat waves and other meteorological instabilities in Poland. In recent decades, the number of days with heavy rains has grown. The number of days with snow cover fell, and the intensity of hurricanes, thunderstorms, and other similar weather phenomena has increased. Floods and droughts are Poland's principal weather-related concerns, and they are likely to grow more frequent and intense in many scenarios due

to predicted climate change. The Polish Ministry of Environment remains primarily concerned with agriculture and water management. (Piniewski, 2018).

Poland has announced plans to address the effects of climate change on many sectors. These include energy, through its 2030 National Environmental Policy and a special adaptation plan that will operate until 2030. Poland is working on local projects and disseminating climate data online. Although these climate strategies emphasize making the energy sector more adaptable to climate change, Poland's Energy Policy to 2040. It focuses on ensuring the energy system's security and mitigating climate change effects by changing the types of energy used and becoming more efficient during crises. (Lea 50, 2022)

The effects of climate change on Poland have been studied in recent academic papers. They underline the country's numerous concerns. The study describes how European cities are addressing climate change through environmental practices, providing a detailed picture of Polish residents' attitudes about climate change. The study suggests that effective climate change requires collaboration between cities along with good practice from European leaders and the involvement of citizens in the decision-making process. (Życk, 2023)

(Herlevi, 2024)explores another aspect of the effect of climate change. They study how climate change is making it easier for plants and animals that aren't originally from a place to settle into coastal areas in Poland. These new species are changing the way local ecosystems work because of climate change. The research uses information from Poland's environmental watch program to show how climate change affects the living things in the area. Also, the problems that come with trying to control these new species. It highlights how important it is to find ways to manage these changes while also maintaining the variety of life in these regions.

(Haleh Samini1, 2023)provide insight into the wider effects of climate changes on Poland's natural habitat. Their findings highlight the crucial role of phytoplankton and zooplankton in understanding ecosystem dynamics. This study highlights the possible implications of climate change on marine and aquatic ecosystems in Poland. The study emphasizes the importance of continuous ecological monitoring and conservation efforts.

(Platje, et al., 2024)conducted research into the impact of major social structures on energy transition decisions in Poland. It revealed a complex relationship between personal beliefs, social norms, and environmental policy decisions. According to the study, addressing

individual and collective attitudes towards climate change is important for a sustainable energy transition in Poland.

Climate change has a wide-ranging and significant impact on Poland's ecosystems, urban and rural people, and social attitudes. It emphasizes the vital need for organized policy responses that focus on the ecological, social, and economic elements of climate change. The findings of these studies provide significant information for policymakers, practitioners, and researchers.

3.5 Poland's Energy Landscape and Challenges.

Poland's energy landscape and challenges are influenced by a mix of factors, including its historical reliance on coal, its energy security concerns, environmental pressures, and the need to transition to cleaner and more sustainable energy.

Coal mining has played a significant role in Poland's history and economy for decades. Poland has a substantial coal reserve and coal has traditionally been a major source of energy for the country. It has a long history in Poland, back to the 18th century. It played a pivotal role in fueling the Industrial Revolution in Europe during the 18th and 19th centuries. The development of coal mining in the region was closely tied to the growth of industrialization and the need for energy to power factories and homes. It has significant coal reserves, particularly in the Upper Silesian Coal Basin (known as Silesian Coal Basin or Górnośląskie Zagłębie Węglowe in Polish) This region is one of the largest coal-producing areas in Europe. This region includes various types of coal.

During the communist era, from 1945 to 1990, the economy was centered on dominant heavy industry and a development paradigm that ignored environmental costs (the communist theory of environmental services as free products). Despite enormous socioeconomic changes following 1989 (the year of the Soviet Union's demise), this legacy can still be traced. Coal accounts for more than 90% of all electrical production. On the one hand, the country's reliance on energy imports is merely 14.7%. As a result, Poland has the lowest reliance on energy imports in the EU (Kundzewicz, 2012).

Coal remains a crucial part of energy security, accounting for most of the energy mixed. Despite restructuring efforts, Poland has not achieved the expected results. The country is lagging in European Climate and energy policy implementation and protecting domestic coal.

The development of Poland’s electricity sector, which relies on hard coal and lignite-based power, has been criticized for its dependence on these resources. The biggest threat to coal and nuclear power is the “death spiral” which could give these assets orphan status. Conflict in abandoning coal is primarily political and ideological. (Jan A. Wendt, 2021).

The coal industry faces economic challenges as the cost of coal production has been rising, making it less competitive compared to alternative energy sources. Transitioning to cleaner and more sustainable energy options is a complex challenge as it requires significant investment and job training for those employed in the coal industry.

Biomass is Poland's most significant form of renewable energy in terms of potential. Leftovers from the food and agricultural industries are used to make biocomponents. Maize grain is the feedstock that is most frequently used in Poland to make bioethanol, while most rapeseed oil is used to make biodiesel. Processing biomass in agricultural biogas plants could be a useful approach for Poland to use for heat and energy. The Agricultural Market Agency in Poland is the entity in charge of maintaining the list of businesspeople engaged in agricultural biogas-producing activity. As of December 31, 2017, the ARR reported 84 entities listed in the register of agricultural biogas producers. (Arkadiusz Piwowar, 2019).

Poland has significant potential for offshore wind energy development in the Baltic Sea region, with investors planning projects in Polish maritime areas. Wind energy profitability in the Baltic Sea varies, with southern regions being the most attractive demand centers. Poland’s political consensus supports offshore wind energy development, but challenges include linking it with climate policy implementation and effectively implementing political decisions. The location of the installation terminal is a major issue. Polish government, investors, and offshore wind energy supply chain are working on a “Polish Offshore Sector Deal” to involve Polish entrepreneurs in offshore wind energy development. (Jan A. Wendt, 2021).

In the past, Poland has struggled with its heavy reliance on natural gas imports, which are primarily obtained from Russia via pipelines. There are legitimate worries about the nation’s energy security as it makes it susceptible to supply disruptions and price fluctuations, especially during periods of political instability. However, in 2022 the Baltic pipeline was launched. It transports natural gas from the Norwegian to Poland via Denmark and the Baltic Sea. Negotiating gas contracts and securing alternative supply agreements with countries like

the US, Qatar or Norway are essential steps but they also require careful diplomacy and investment. Poland faces economic and environmental challenges due to coal heritage, and the necessity to shift towards cleaner alternatives while ensuring stability and embracing a sustainable future.

Poland’s environment is defined by its historical reliance on coal. Other European Union (EU) countries have steadily transitioned to renewable energy sources, while Poland's energy mix has remained highly reliant on coal for both power generation and heating. This dependence comes from the country’s huge coal reserves. Also, the socioeconomic fabric that has grown up around the coal sector over the years. (Jakub Kubiczek, 2023) emphasize Poland’s continued attempt to balance its energy mix by taking in renewable energy. However, to an extent, it requires speeding to reach both national and EU-wide environmental goals.

The European Union has set high targets for renewable energy to tackle climate change and cut greenhouse gas emissions. As mentioned before, the goals are part of the EU’s larger ambition to become carbon neutral by 2050, as defined by the European Green Deal (EU, 2024). Poland’s agreement with these aims is important. It is important for the preservation of the environment and its economic viability within the union. Many countries in the EU are quickly adopting renewable energy while Poland is gradually trying to use more renewable energy. The country is spending a lot of money to increase its use of wind and solar energy.

Poland understands the importance of using various kinds of energy sources and to make less pollution. The government offers programs and subsidies to encourage investment in sustainable energy. These measures are crucial for Poland to satisfy the EU’s renewable energy targets.

3.6 Case Studies on Energy Transitions.

There has been research about how to successfully transition to renewable energy. This information may help Poland in developing more effective policies and regulations for the use of sustainable energy. (Qiu, 2024) study market design for secondary services provided through virtual plants. It presents a non-convex bi-level optimization approach. It is a two-step problem-solving method where the first step influences the second. The study studies analyze energy dispatches and frequency responses, resulting in an advanced model that could guide energy transition strategies in Poland. The case studies included in this work

demonstrate how virtual power plants can help to create a more flexible and resilient energy system.

Additionally, the application of the Fowler-Guggenheim adsorption model to the hydrate model, as studied by (Simin Keshtkari, 2024) . It provides information about the technical aspects of energy transitions. This study on methane-ethane hydrate systems sheds light on the impact of transitioning to alternative energy sources. Also, the role of technology in supporting them.

Germany's Energiewende is a leading example of a comprehensive and successful energy transition. The initiative was launched in the early 2000s. It aimed to significantly reduce greenhouse gas emissions, phase out nuclear power, and increase renewable energy's share of the national energy mix. Germany has significantly expanded its renewable energy sector by implementing policies such as the Renewable Energy Sources Act (EEG). As of 2021, renewable sources accounted for approximately 46% of Germany's electricity consumption, indicating a significant shift away from fossil fuels and toward cleaner energy sources. (Müller, 2021)

Denmark's journey to become a global leader in wind energy demonstrates the value of targeted government policies and public support. The Danish government's consistent investment in wind power since the 1970s, combined with policies that helped the development of both onshore and offshore wind farms. It has contributed significantly to this achievement. By 2020, wind power would account for roughly half of Denmark's total electricity production. This shows the country's commitment to renewable energy and sustainability (Jensen, 2020).

Sweden's ambitious goal of becoming carbon neutral by 2045 demonstrates a variety of approaches to energy transition. Sweden's carbon tax, implemented in 1991, is central to its strategy. As it has resulted in significant reductions in fossil fuel use across a variety of sectors. The country has also heavily invested in renewable energy sources. It has made significant progress toward converting its transportation sector. These initiatives emphasize the importance of innovative policies and technologies in achieving sustainable energy transitions (Millot, 2020).

Analyzing these case studies reveals common themes and strategies that could be applied in Poland's energy landscape. The importance of full evaluation methodologies, the potential for

technological innovations, and the role of market design in facilitating transitions are all important factors for Poland. By examining the successes and challenges encountered in these case studies, Polish policymakers and stakeholders can gain insight into effective strategies for advancing the country's energy transition goals.

3.7 The European Union's Influence.

In an increasingly interconnected world where environmental concerns transcend national borders. The influence of regional entities on a nation's climate and energy policies becomes of paramount importance. Poland functions within a framework that goes beyond its national boundaries as an EU member state. Poland's strategy for combating climate change and securing a sustainable energy future is significantly influenced by the EU, which is recognized for its ambitious climate goals and thorough energy strategies.

Poland is the EU's sixth-largest member state by population. In 2007, Poland agreed to the EU 20-20-(20) climate and energy targets, aiming to cut GHG emissions and increase renewable and energy efficiency by 20% by 2020. Poland appears to have become more resistant to both short- and long-term EU climate policies since 2009. It opposed the Commission's energy roadmap in 2011 and 2012, which proposed a step-by-step plan to decarbonize Europe by 2050. (Skjærseth, 2014).

The European Council adopted a new 2030 climate and energy policy framework in October 2014. It is a global commitment to combat climate change. The Paris Agreement reinforced the EU's existing climate targets. It binds the EU to reduce greenhouse gas emissions by at least 40% by 2030 compared to 1990 (Delbeke, 2019). Poland as a significant member of the European Union (EU), plays a vital role in the collective efforts to address climate change under the Paris Agreement. The country's stance on a climate issue is influenced by its domestic energy landscape, economic, considerations, and the imperative to meet international climate commitments. Balancing these factors while pursuing the ambitious goals set forth by the Paris Agreement presents both challenges and opportunities, positioning Poland as a critical player in the global effort to combat climate change.

Poland is also funded by the EU to support aimed at advancing its effort to address climate change and transition towards more sustainable energy practices. At the heart of this support system is the European Green Deal, a comprehensive EU strategy aimed at achieving climate neutrality by 2050 (EU, 2024). Additionally, Poland is a major recipient of the Just Transition

fund, which is specifically designed for regions and communities that have historically relied on fossil fuels (Wang, 2021). This fund is designed to support a just and equitable transition away from coal, with a particular focus on economic diversification, job creation, and social development. Poland is also a recipient of the Just Transition Fund, European Structural and Investment Funds, covid response plan Next Generation EU, Horizon Europe, and collaborations.

However, there are several challenges that Poland has faced while integrating with EU climate-energy policies. Its dependency on coal has led to concerns about the economic impact of transitioning to cleaner energy sources. The problems are the potential loss of jobs in coal-related industries and the need for financial support to ensure a just transition for affected regions. There have been political debates within Poland about the pace and climate actions. It is often about national sovereignty and the economic and perceived fairness of EU policies. Poland’s energy mix includes a variety of sources beyond coal, such as natural gas and nuclear power. Ensuring these sources align with EU standards and contribute to emission reduction is an ongoing challenge.

Due to historical dependency on coal, Poland faces a significant energy transformation that could cost up to EUR 240 billion. For transformational developments, the government is focusing on the Just Transition Fund. The European Green Deal financing will be supported by a green finance strategy that will provide funds for research and innovation. The European Green Deal is partially supported by the EU budget and the next Generation EU Facility, with climate goals accounting for 30% of expenditure. The World Health Organization recently issued new air quality guidelines for governments to follow. Renewable energy and resource exploration are in the early stage of development, with EU countries actively participating and committing to renewable energy usage. (Simionescu, 2020).

The European Union acts as a guiding hand, assisting Poland in changing its energy habits. They're giving Poland money and assistance to transition away from coal and towards cleaner energy. Poland is making significant strides in the right direction with EU funds and green strategies, and the future holds the promise of a cleaner, more sustainable energy landscape. The European Union is a committed partner in Poland's journey to a greener tomorrow, working together to create a brighter, more environmentally responsible future.

4. Climate change awareness and Public Opinion.

Climate change awareness significantly influences public opinion and collective responses to the global environmental crisis. Understanding how people perceive and respond to climate change is critical for policymakers, activists, and researchers as well.

Awareness helps people understand the consequences of rising temperatures, sea-level rise, extreme weather events, and habitat destruction. This knowledge can motivate individuals and communities to act to protect natural environments and the species that inhabit them. Climate change has direct and indirect impacts on human health. Many server diseases are caused due to climate change. Increased heatwaves, the spread of diseases, and poor air quality can result in illness and death. Public awareness and support are critical for the implementation of effective climate policies. When people understand the urgency of the climate crisis, they are more likely to support and vote for policies that address it. Awareness helps foster a sense of global citizenship and encourages countries to work together to reduce greenhouse emissions and adapt to changing conditions.

However, public awareness of the international framework for combating climate change is low. The public appears to be underestimating climate change. In 2002, MORI research for the Scientific Alliance found that 70% of people couldn't name the gas that most contributes to global warming. While carbon dioxide is the most frequently mentioned top-of-mind by three out of ten people, two out of them incorrectly cite CFCs (Norton, 2004).

The study found that different types of knowledge impact the perception and acceptance of climate change measures. Causal knowledge positively relates to climate change concern and policy acceptance, while action-related knowledge positively influences willingness to change behaviors. Results-related knowledge and action-related knowledge directly influence willingness to change behaviors. The findings suggest that providing more causal knowledge, such as the causes of temperature changes and greenhouse gas accumulation, can increase people's willingness to change their behaviors. However, it is crucial to avoid providing result-related knowledge that makes people feel powerless. (Shwom, 2015)

4.1 Public awareness campaign on energy transition.

Public awareness campaigns play an important role in transforming social attitudes and behaviors. Recently, various platforms and techniques have been used to encourage communities to adopt renewable energy and sustainability.

One of them is the “Humanizing Energy” project. It explores the connection of design, art, and technology in promoting energy transition. This program highlights the value of creative disciplines. It introduces new ways to engage the public in the energy transition by promoting consensus, improving awareness, and increasing involvement (Barbara Di Prete & Milano, 2024).

Also, educational programs such as “Sustainability Policy & Practice” highlight the importance of adopting sustainability into academic courses. This method aims to prepare future generations for energy transition by highlighting the importance of education in raising public awareness and promoting sustainability (Cohen, 2024).

Another effective strategy is to use digital platforms and social media to share information and engage a large audience. These techniques have shown great reach and engagement which highlights the power of online communities. The campaigns use digital communication to motivate change by providing success stories, instructional content, and practical suggestions.

Furthermore, community-based efforts have helped to localize the energy transition narrative. These projects mainly engage local stakeholders by conducting seminars and public events to explore the advantages of renewable energy and energy efficiency. These campaigns promote collective action toward energy transition goals by customizing messages to local conditions and using community networks.

These examples teach Poland vital lessons about creating and implementing effective public awareness campaigns. Creative engagement, educational outreach, digital mobilization, and community involvement can help increase public knowledge and support for energy transition programs. By taking a variety of approaches, Poland may develop a well-informed population that is eager to embrace and advocate sustainable energy solutions.

5. Socio-demographic Factors and climate change attitudes.

This section delves into the complex relationship between socio-demographic factors and public attitudes towards climate change, highlighting the various factors that influence these perspectives, given the growing global concern over climate change.

i. Age

Age significantly influences climate change attitudes, with the younger generation showing a higher level of awareness. This digital age has made information more accessible, which helps younger people to be more engaged in climate-related topics (Haq, 2017) have also mentioned younger people are more concerned as they know the reason for climate change in that locality. However, (Kim, 2012)found out older people are more concerned about climate and environment than younger people. The reasons behind this could be the older generation may have experienced the consequences of environmental issues in their lives which can make them more concerned about these things or a sense of responsibility for the well-being of future generations.

ii. Gender

A significant amount of research has revealed distinct patterns in gender-related climate attitudes. Multiple studies have consistently shown that women exhibit a higher level of climate change awareness and concern for environmental issues (Haq, 2017). Serval factors contribute to these disparities. Women's multiple roles and prioritizing collective well-being, while men may have a more skeptical stance due to societal norms, gendered expectations, and economic implications (McCright, 2010).

iii. Education.

Multiple studies have highlighted that higher levels of education are often associated with increased climate change awareness and concern. As they tend to have a greater understanding of climate change and support for climate action policies. On the other hand, individuals with lower levels of education may have less climate change awareness and support for climate change policies.

There are other factors that play a role in influencing climate change attitudes. Some of them are income, geographical location, political ideology or religion spirituality, media exposure, and so on (Huda, 2013).

iv. Media

The media has a significant influence on people's opinions toward climate change and energy measures. The media may raise awareness about the importance of these issues. The public learns about the efforts that can be taken to address climate change. Positive stories can inspire individuals and groups to embrace more sustainable behaviors. However, how the

media presents these issues can also influence public perception; dramatic or biased reporting can lead to confusion.

v. Political ideology

According to the study (Thea Gregersen, 2020), people's political views influence their level of concern about climate change. The study says one should not simply provide more knowledge about climate change to increase public concern. It may not be effective for everyone in Europe due to differing political perspectives. Instead, how one discusses climate change should be considering what various individuals believe based on their politics.

vi. Income level.

A person's income can shape their perspective on climate change. People with higher income levels may be able to purchase more sustainable solutions, such as electric automobiles or solar panels. These individuals may install solar panels in their homes. Solar panels are a significant upfront investment that pays off by lowering electricity bills and decreasing dependency on fossil fuels. Furthermore, consumers with more money might opt to buy products from ecologically conscious firms. They are more likely to support environmental regulations. However, those with lower salaries may be more concerned with current expenditures and may not prioritize climate change as much owing to financial restrictions. This is not to say they care less about the environment, but their financial status limits their options. For example, individuals may choose the more economical, conventional car over the electric one because it matches their present budget,

vii. Geographical locations

A person's perception of climate change can be substantially influenced by where they live. For example, people living in regions that are threatened by increasing sea levels may be more concerned about climate change than those living in the interior. Similarly, people living in places exposed to severe weather events, such as hurricanes or droughts, may be more directly affected by climate change. Countries like Maldives and Venice which is known for their historic canals are at risk of serve weather events. It includes hurricanes, typhoons, droughts. Extremes storms and typhoons are becoming more common in the Caribbean, Southeast Asia, while server droughts and wildfires in California, Australia and Sahel region of Africa are significant signs of climate change.

6. Analytical Part.

6.1 Evaluation of the Survey

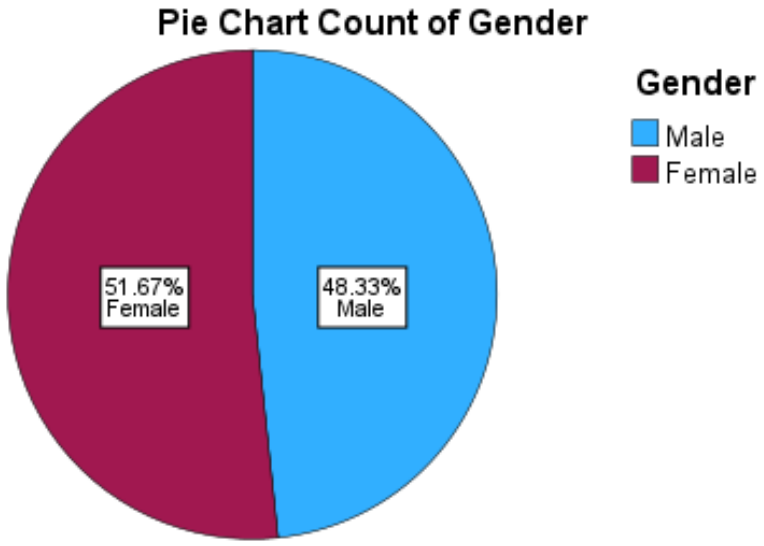
The data that is used in this thesis is collected from the survey that was conducted by the European Social Survey. It is an academically driven cross-national survey that has been conducted every two years across Europe since 2001. They have performed 10 different rounds of surveys through the years. It collects useful data for studying how living conditions and people's attitudes evolve in European countries. It also follows the finest scientific principles for comparing information from different countries. It teaches people how to use its data successfully and aspires to be known both nationally and globally. The survey has been conducted across more than 30 European countries.

The data are taken that are only related to Poland. The data are used from round 10SC, which is the recent data available in Poland. It has the data related to the objectives. The ESS typically relies on an hour-long face-to-face interview for data collection. However, due to the pandemic, there was a shift in the approach. Due to the pandemic, the round 10 fieldwork took longer than usual period. It is mentioned that they started the survey (fieldwork) in September 2020 and finished along with 9 countries in August 2022. In Round 10, a total of 9 countries adopted a self-completion approach, utilizing web and paper formats. This change in methodology was likely a response to the challenges posed by the pandemic and the need to ensure the safety and well-being of both interviewers and respondents. Poland was one of the 9 countries that adopted a self-completion approach.

The European Social Survey surveyed all individuals aged 15 and up who live in private households. Everyone in this age group living in private households is eligible for the survey, regardless of where they come from, their citizenship, the language they speak, or their legal status. They gathered data for the survey in two ways. Initially, they used a traditional paper questionnaire. This means that people could complete the survey on paper, and have it delivered or collected by mail, fax, or in person by either the interviewer or the person answering the questions. The second method was slightly more modern. They conducted a computer-assisted web interview (CAWI). They created a survey that people could fill out online. This online survey could be customized based on how respondents answered each question. It could also include images, audio, video clips, and links to other web pages. So, they used both old-fashioned paper and new technology to collect information from people.

6.3 Evaluation of personal questions.

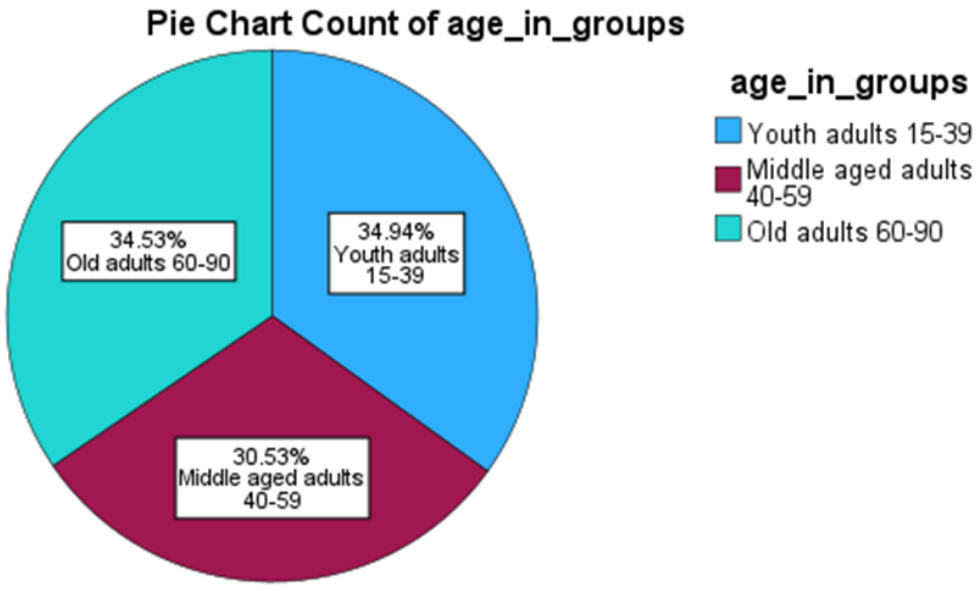
Figure 2 Gender.



Source: Own work in SPSS

From the data obtained from the survey, there is a total of 2065 observations, in which there are 998 males which represents 48% of the total sample, and 1067 females which represents 52% of the total sample.

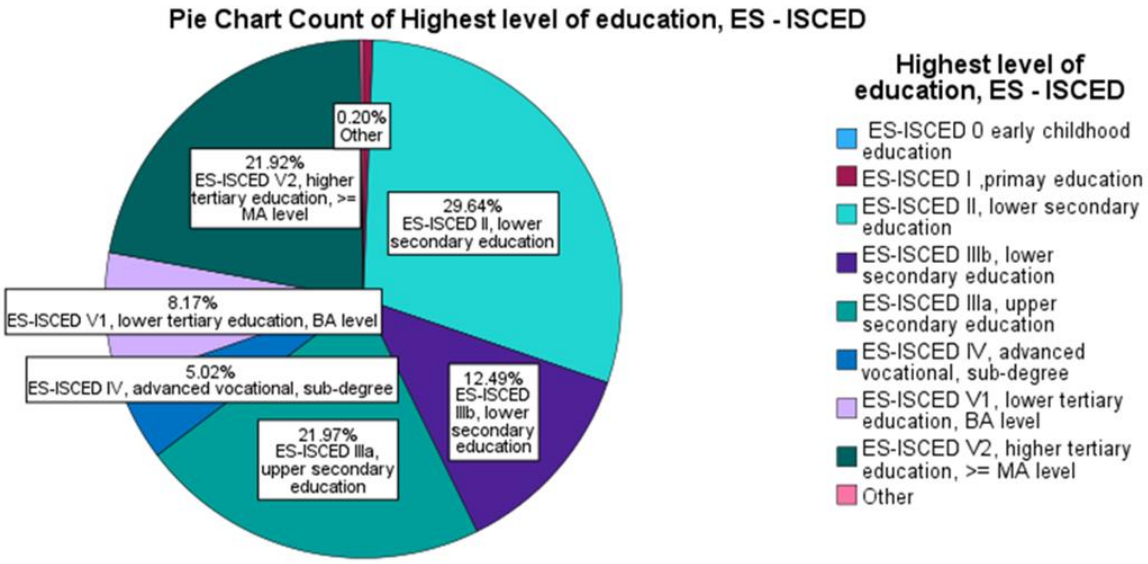
Figure 3 Age in Groups



Source: Own Work in SPSS.

In age category, the sample is divided into 4 distinct age groups. The classification is based on scientific research by (Horng, 2001). Their work provided a systematic technique for age classification. This has been applied to the current data set to identify the age ranges of young adults (15-39), middle-aged adults (40-59), and elderly adults (60-90) (Horng, 2001). Based on the obtained results, there are 93 missing cases, most of the respondents taking part in this survey belong to the young adults 15-39 category, accounts 33.4%, second belongs to the old adults 60-90, accounts 33% of the total respondents. The last belongs to middle-aged adults 40-59 which accounts for 29.2% of the total respondents.

Figure 4 Education.



Source: Own Work in SPSS

Education.

For proper understanding of the educational background of respondents. It is divided into 7 categories along with others and unknown. The ISCED classification is used internationally to ensure comparability across different education systems The results show that the category with ES-ISCED V2 higher tertiary education has the most responses (21.2%) followed by ES-ISCED upper secondary education which represents 21.2 % of the total sample. The "Other" category likely represents a range of educational experiences that don't align with the standard categories outlined by the ES-ISCED framework. During the hypothesis, they are

merged into 3 categories education group, the higher education group, and the other group in which there are respondents that did not answer the question.

Political involvement of the respondents.

Figure 5 voted in the last national election.

Voted last national election

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1654	80.1	80.4	80.4
	No	252	12.2	12.3	92.7
	Not eligible to vote	151	7.3	7.3	100.0
	Total	2057	99.6	100.0	
Missing	No answer	8	.4		
Total		2065	100.0		

Source: Own work in SPSS.

Out of the 2065 people polled, a large proportion, 80.1%, or 1654 respondents, said they voted. A smaller percentage, 12.2%, or 252 people, said they did not vote. There were 151 respondents, or 7.3%, who were not eligible to vote. The survey also notes that 8 responses were missing because the individuals did not respond, accounting for 0.4% of the total.

Figure 6 How interested in Politics.

How interested in politics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very interested	215	10.4	10.5	10.5
	Quite interested	804	38.9	39.1	49.5
	Hardly interested	860	41.6	41.8	91.3
	Not at all interested	178	8.6	8.7	100.0
	Total	2057	99.6	100.0	
Missing	No answer	8	.4		
Total		2065	100.0		

Source: Own Work in SPSS

According to the data, while most respondents show some interest in politics, a large proportion expresses little interest. Out of 2065 respondents, 215 people, or 10.4% of the total, said they were very interested in politics. A large proportion of participants, 804 (38.9%), reported being very interested. Many respondents, 860 or 41.6%, said they were barely interested, while a smaller proportion, 178 or 8.6%, said they were completely uninterested in politics.

Figure 7 Internet use.

Statistics

Internet use, how often

N	Valid	2038
	Missing	27
Mode		5
Range		4
Minimum		1
Maximum		5

Internet use, how often

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	245	11.9	12.0	12.0
	Only occasionally	196	9.5	9.6	21.6
	A few times a week	181	8.8	8.9	30.5
	Most days	179	8.7	8.8	39.3
	Every day	1237	59.9	60.7	100.0
	Total	2038	98.7	100.0	
Missing	No answer	27	1.3		
Total		2065	100.0		

Source: Own Work in SPSS

Based on the responses, out of 2065 respondents, 2038 provided valid responses to the question. The most common answer (the mode) was “5”. This indicates the majority of respondents use the internet every day. 27 respondents did not provide an answer to the question.

6.4 Evaluation of survey questions.

i. Question related to energy measures.

The ESS has questions related to energy measures, such as how likely it is for large numbers of people to limit energy use and reduce climate change in the survey. Based on those the hypothesis was made that if there are differences in opinions on energy measures between different age groups or not. But in the case of Poland, there were not any responses to these questions. It was not possible to obtain information about the questions from EES. As an alternative, a survey based on energy saving with similar questions was chosen. The data was collected from the Eurobarometer, which also conducted a survey on energy challenges for the EU (Eurobarometer, 2022)

Figure 8 Energy consumption.

Statistics

Q7_5 And how much do you agree or disagree with each of the following statements? We shou

N	Valid	1017
	Missing	0
Mean		44.84
Median		2.00
Mode		2
Range		997
Minimum		1
Maximum		998

Q7_5 And how much do you agree or disagree with each of the following statements? We should all make an effort to reduce energy consumption during peak hours

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally agree	395	38.8	38.8	38.8
	Tend to agree	463	45.5	45.5	84.4
	Tend to disagree	89	8.8	8.8	93.1
	Totally disagree	26	2.6	2.6	95.7
	Don't know	44	4.3	4.3	100.0
	Total	1017	100.0	100.0	

Source: Own work in SPSS

Based on the responses, adding up the percentages, it shows a large majority, 88.4% of the respondents support the idea of reducing energy use during peak times. On the other hand,

only 11.4% of respondents are against or have doubts. The ‘Don’t know’ responses account for the remaining 4.3%. The alternative hypothesis will be formed based on the responses collected from the survey. However, the responses will be combined into two categories - Agree (which includes both totally agree and tend to agree) and Disagree (which includes both totally disagree and tend to disagree). Additionally, the age category will be taken from this survey for analysis.

However, the data from another (Czechia) country from ESS about these questions could be used for the reference.

Figure 9 Reduce climate change.

Statistics

image large number of people limit energy use, how likely reduce climate change

N	Valid	2476
	Missing	0
Mode		3.00
Range		2.00
Minimum		1.00
Maximum		3.00

image large number of people limit energy use, how likely reduce climate change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	likely	408	16.5	16.5	16.5
	not likely	359	14.5	14.5	31.0
	no answer	1709	69.0	69.0	100.0
	Total	2476	100.0	100.0	

Source: Own work in SPSS

Since the sample size was large, the values were coded into different variables. There were 9 values. Values like likely more likely were labeled as likely (1), values like less likely, not at likely at all were labeled not likely (2), and rest values like not applicable, refusal, no answer were labeled as no answer (3). Based on the responses, the majority of respondents, 69% or 1309 respondents, did not provide a definitive answer to the question. One of the reasons behind this might be they are unaware of these issues. Another reason could be that the

survey question did not apply to them. If the question had been simpler, more people would have responded. Further, examining the response, 16.5% of respondents accounting for 408, believe that it is likely to reduce climate change while a slightly lower percentage, 14.5% accounting for 359 respondents, are skeptical about the effectiveness of these measures. This indicates that they don't believe it will reduce climate change.

Figure 10 Limit energy use.

How likely, large number of people limit energy use

N	Valid	2476
	Missing	0
Mode		6.00
Range		7.00
Minimum		1.00
Maximum		8.00

How likely, large number of people limit energy use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	not likely at all	158	6.4	6.4	6.4
	not very likely	438	17.7	17.7	24.1
	likely	156	6.3	6.3	30.4
	very likely	23	.9	.9	31.3
	not applicable	1671	67.5	67.5	98.8
	refusal	2	.1	.1	98.9
	dont know	28	1.1	1.1	100.0
	Total	2476	100.0	100.0	

Source: Own work in SPSS

There was another question, related to energy measures. In this case values aren't coded. Based on the responses, most of the respondents 67.5% chose that the question didn't apply to them. The reason could be like the earlier one. Respondents aren't exposed to these terms. They might have felt they didn't have enough knowledge and understanding so they could answer the question. Some might not care enough about the issue to provide any answer to this. Further, examining the responses 23.5% of respondents think it is less likely to limit energy use while 15,3% of respondents think it is likely to limit energy use.

ii. Questions related to climate change.

Figure 11 Descriptive statistics of responsibility to reduce climate change.

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
To what extent feel personal responsibility to reduce climate change	1950	10	0	10	6.51	2.650
Valid N (listwise)	1950					

Source: Own work in SPSS.

One of the questions of EES was about how much responsibility respondent feels to reduce climate change. They could answer with numbers from 0 (not at all) to 10 (a great deal) or choose not to answer. Based on the results, out of 2065 respondents, 1950 responded and 115 didn't. The average responsibility rate is 6.51. This indicates that, on average, the respondents feel more than half responsible for reducing climate change. Based on the results, it can be concluded that the respondents feel a moderate to high responsibility for reducing climate change.

Figure 12 How worried about climate change.

Statistics

How worried about climate chan

N	Valid	1981
	Missing	84
Mode		3
Range		4
Minimum		1
Maximum		5

How worried about climate change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all worried	69	3.3	3.5	3.5
	Not very worried	244	11.8	12.3	15.8
	Somewhat worried	952	46.1	48.1	63.9
	Very worried	625	30.3	31.5	95.4
	Extremely worried	91	4.4	4.6	100.0
	Total	1981	95.9	100.0	
Missing	Not applicable	35	1.7		
	No answer	49	2.4		
	Total	84	4.1		
Total		2065	100.0		

Source: Own work SPSS.

Based on the responses, adding up the percentages, it shows a large majority, 95.4% of the respondents are at least somewhat worried, with 4.6% being extremely worried. On the other hand, only 15.8% of respondents are not very worried or less. There were 84 responses that weren't counted because they didn't answer the question, or the question did not apply to the respondent. This will be used for the hypothesis to know if females are more concerned about the climate than men and if people with higher education have positive attitudes towards climate change or not. During hypothesis testing, they are merged into two categories worried and not worried.

Figure 13 Climate change is a natural process.

Statistics

Climate change caused by natural processes, human activity, or both

N	Valid	2029
	Missing	36
Mode		3
Range		54
Minimum		1
Maximum		55

Climate change caused by natural processes, human activity, or both

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Entirely by natural processes	53	2.6	2.6	2.6
	Mainly by natural processes	138	6.7	6.8	9.4
	About equally by natural processes and human activity	890	43.1	43.9	53.3
	Mainly by human activity	800	38.7	39.4	92.7
	Entirely by human activity	113	5.5	5.6	98.3
	I don't think climate change is happening	35	1.7	1.7	100.0
	Total	2029	98.3	100.0	
Missing	No answer	36	1.7		
Total		2065	100.0		

Source: own work in SPSS.

Based on the responses, out of 2065 responses, 2029 responses are categorized valid. They were marked as "missing" because they didn't provide any answer. Most of the respondents believe that climate change is either caused equally by natural processes or mainly by human activity. Out of 2029 respondents 890 believe that it is equally both whereas 913 respondents think it's human activity. The reason might be they are aware of climate change through different sources like education, personal experience, or some political ideology. In this digital world, people can know about everything. Since climate change is an ongoing problem and is on the news or any social media platform or through documentaries, educational content helps people to know and be aware about it. 35 respondents out of 2029 respondents don't think climate change is happening. The reason might be that they are not aware of climate change. They might have less experience with climate change. 191 respondents think that it is a natural process. They can be influenced by social media, and educational content they have received about climate change can shape their views on climate change. Beliefs about climate change can be influenced by various factors.

6.5 Hypothesis testing.

The hypotheses are proposed to know if socio-demographic factors such as age, gender, education level, and political engagement influence people's attitudes and behaviors towards environmental issues and climate change. It helps to explore whether these different aspects of an individual's identity and social involvement might affect how they perceive energy policies, their level of concern about climate change, and their positivity towards nature and the environment. Based on these 3 hypotheses was proposed:

H1: Are there differences in opinions on energy measures between different age groups?

H2: Females are more concerned than males about climate change.

H3: People with higher education have positive attitudes towards nature and the environment.

6.5.1. Hypothesis I.

Since there wasn't any data on responses to the questions related to energy measure, the hypothesis couldn't be done. However, the alternative hypothesis from an alternative survey which is of Poland is formed which is like the original hypothesis.

H0: There is no relationship between age and their opinion on energy measures.

HA: There is a relationship between age and their opinion on energy measures.

Let $\alpha = 0.05$

Based on the result obtained, most respondents agree with energy saving. 84.4% of total respondents agree with energy saving. The agreement is highest among youth adults (15-39)76.7% of the age group agreeing. The disagreement is lowest among old adults (60-90) about 4.9%of the age group disagreeing. The least selected category across all groups is the "don't know" category.

Figure 14 Hypothesis I

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
age_ * energy__saving	1017	100.0%	0	0.0%	1017	100.0%

age_ * energy__saving Crosstabulation

			energy__saving			
			agree	disagree	dont know	Total
age_	Youths adults 15-39	Count	309	69	25	403
		% of Total	30.4%	6.8%	2.5%	39.6%
	Middle age adults 40-59	Count	285	32	14	331
		% of Total	28.0%	3.1%	1.4%	32.5%
	old adults 60-90	Count	264	14	5	283
		% of Total	26.0%	1.4%	0.5%	27.8%
Total		Count	858	115	44	1017
		% of Total	84.4%	11.3%	4.3%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	36.147[a]	4	<.001
Likelihood Ratio	38.114	4	<.001
Linear-by-Linear Association	7.924	1	.005
N of Valid Cases	1017		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.24.

Source: Own work in SPSS.

It mentioned that 0 cells (0.00%) have an expected count of less than 5, which is important information. This helps to check if the Chi-squares test is valid or not. The minimum expected count is 12.24 which is sufficient to consider this test reliable.

Based on the results obtained, the P(<0.001) value is less than α, the null hypothesis is rejected and we can conclude that there is a relationship between age and their opinion on energy measures.

As it’s known, different generations have different perspectives on different things. In this case, it is about energy measures. Their perspective can be influenced by their beliefs, life experiences, and access to information. The younger generation grew up in an era of technological progress and increased knowledge of climate change. They are also eager to invest in energy-saving measures to reap long-term benefits. Older generations may prefer conventional energy sources for economic stability and reliability, also they can be influenced by political factors.

6.5.2 Hypothesis II

HO: Females are not more concerned about climate change than men

HA: Females are more concerned about climate change than men.

Let $\alpha = 0.05$

The crosstab shows counts and percentages of responses by gender to the question about being worried about climate change. Based on the results, out of 998 men, 758(76%) responded they are worried about climate change while 910 women out of 1067 responded that they are worried. This shows higher proportion of women are worried about climate change compared to men.

It mentioned that 0 cells (0.00%) have an expected count of less than 5, which is important information. This helps to check if the Chi-squares test is valid or not. The minimum expected count is 40.60, which is sufficient to consider this test reliable. P value (<0.001) is less than α, the null hypothesis is rejected. As the data shows a higher percentage of females expressing concern and the Chi-square test indicates that this difference is statistically significant. We can conclude that women are more concerned than men.

Figure 15 Hypothesis II

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Gender * worried_about_climate_change	2065	100.0%	0	0.0%	2065	100.0%

Gender * worried_about_climate_change Crosstabulation

			worried_about_climate_change			
			not worried	worried	no answer	Total
Gender	Male	Count	203	758	37	998
		% of Total	9.8%	36.7%	1.8%	48.3%
	Female	Count	110	910	47	1067
		% of Total	5.3%	44.1%	2.3%	51.7%
Total		Count	313	1668	84	2065
		% of Total	15.2%	80.8%	4.1%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	40.414[a]	2	<.001
Likelihood Ratio	40.812	2	<.001
Linear-by-Linear Association	32.969	1	<.001
N of Valid Cases	2065		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 40.60.

Source: Own work in SPSS.

There are many reasons that support this conclusion. It is a study of different topics like sociology, gender, and environment. This does not mean all women are concerned. Everyone has their perception and choices and not all will fit into the typical pattern. However, cultural, and societal norms have always placed women as caregivers. Some research implies that women have higher levels of empathy and generosity which improve their response to environmental challenges.

6.5.3 Hypothesis III

HO: People with higher education have no positive attitude toward nature and the environment.

HA: People with higher education have a positive attitude toward nature and the environment.

Let $\alpha = 0.05$

Based on the results, most respondents are worried about climate change regardless of their education level.

Earlier it was seen the education level of the respondent was divided into several categories, but while doing the hypothesis they were divided into 3 groups only. The category “other” was not included in hypothesis testing. The reason was it did not have any significant value. It was equivalent to respondents who had no education. In the crosstabulation, respondents with higher education have less response to “not worried” than respondents with basic education. Through this, it can be said that higher education people have a positive attitude towards nature and the climate. 84 out of 2065 responses are that they have no answer.

It mentioned that 0 cells (0.00%) have an expected count of less than 5, which is important information. This helps to check if the Chi-squares test is valid or not. The minimum expected count is 28.89, which is sufficient to consider this test reliable. P value (<0.001) is less than α, the null hypothesis is rejected. As the data shows a higher percentage of females expressing concern and the Chi-square test indicates that this difference is statistically significant. Therefore, we can conclude that people with higher education have a positive attitude toward nature and the environment.

Figure 16 Hypothesis III

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
education__ * worried_about_climate_change	1990	96.4%	75	3.6%	2065	100.0%

education__ * worried_about_climate_change Crosstabulation

			worried_about_climate_change			
			not worried	worried	no answer	Total
education__	basic education group	Count	155	645	52	852
		% of Total	7.8%	32.4%	2.6%	42.8%
	higher education group	Count	150	973	15	1138
		% of Total	7.5%	48.9%	0.8%	57.2%
Total		Count	305	1618	67	1990
		% of Total	15.3%	81.3%	3.4%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	46.871[a]	2	<.001
Likelihood Ratio	47.415	2	<.001
Linear-by-Linear Association	.014	1	.904
N of Valid Cases	1990		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 28.69.

Source: Own work in SPSS.

The are many reasons that say education is associated with these terms. Education prepares people to think critically and solve challenges. This means they have a better understanding of different subjects, in this case environmental protection, and are more likely to desire to preserve nature. People with higher education can find and understand lots of information. Also, knowing these things can also inspire a person to preserve nature. In some cases, knowledge is more than education or a degree. An individual can gain knowledge about these things through different sources too. However, education pushes a person to think critically, take difficult decisions, actions and gather more information which can motivate them to protect nature.

7. Conclusion

The study suggests that Poland's popular perceptions toward climate change provide critical information. Key findings highlight the importance of socio-demographic characteristics, such as age, education, and income, in defining individuals' perceptions and responses to climate change. The findings show a clear link between people's awareness of climate change and their socio-demographic characteristics. For example, younger people and those with greater education levels are more concerned about climate change. It indicates a deeper awareness and grasp of the consequences. The difference in perceptions based on age and education level highlights the need for complex strategies in communication and policymaking. Also, for elderly groups or those with lower education levels, conventional media channels and community-based participation may be more effective. These groups may benefit from teaching campaigns that connect climate change to current, local environmental concerns. For example, describing how climate change affects local agriculture, weather patterns, and health may generate more interest and participation.

However, the public's willingness to embrace energy-saving measures varies greatly, depending on awareness levels. And it depends also on the perceived economic implications of these actions. The findings show that, while there is a general willingness to change energy usage habits. Financial issues and lack of complete information limit widespread use. These findings emphasize the significance of personalized communication methods. It not only promotes awareness but also addresses people’s concerns and limitations. It also calls for the use of personalized strategies for communication. Such methods must promote awareness and fulfill the public's economic and informational requirements.

We can also see the importance of digital channels in raising awareness. In today's digital age, using social media and online forums can greatly increase the reach of environmental actions. It's becoming increasingly evident that everyone has a role to play in creating a sustainable future. Mitigating climate change is a community effort that involves the collaboration of all sectors of society. This study encourages people to consider our beliefs and actions, suggesting a joint effort toward more sustainable, energy-conscious civilizations.

The findings highlight the need for politicians to take these socioeconomic aspects into account when developing and implementing climate policies. Public policy and developing effective educational campaigns and climate change efforts. They emphasize the importance of complex policy measures tailored to the varying demands and conditions of Poland's many

demographic groups. For example, the clear link between socio-demographic characteristics and climate change awareness implies that educational campaigns. It should be tailored to reach and connect with older populations and those with lower educational levels. Especially those who are currently less engaged with climate issues. It’s important for the people who make laws and the ones who teach about climate change to remember the differences. They should make sure their messages and plans fit everyone's needs.

We must note the constraints that may influence the interpretation and generalization of our findings. The geographic scope of the research, which was mostly focused on Poland. This limits the application of our findings to other cultural and environmental situations. Poland's different socioeconomic and political situation, opinions about climate change recorded here may not be directly applicable in other places. However, the sample size is enough for the initial study. It may not reflect the complete range of opinion. Specific demographic groups may be neglected, limiting the range of information obtained. The finding should be seen as a piece of a larger puzzle, promoting further research.

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